Health Alterations

Health Alterations

OPEN RESOURCES FOR NURSING (OPEN RN)

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Introduction

This textbook is an open educational resource based on the Wisconsin Technical College System (WTCS) statewide nursing curriculum for the Health Alterations course (543-105), a second semester nursing course designed for students in the Practical Nursing program and the first year of the Associate Degree Nursing program. It is also aligned with the 2023 NCLEX-PN and NCLEX-RN test plans.

This textbook elaborates on the basic concepts of health and illness as presented in Open RN *Nursing Fundamentals, 2e* and builds on content presented in Open RN *Nursing Skills, 2e* and Open RN *Nursing Pharmacology, 2e*. It applies theories of nursing in the care of clients through the life span, utilizing problem-solving and critical thinking while studying common conditions affecting different body systems. Evidence-based nursing interventions are discussed while applying the nursing process. Concepts of leadership and management are also introduced. Interactive learning activities are provided in each chapter, including NCLEX Next Generation-style case studies and questions. Brief video overviews of each condition are provided in each chapter. These videos can also be accessed on the Health Alterations RN Recap Video Series playlist on the Open RN YouTube channel.

This e book is free with CC BY 4.0 licensing and can be viewed online or downloaded as a PDF or in other formats for offline use. It is part of the Open RN© Nursing OER textbook series, originally funded by a $2.5 million Open Textbook Pilot grant from the Department of Education with sustainability funded by WisTech Open. This book was written by subject matter experts and is based on reliable scholarly research and evidence. It has been carefully peer reviewed to ensure its accuracy and quality. The content was developed without relying on large language models or AI tools, ensuring that the information is grounded in expert analysis and trusted sources. Read about other OER textbooks available on the Open RN and the WisTech Open websites.

The following video provides a quick overview of how to navigate the online version.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=4#oembed-1

Preface

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Several learning activities are included in this book simulating nurse-client interactions during telehealth visits. These workforce products were funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The product was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The U.S. Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership. These products have CC BY-NC 4.0 licensing by Chippewa Valley Technical College.

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Standards and Conceptual Approach

The Open RN *Nursing Health Alterations* textbook is based on several external standards and uses a conceptual approach based on concepts introduced in Open RN *Nursing Fundamentals,2e*.

External Standards

American Nurses Association (ANA)

The ANA establishes Standards for Professional Nursing Practice and the Nursing Code of Ethics.[1,2]

- American Nurses Association. (2021). *Nursing: Scope and standards of practice* (4th ed.). American Nurses Association. https://www.nursingworld.org/ana/about-ana/standards/
- American Nurses Association. (2015). *Code of ethics for nurses with interpretive statements*. American Nurses Association. https://www.nursingworld.org/practice-policy/nursing-excellence/ethics/code-of-ethics-for-nurses

The National Council Licensure Examination for Registered Nurses: NCLEX-RN and NCLEX-PN Test Plans

The NCLEX-RN and NCLEX-PN test plans are updated every three years to reflect fair, comprehensive, current, and entry-level nursing competency.[3]

1. American Nurses Association. (2021). *Nursing: Scope and standards of practice* (4th ed.).
2. American Nurses Association. (2015). *Code of ethics for nurses with interpretive statements*. https://www.nursingworld.org/practice-policy/nursing-excellence/ethics/code-of-ethics-for-nurses/
3. National Council of State Boards of Nursing. (2023). *Test plans*. https://www.ncsbn.org/exams/testplans.page

- https://www.ncsbn.org/nclex.htm

The National League for Nursing (NLN): Competencies for Graduates of Nursing Programs

NLN competencies guide nursing curricula to position graduates in a dynamic health care arena with practice that is informed by a body of knowledge to help ensure the public receives safe, quality care.[4]

- https://www.nln.org/education/nursing-education-competencies/competencies-for-graduates-of-nursing-programs

American Association of Colleges of Nursing (AACN): The Essentials: Core Competencies for Professional Nursing Education

The AACN provides a framework for preparing individuals as members of the discipline of nursing, reflecting expectations across the trajectory of nursing education and applied experience.[5]

- https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-2021.pdf

Quality and Safety Education for Nurses (QSEN) Institute: Prelicensure Competencies

Quality and safety competencies include knowledge, skills, and attitudes to be developed in nursing prelicensure programs. QSEN competencies include

4. National League of Nursing. (n.d.). *Competencies for graduates of nursing programs*. https://www.nln.org/education/nursing-education-competencies/competencies-for-graduates-of-nursing-programs

5. American Association of Colleges of Nursing. (2021). *The essentials: Core competencies for professional nursing education*. https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-2021.pdf

client-centered care, teamwork and collaboration, evidence-based practice, quality improvement, safety, and informatics.[6]

- https://qsen.org/competencies/

Wisconsin State Legislature, Administrative Code Chapter N6

The Wisconsin Administrative Code governs the Registered Nursing and Practical Nursing professions in Wisconsin.[7]

- https://docs.legis.wisconsin.gov/code/admin_code/n/6

Healthy People 2030

Healthy People 2030 envisions a society in which all people can achieve their full potential for health and well-being across the life span. Healthy People provides objectives based on national data and includes social determinants of health.[8]

- https://health.gov/healthypeople

Conceptual Approach

The Open RN *Nursing Health Alterations* textbook incorporates several concepts including, but not limited to, the following:

6. Quality and Safety Education for Nurses. (n.d.). *About*. https://qsen.org/about-qsen/
7. Wisconsin State Legislature. (2018). *Chapter 6: Standards of practice for registered nurses and licensed practical nurses*. Board of Nursing. https://docs.legis.wisconsin.gov/code/admin_code/n/6
8. Healthy People 2030. (n.d.). *Social determinants of health*. U.S. Department of Health and Human Services. https://health.gov/healthypeople/objectives-and-data/social-determinants-health

- **Evidence-Based Practice.** Evidence-based practices are referenced by footnotes throughout the textbook. To promote the development of digital literacy, links are provided to credible, free online resources that supplement content. The Open RN series of textbooks will be updated on a three-year cycle in alignment with the release of updated NCLEX test plans.
- **Clinical Judgment.** Learning activities include case studies written to reflect verbiage by the NCSBN Clinical Judgment Measurement Model used on the NCLEX-RN. Formative assessments encourage students to recognize cues, analyze cues, prioritize hypotheses, generate solutions, take action, and evaluate outcomes.[9]
- **Cultural Humility.** Nurses have an ethical obligation to practice with cultural humility and provide culturally responsive care to the clients and communities they serve based on the ANA Code of Ethics[10] and the ANA Scope and Standards of Practice.[11]
- **Safe, Quality, Client-Centered Care.** Content reflects the priorities of safe, quality, client-centered care.
- **Clear and Inclusive Language.** Clear language is used based on preferences expressed by prelicensure nursing students to enhance understanding of complex concepts.[12] "They" is used as a singular

9. Dickison, P., Haerling, K. A., & Lasater, K. (2019). Integrating the National Council of State Boards of Nursing clinical judgment model into nursing educational frameworks. *Journal of Nursing Education*. *58*(2), 72-78. https://doi.org/10.3928/01484834-20190122-03

10. American Nurses Association. (2015). *Code of ethics for nurses with interpretive statements*. https://www.nursingworld.org/practice-policy/nursing-excellence/ethics/code-of-ethics-for-nurses/

11. American Nurses Association. (2021). *Nursing: Scope and standards of practice* (4th ed.).

12. Verkuyl, M., Lapum, J. L., St-Amant, O., Bregstein, J., & Hughes, M. (2020).

pronoun to refer to a person whose gender is unknown or irrelevant to the context of the usage, as endorsed by APA style. It is inclusive of all people and helps writers avoid making assumptions about gender.[13]

- **Open-Source Images and Fair Use.** Images are included to promote visual learning. Students and faculty can reuse open-source images by following the terms of their associated Creative Commons licensing. Some images are included based on Fair Use as described in the "Code of Best Practices in Fair Use for Open Educational Resources" presented at the OpenEd 2020 conference. Refer to the footnotes of images for source and licensing information throughout the text.
- **Open Pedagogy.** Students are encouraged to contribute to the Open RN project in meaningful ways by reviewing content for clarity and assisting in the creation of open-source images.[14]

Supplementary Materials

Several supplementary resources are provided with this textbook:

- "Pretests" are provided at the beginning of each chapter.
- Supplementary "RN Recap" videos are included in each chapter to address the needs of auditory learners.
- Interactive and written learning activities encourage students to apply content to authentic client care scenarios.
- NCLEX Next Generation-style case studies and questions encourage the

Healthcare students' use of an e-textbook open educational resource on vital sign measurement: A qualitative study. *Open Learning: The Journal of Open, Distance and e-Learning. 38*(1), 22-37. https://doi.org/10.1080/02680513.2020.1835623

13. American Psychological Association. (2021). *Singular "they."* https://apastyle.apa.org/style-grammar-guidelines/grammar/singular-they

14. Wagstaff, S. (2023). Open Pedagogy Notebook. https://openpedagogy.org/

development of clinical judgment and provide immediate formative feedback with rationale for the correct answers.

- Free downloadable PDFs and other versions can be downloaded from the home page for offline use.

PART I

CHAPTER 1 LEADERSHIP PRINCIPLES

1.1 Leadership Introduction

Learning Objectives

- Apply leadership principles
- Identify leadership styles and actions
- Identify principles of delegation and prioritization according to the Nurse Practice Act
- Identify conflict resolution strategies
- Explain the role and responsibilities of a charge nurse
- Discuss characteristics of effective leadership
- Describe constructive feedback
- Apply prioritization strategies
- Incorporate principles of time management

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=71#h5p-35

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Leadership skills are required by every nurse when providing direct client care. Making informed clinical decisions and advocating for clients are foundational to professional nursing practice. Many nurses also take on additional leadership responsibilities such as managing the nursing team. Members of the **nursing team** include registered nurses (RNs), licensed

practical/vocational nurses (LPNs/VNs), and unlicensed assistive personnel (UAP).[1]

A **registered nurse (RN)** is a nurse who has completed a required program of study (i.e., associate degree, diploma, or bachelor's degree), successfully passed the NCLEX-RN, and received an RN nursing license. The RN is considered the leader of a nursing team for an assigned group of clients. The RN follows the standards of care known as the nursing process (assessment, diagnosis, outcome identification, planning, implementation of interventions, and evaluation).

Licensed practical/vocational nurses (LPNs/VNs) complete a state-approved practical nursing program, successfully pass the NCLEX-PN, and receive an LPN or LVN license. LPNs/VNs perform basic nursing care for stable clients under the supervision of an RN. RNs may delegate nursing tasks to qualified, competent LPNs under specific situations.

Nursing assistants (NAs), a type of **unlicensed assistive personnel (UAP)**, work under the supervision of LPNs/VNs and RNs and to whom a nursing responsibility may be delegated. In some states, nursing assistants must complete a state-approved nursing assistant training program and successfully pass the state competency evaluation to become a certified nursing assistant (CNA) to work in long-term care centers. NAs provide basic care and help clients with activities of daily living. They typically perform the following tasks:

- Measure and record clients' vital signs and other basic measurements like input/output
- Assist clients with activities of daily living (dressing, bathing, toileting, and eating)
- Reposition and transfer clients between beds, chairs, and/or wheelchairs
- Document client behaviors and report suspected changes in condition to

1. American Nurses Association and National Council of State Boards of Nursing. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

nurses

WHAT IS A MANAGER?

Managers serve in roles within a hierarchy of an organization, starting with leadership by the Health Care Administrator and trickling down to Directors of Nursing, Nurse Managers, and Charge Nurses[2]:

- **Health Care Administrator (CEO or VP of Nursing):** There are a variety of job titles for individuals serving in the health care administrator role, including chief executive officer (CEO) or vice president (VP) of nursing. Health care administrators may have advanced degrees in nursing or other fields, such as health care administration. Health care administrators may focus on a variety of priorities, such as collaborative care coordination, resource utilization, community and public health, satisfactory client experiences, and good health outcomes.
- **Chief Nursing Officer (CNO):** The CNO is a key nursing leadership position that manages the budget for nursing-related items and ensures client safety by enforcing agency policies and procedures. CNOs typically have a master's degree in nursing (MSN).
- **Director of Nursing (DON):** Directors of nursing work in hospitals and other health care facilities to lead the overall strategy of the nursing department. A director of nursing's top priorities are to achieve excellent client outcomes by ensuring quality client care and to ensure that all team members comply with state and federal regulations.
- **Nurse Manager:** The nurse manager serves as a supervisor of nursing team members. In hospitals, there may be one nurse manager for every

2. Western Governors University. (2020). *The top 4 nursing leadership roles*. https://www.wgu.edu/blog/top-4-nursing-leadership-roles2001.html

client care area in the hospital, such as the Medical-Surgical unit, Cardiac unit, Labor and Delivery unit, Surgical unit, etc.). In long-term care agencies, there may be one nurse manager for the entire facility. Nurse managers are typically RNs and, in many agencies, also have a bachelor's degree in nursing (BSN). Responsibilities of nurse managers include managing a department budget, completing performance appraisals of team members, interviewing and hiring employees for that unit's nursing team, disciplining employees, creating work schedules, and ensuring training and continuing education requirements are met for the nursing team members on that unit.

- **Charge Nurse:** A charge nurse makes client assignments for the nursing team and serves as a resource to the team. In hospitals, RNs serve as charge nurses of the nursing team. In long-term care facilities, an LPV/VN may serve as a charge nurse while also being supervised by an RN, according to their scope of practice in the state's Nurse Practice Act. Read more about scope of practice in the "Managing the Nursing Team" section later in this chapter.

No matter the role, managers serve common functions such as organizing and prioritizing work performed in their areas, and communicating and motivating people on their team to reach established goals.

CHARGE NURSES

This chapter will focus on leadership provided by charge nurses. Charge nurses oversee the operations of their specific nursing unit during a set period while working with the nursing team. The primary role of a charge nurse is to ensure that nursing functions within the department run smoothly and efficiently. They also provide guidance and support staff through challenging client care situations as they arise. Like staff nurses, charge nurses often provide direct client care.

Typical charge nurse responsibilities include the following[3]:

- Assign client care to the nursing team based on acuity
- Serve as a resource to the nursing team and answer care-related questions
- Evaluate staffing plans for the following shift and call additional staff as needed
- Prioritize care for a group of clients and allocate resources as additional needs arise
- Assist with admission and discharge paperwork
- Oversee a smooth transition from one shift to another
- Check the availability of client supplies and order additional supplies
- Provide nursing care for their assigned clients, if applicable (varies by facility)

In many facilities, charge nurses are RNs who serve as a liaison between nurses and physicians. In long-term care settings, they are the primary contact when communicating changes in client condition and processing new orders.

In some states, LPN/VNs serve as charge nurses in long-term care facilities. Each state's Nurse Practice Act outlines the scope of practice for LPNs/VNs functioning as charge nurses. In Wisconsin, LPNs/VNs may function as a charge nurse in long-term care facilities with the following restrictions[4]:

- Follow written protocols and procedures developed and approved by an RN

3. American Nursing Association. (2023). *Charge nurse vs. nurse manager: What's the difference?* https://www.nursingworld.org/content-hub/resources/nursing-resources/charge-nurse-vs-nurse-manager/

4. Wisconsin State Legislature. (2018). *Chapter 6: Standards of practice for registered nurses and licensed practical nurses.* Board of Nursing. https://docs.legis.wisconsin.gov/code/admin_code/n/6

- Manage and direct the nursing care and other activities of LPNs and nursing support personnel under the general supervision of an RN
- Accept the charge nurse position only if prepared for the responsibilities of charge nurse based on education, training, and experience beyond the practical nurse curriculum

Performing the role of a charge nurse requires ethical leadership. Nurse leaders must exhibit a strong sense of professionalism and integrity, ensuring that evidence-based nursing care is provided according to professional nursing standards. Additionally, charge nurses must be responsive to the unique needs of each individual client, recognizing that care situations are multifaceted and require tailored approaches. Furthermore, nurse leaders must ensure that clients' rights, dignity, and cultural preferences are respected. This necessitates not only a good understanding of common medical practices but also an empathetic mindset that acknowledges the impact of potential barriers to a person's health. Through skilled coordination and communication, ethical leadership, and dedication to individualized care, charge nurses ensure that client needs are met, and optimal care is delivered.

This chapter will introduce concepts related to cultivating nurse leadership, including discussing leadership styles, describing characteristics of effective leadership, and explaining conflict resolution strategies and techniques for constructive feedback. Managing the nursing team, including delegating according to the Nurse Practice Act, using prioritization strategies, and applying principles of time management will also be discussed.

WHAT IS NURSE LEADERSHIP?

Nurse leadership is defined by a nurse's actions and does not necessarily mean the nurse is serving in a management or administrative role. Leaders inspire and influence others to achieve their maximum potential. They apply leadership principles and use critical thinking principles while collaborating with the health care team, promoting teamwork, and advocating for quality,

evidence-based client care. Nurse leaders take a broad view of how daily tasks impact the overall goals of the health care organization. They communicate expectations to their team and motivate them to achieve predetermined goals. Nurses can lead from various roles if they project the necessary leadership qualities to influence others.[5]

Projecting leadership skills can allow a nurse to lead without being assigned a specific management position. A nurse can become involved in the following activities to project leadership.[6]

- Seek out a mentor or become a mentor
- Volunteer for roles on committees
- Become involved in the community
- Participate in additional professional development activities
- Stay current on the latest health care trends
- Get involved with public policy

> Read additional information about concepts related to RN nurse managers and leaders in Open RN *Nursing Management and Professional Concepts, 2e*.

5. American Nurses Association. (2023). *Leadership in nursing: Qualities & why it matters*. https://www.nursingworld.org/content-hub/resources/nursing-leadership/leadership-in-nursing/

6. American Nurses Association. (2023). *Leadership in nursing: Qualities & why it matters*. https://www.nursingworld.org/content-hub/resources/nursing-leadership/leadership-in-nursing/

1.2 Leadership Skills

Leadership skills are critical in a professional nursing role. During their educational journey, nursing students and new nursing graduates cultivate leadership skills while learning how to make informed decisions requiring clinical judgment. They identify, respond, and learn from their mistakes and seek guidance and mentorship from other nurses. They effectively communicate and collaborate with members of the interprofessional team to advocate for holistic care and to improve client outcomes. Successful nurses continue to reflect on each client interaction throughout their career as an opportunity to learn and grow as a professional nurse and leader.

Making Informed Clinical Decisions

Making informed clinical decisions is a foundation of professional nursing practice that requires clinical judgment and demonstrates nursing leadership at the bedside. To use clinical judgment, nurses must integrate critical thinking, clinical expertise, problem-solving, ethical decision-making, and emotional intelligence:

- **Critical Thinking:** Critical thinking is the ability to gather and evaluate relevant information, consider different perspectives, and make reasoned judgments. Critical thinking skills are reflected in the nurse's ability to assess a client's condition, identify risks and complications, and make adjustments to the nursing plan of care.
- **Clinical Expertise:** Clinical expertise is the aggregation of clinical knowledge that is foundational for making informed nursing decisions. Clinical expertise includes knowledge of evidence-based nursing practice, clinical guidelines, standards of practice, and technology advancements. Clinical expertise is reflected by the nurse's ability to accurately analyze information, understand the connection to the client's condition, and make informed decisions.
- **Problem-Solving:** Effective leaders in nursing excel in problem-solving. They approach challenges with a systematic and analytical mindset,

seeking innovative solutions to improve client outcomes. Problem-solving involves identifying underlying causes of problems, generating alternative strategies, evaluating potential risks and benefits, and implementing effective interventions.

- **Ethical Decision-Making:** Nursing leadership requires the ability to make ethical decisions that prioritize the well-being and autonomy of clients. Nurses must navigate complex ethical dilemmas, balancing principles such as beneficence, autonomy, justice, and non-maleficence.
- **Emotional Intelligence:** Leadership in nursing involves emotional intelligence, which is the ability to understand and manage one's own emotions and empathize with others. Nurses with high emotional intelligence can navigate challenging situations with empathy, respect, and effective communication.

Identifying, Responding, and Learning from Mistakes

The ability to identify, take ownership, and learn from one's mistakes is a critical part of one's nursing leadership role. Although all nurses strive to prevent errors, it is unrealistic to believe that as humans, our nursing practice will be without mistakes. At some point, every nurse will make an error, and it is critical that errors are acknowledged, addressed, and new strategies incorporated to avoid future errors. Strong leaders humbly acknowledge their errors to demonstrate that mistakes can and will occur, no matter one's position or expertise. Sharing errors builds a "culture of safety" work environment in which the emphasis is on ownership and learning from errors rather than penalty.

A **culture of safety** is an organizational culture that embraces error reporting by employees with the goal of identifying systemic causes of problems that can be addressed to improve client safety. According to The Joint Commission, a culture of safety includes the following components[1]:

1. The Joint Commission. (2021). The essential role of leadership in developing a safety culture. *Sentinel Event Alert 57*. https://www.jointcommission.org/

- **Just Culture:** A Just Culture is where people feel safe raising questions and concerns and reporting safety events in an environment that emphasizes a nonpunitive response to errors and near misses. Clear lines are drawn by managers between human error, at-risk, and reckless employee behaviors. See Figure 1.1[2] for an illustration of Just Culture.
- **Reporting Culture:** People realize errors are inevitable and are encouraged to speak up for client safety by reporting errors and near misses. For example, nurses complete an "incident report" according to agency policy when a medication error occurs or a client falls. Error reporting helps the agency manage risk and reduce potential liability.
- **Learning Culture:** People regularly collect information and learn from errors and successes while openly sharing data and information and applying best evidence to improve work processes and client outcomes.

resources/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-57-the-essential-role-of-leadership-in-developing-a-safety-culture/

2. "Just Culture Infographic.png" by Valeria Palarski 2020. Used with permission.



Figure 1.1 "Just Culture Infographic.png" by Valeria Palarski 2020. Used with permission.

Seeking Guidance and Mentorship

Mentorship has a significant impact on the professional development of nurses' leadership skills. Mentorship is critical for knowledge transfer, skill development, career advancement, and personal growth.

Knowledge Transfer

Mentoring allows experienced and knowledgeable nurses to share their expertise, insights, and practical wisdom with less experienced nurses. This knowledge transfer is invaluable for developing clinical skills, enhancing critical thinking abilities, and gaining a deeper understanding of the complexities of nursing practice. Mentors provide guidance, answer questions, and offer real-world perspectives that textbooks and classroom education alone cannot provide.

Skill Development

A mentor acts as a role model and helps mentees develop a wide range of skills necessary for nursing leadership. This includes communication skills, decision-making abilities, conflict resolution techniques, and interpersonal skills. By observing and learning from their mentors, nurses can refine their own leadership capabilities, which, in turn, enhances their effectiveness in clinical decision-making, teamwork, and client care.

Career Advancement

A mentor can provide valuable guidance and support in navigating the various career pathways and opportunities within nursing. They can help mentees set goals, identify strengths and areas for improvement, and create personalized development plans.

Personal Growth

Mentorship extends beyond professional development and encompasses personal growth as well. Mentors can offer emotional support, encouragement, and advice on work-life balance, self-care, and managing stress. They can serve as a sounding board for challenges and help mentees build resilience and confidence in their abilities. The mentor-mentee relationship fosters a safe and nurturing environment where mentees can seek guidance, reflect on their experiences, and develop a strong professional identity.

Collaborating and Communicating

As advocates for quality, holistic care for their clients, all nurses demonstrate leadership skills while collaborating and communicating with health care team members, including other nurses, physicians, therapists, pharmacists, and other staff. Effective communication skills are essential to ensure the accurate exchange of information and to facilitate collaborative decision-making while also advocating for holistic care and quality client outcomes. Nurse leaders utilize standardized communication tools such as ISBARR, articulate their clinical assessments and rationales clearly, listen actively to others, and foster an open and respectful environment for team communication.

ISBARR

A common format used by health care team members to exchange client

information is **ISBARR**, a mnemonic for the components of **I**ntroduction, **S**ituation, **B**ackground, **A**ssessment, **R**equest/Recommendations, and **R**epeat back.[3,4]

- **Introduction:** Introduce your name, role, and the agency from which you are calling.
- **Situation:** Provide the client's name and location, the reason you are calling, recent vital signs, and the status of the client.
- **Background:** Provide pertinent background information about the client such as admitting medical diagnoses, code status, recent relevant lab or diagnostic results, and allergies.
- **Assessment:** Share abnormal assessment findings and your evaluation of the current client situation.
- **Request/Recommendations:** State what you would like the provider to do, such as reassess the client, order a lab/diagnostic test, prescribe/change medication, etc.
- **Repeat back:** If you are receiving new orders from a provider, repeat them to confirm accuracy. Be sure to document communication with the provider in the client's chart.

Before using ISBARR to call a provider regarding a changing client condition or concern, it is important for nurses to prepare and gather appropriate information. See the following box for considerations when calling the provider.

3. Institute for Healthcare Improvement. (n.d.). *SBAR tool*. https://www.ihi.org/resources/tools/sbar-tool-situation-background-assessment-recommendation

4. Grbach, W., Vincent, L., & Struth, D. (n.d.). *Reformulating SBAR to "I-SBAR-R"*. Quality and Safety Education for Nurses. https://www.qsen.org/strategies-submission/reformulating-sbar-to-%22i-sbar-r%22

Communication Guidelines for Nurses[5]

- Have I assessed this client before I call?
- Have I reviewed the current orders?
- Are there related standing orders or protocols?
- Have I read the most recent provider and nursing progress notes?
- Have I discussed concerns with my charge nurse, if necessary?
- When ready to call, have the following information on hand:
    - Admitting diagnosis and date of admission
    - Code status
    - Allergies
    - Most recent vital signs
    - Most recent lab results
    - Current meds and IV fluids
    - If receiving oxygen therapy, current device and L/min
- Before calling, reflect on what you expect to happen as a result of this call and if you have any recommendations or specific requests.
- Repeat back any new orders to confirm them.
- Immediately after the call, document with whom you spoke, the exact time of the call, and a summary of the information shared and received.

5. Patient Safety and Quality: An Evidence-Based Handbook for Nurses is in the public domain.

Read an example of an ISBARR report in the following box.

Sample ISBARR Report From a Nurse to a Health Care Provider

I: "Hello Dr. Smith, this is Jane Murphy, RN from the Med-Surg unit."

S: "I am calling to tell you about Ms. White in Room 210, who is experiencing an increase in pain, as well as redness at her incision site. Her recent vital signs were BP 160/95, heart rate 90, respiratory rate 22, O2 sat 96% on room air, and temperature 38 degrees Celsius. She is stable but her pain is worsening."

B: "Ms. White is a 65-year-old female, admitted yesterday post hip surgical replacement. She has been rating her pain at 3 or 4 out of 10 since surgery with her scheduled medication, but now she is rating the pain as a 7, with no relief from her scheduled medication of Vicodin 5/325 mg administered an hour ago. She is scheduled for physical therapy later this morning and is stating she won't be able to participate because of the pain this morning."

A: "I just assessed the surgical site, and her dressing was clean, dry, and intact, but there is 4 cm redness surrounding the incision, and it is warm and tender to the touch. There is moderate serosanguinous drainage. Her lungs are clear, and her heart rate is regular. She has no allergies. I think she has developed a wound infection."

R: "I am calling to request an order for a CBC, a wound culture, and increased dose of pain medication."

R: "I am repeating back the order to confirm that you are ordering a STAT CBC and an increase of her Vicodin to 10/325 mg."

View or print an ISBARR reference card.

Handoff Reports

Handoff reports are defined by The Joint Commission as "a transfer and acceptance of client care responsibility achieved through effective communication. It is a real-time process of passing client specific information from one caregiver to another, or from one team of caregivers to another, for the purpose of ensuring the continuity and safety of the client's care."[6] In 2017 The Joint Commission issued a sentinel alert about inadequate handoff communication that has resulted in client harm such as wrong-site surgeries, delays in treatment, falls, and medication errors.[7]

The Joint Commission encourages the standardization of critical content to be communicated by interprofessional team members during a handoff report both verbally (preferably face to face) and in written form. Critical content to communicate to the receiver in a handoff report includes the following components[8]:

6. Starmer, A. J., Spector, N. D., Srivastava, R., Allen, A. D., Landrigan, C. P., Sectish, T. C., & I-Pass Study Group. (2012). Transforming pediatric GME. *Pediatrics, 129*(2), 201-204. https://www.ipassinstitute.com/hubfs/I-PASS-mnemonic.pdf

7. The Joint Commission. (2021). The essential role of leadership in developing a safety culture. Sentinel Event Alert 57. https://www.jointcommission.org/resources/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-57-the-essential-role-of-leadership-in-developing-a-safety-culture/

8. The Joint Commission. (2021). The essential role of leadership in developing a safety culture. Sentinel Event Alert 57. https://www.jointcommission.org/

- Sender contact information
- Illness assessment, including severity
- Client summary, including events leading up to illness or admission, hospital course, ongoing assessment, and plan of care
- To-do action list
- Contingency plans
- Allergy list
- Code status
- Medication list
- Recent laboratory tests
- Recent vital signs

Several strategies for improving handoff communication have been implemented nationally, such as the Bedside Handoff Report Checklist, closed-loop communication, and I-PASS.

BEDSIDE HANDOFF REPORT CHECKLIST

See Figure 1.2[9] for an example of the Agency for Healthcare Research and Quality's (AHRQ) **Bedside Handoff Report Checklist** to improve nursing handoff reports.[10] Although a bedside handoff report is similar to an ISBARR report, it contains additional information to ensure continuity of care across nursing shifts.

resources/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-57-the-essential-role-of-leadership-in-developing-a-safety-culture/

9. "Bedside Shift Report Checklist" by AHRQ is in the public domain.
10. "Bedside Shift Report Checklist" by AHRQ is in the public domain.

Bedside Shift Report Checklist

- ☐ Introduce the nursing staff to the patient and family. Invite the patient and family to take part in the bedside shift report.
- ☐ Open the medical record or access the electronic work station in the patient's room.
- ☐ Conduct a verbal SBAR report with the patient and family. Use words that the patient and family can understand.
  - **S** = **Situation**. What is going on with the patient? What are the current vital signs?
  - **B** = **Background**. What is the pertinent patient history?
  - **A** = **Assessment**. What is the patient's problem now?
  - **R** = **Recommendation**. What does the patient need?
- ☐ Conduct a focused assessment of the patient and a safety assessment of the room.
  - Visually inspect all wounds, incisions, drains, IV sites, IV tubings, catheters, etc.
  - Visually sweep the room for any physical safety concerns.
- ☐ Review tasks that need to be done, such as:
  - Labs or tests needed
  - Medications administered
  - Forms that need to be completed (e.g., admission, patient intake, vaccination, allergy review, etc.)
  - Other tasks: _____
- ☐ Identify the patient's and family's needs or concerns.
  - Ask the patient and family:
    - *"What could have gone better during the last 12 hours?"*
    - *"Tell us how your pain is."*
    - *"Tell us how much you walked today."*
    - *"Do you have any concerns about safety?"*
    - *"Do you have any worries you would like to share?"*
  - Ask the patient and family what the goal is for the next shift. This is the patient's goal — not the nursing staff's goal for the patient.
    - *"What do you want to happen during the next 12 hours?"*
    - Follow up to see if the goal was met during the verbal SBAR at the next bedside shift report.

Adapted from the Emory University Bedside Shift Report Bundle.

AHRQ Agency for Healthcare Research and Quality
Advancing Excellence in Health Care • www.ahrq.gov

Guide to Patient and Family Engagement

Figure 1.2 Bedside Handoff Report Checklist

- Print a copy of the AHRQ Bedside Shift Report Checklist PDF.[11]

View a supplementary YouTube video[12] for bedside handoff report: Mastery Level Bedside Shift Report.

Closed-Loop Communication

The **closed-loop communication** strategy is used to ensure that information conveyed by the sender is heard by the receiver and completed. Closed-loop communication is especially important during emergency situations when verbal orders are being provided as treatments are immediately implemented. See Figure 1.3[13] for an illustration of closed-loop communication.

11. "Bedside Shift Report Checklist" by AHRQ is in the public domain.

12. UP Health System. (2016, December 22). *Mastery level bedside shift report* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=RHpbuljThoc

13. Image is derivative of "close-loop.png" by unknown and is licensed under CC0. Access for free at https://www.ahrq.gov/teamstepps/instructor/essentials/pocketguide.html

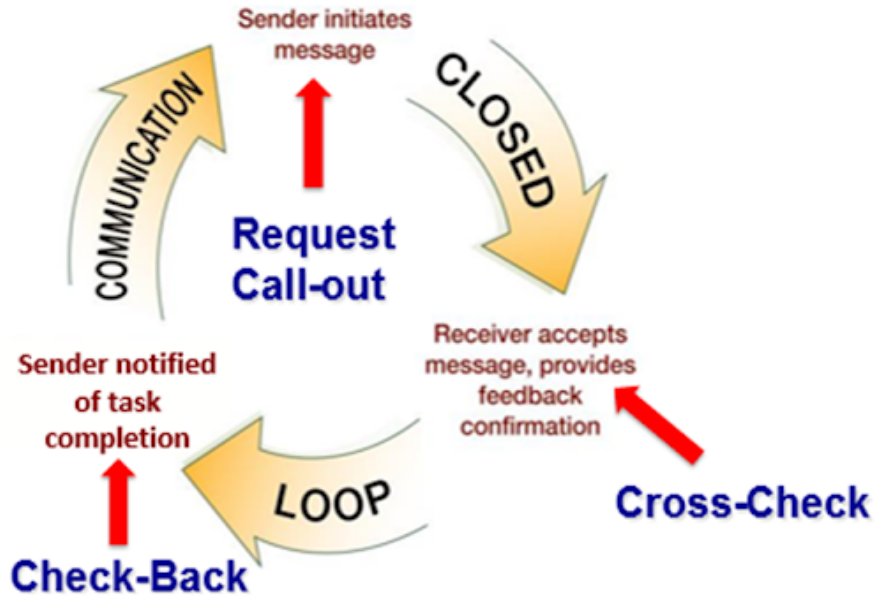


Figure 1.3 Closed-Loop Communication

During closed loop communication, the following actions occur:

- The sender initiates the message.
- The receiver accepts the message and repeats back the message to confirm it (i.e., “Cross-Check”).
- The sender confirms the message.
- The receiver notified the sender the task was completed (i.e., “Check-Back”).

See an example of closed-loop communication during an emergent situation in the following box.

Closed-Loop Communication Example

Doctor: “Administer Benadryl 50 mg PO STAT.”

Nurse: “Give the resident Donna Smith Benadryl 50 mg PO STAT?”

Doctor: "That's correct."

(A few minutes later) **Nurse:** "Benadryl 50 mg PO given at 1125 to Donna Smith."

I-PASS

I-PASS is a mnemonic used to provide structured communication among interprofessional team members. I-PASS stands for the following components[14]:

I: Illness severity
P: Patient summary
A: Action list
S: Situation awareness and contingency plans
S: Synthesis by receiver (i.e., closed-loop communication)

See a sample I-PASS handoff in Table 1.2.[15]

Table 1.2. Sample I-PASS Verbal Handoff[16]

14. The Joint Commission. (2017). Inadequate hand-off communication. *Sentinel Event Alert 58*. https://www.jointcommission.org/resources/patient-safety-topics/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-58-inadequate-hand-off-communication/

15. Starmer, A. J., Spector, N. D., Srivastava, R., Allen, A. D., Landrigan, C. P., Sectish, T. C., & I-Pass Study Group. (2012). Transforming pediatric GME. *Pediatrics, 129*(2), 201-204. https://www.ipassinstitute.com/hubfs/I-PASS-mnemonic.pdf

16. Starmer, A. J., Spector, N. D., Srivastava, R., Allen, A. D., Landrigan, C. P., Sectish, T. C., & I-Pass Study Group. (2012). Transforming pediatric GME. *Pediatrics, 129*(2), 201-204. https://www.ipassinstitute.com/hubfs/I-PASS-mnemonic.pdf

I	**Illness Severity**	This is our sickest patient on the unit, and he's a full code.
P	**Patient Summary**	AJ is a 4-year-old boy admitted with hypoxia and respiratory distress secondary to left lower lobe pneumonia. He presented with cough and high fevers for two days before admission, and on the day of admission to the emergency department, he had worsening respiratory distress. In the emergency department, he was found to have a sodium level of 130 mg/dL likely due to volume depletion. He received a fluid bolus, and oxygen administration was started at 2.5 L/min per nasal cannula. He is on ceftriaxone.
A	**Action List**	Assess him at midnight to ensure his vital signs are stable. Check to determine if his blood culture is positive tonight.
S	**Situations Awareness & Contingency Planning**	If his respiratory distress worsens, get another chest radiograph to determine if he is developing an effusion.
S	**Synthesis by Receiver**	Ok, so AJ is a 4-year-old admitted with hypoxia and respiratory distress secondary to a left lower lobe pneumonia receiving ceftriaxone, oxygen, and fluids. I will assess him at midnight to ensure he is stable and check on his blood culture. If his respiratory status worsens, I will repeat a radiograph to look for an effusion.

Read additional information about the roles and responsibilities of interprofessional team members in "Health Care Settings & Team" in Open RN *Nursing Fundamentals, 2e*.

Documentation

Accurate, timely, concise, and thorough documentation by nurses ensures continuity of care for their clients. It is well-known by health care team members that in a court of law the rule of thumb is, "If it wasn't documented, it wasn't done." Any type of documentation in the electronic health record (EHR) is considered a legal document. Abbreviations should be avoided in legal documentation, and some abbreviations are prohibited. See a list of error prone abbreviations in the box below.

- Read the current list of error-prone abbreviations by the Institute of Safe Medication Practices. These abbreviations should never be used when communicating medical information verbally, electronically, and/or in handwritten applications. Abbreviations included on The Joint Commission's "Do Not Use" list are identified with a double asterisk (**) and must be included on an organization's "Do Not Use" list.

Nursing staff access the electronic health record (EHR) to help ensure accuracy in medication administration and document the medication administration to help ensure client safety. See Figure 1.4[17] for an image of a nurse accessing a client's EHR.

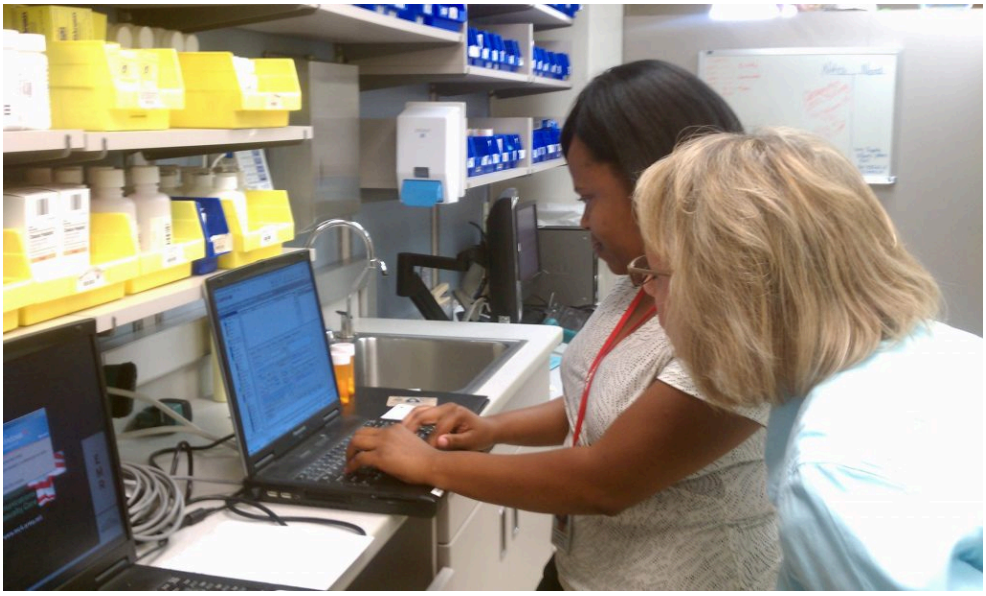


Figure 1.4 Documenting in the EHR

17. "Winn_Army_Community_Hospital_Pharmacy_Stays_Online_During_Power_Outage.jpg" by Flickr user MC4 Army is licensed under CC BY 2.0

Electronic Health Record

The electronic health record (EHR) contains the following important information:

- **History and Physical (H&P):** A history and physical (H&P) is a specific type of documentation created by the health care provider when the client is admitted to the facility. An H&P includes important information about the client's current status, medical history, and the treatment plan in a concise format that is helpful for the nurse to review. Information typically includes the reason for admission, health history, surgical history, allergies, current medications, physical examination findings, medical diagnoses, and the treatment plan.
- **Provider orders:** This section includes the prescriptions, or medical orders, that the nurse must legally implement or appropriately communicate according to agency policy if not implemented.
- **Medication Administration Records (MARs):** Medications are charted through electronic medication administration records (MARs). These records interface the medication orders from providers with pharmacists and are also the location where nurses document medications administered.
- **Treatment Administration Records (TARs):** In many facilities, treatments are documented on a treatment administration record.
- **Laboratory results:** This section includes results from blood work and other tests performed in the lab.
- **Diagnostic test results:** This section includes results from diagnostic tests ordered by the provider such as X-rays,

ultrasounds, etc.

- **Progress notes:** This section contains notes created by nurses, providers, and other interprofessional team members regarding client care. It is helpful for the nurse to review daily progress notes by all team members to ensure continuity of care.
- **Nursing care plans:** Nursing care plans are created by registered nurses (RNs). Documentation of individualized nursing care plans is legally required in long-term care facilities by the Centers for Medicare and Medicaid Services (CMS) and in hospitals by The Joint Commission. Nursing care plans are individualized to meet the specific and unique needs of each client. They contain expected outcomes and planned interventions to be completed by nurses and other members of the interprofessional team. As part of the nursing process, nurses routinely evaluate the client's progress toward meeting the expected outcomes and modify the nursing care plan as needed. Read more about nursing care plans in the "Planning" section of the "Nursing Process" chapter in Open RN *Nursing Fundamentals, 2e*.

Read the American Nurses Association's Principles for Nursing Documentation PDF.

Learning From Client Interactions

Every client interaction provides the nursing student and nurse an opportunity to grow and develop as a leader. Client interaction provides the opportunity to enhance one's clinical skills by applying knowledge and expertise, improving critical thinking and clinical judgment, and enhancing

communication skills. After each client interaction, the nursing student and nurse can self-reflect on the interaction, identify areas for improvement, and set goals for professional development. Nurse leaders who embrace this continuous learning mindset can help to advance the profession and foster a culture of lifelong learning that is critical for addressing the complexities of today's health care environment.

1.3 Leadership Styles

Leadership Theories and Styles

Leadership theories and styles have evolved over time. Kurt Lewin, the father of social psychology, originally identified three leadership styles in the 1930s: authoritarian, democratic, and laissez-faire.[1,2]

Authoritarian leadership means the leader has full power. Authoritarian leaders tell team members what to do and expect team members to execute their plans. When fast decisions must be made in emergency situations, such as when a client "codes," the authoritarian leader makes quick decisions and provides the group with direct instructions. However, there are disadvantages to authoritarian leadership. Authoritarian leaders are more likely to disregard creative ideas of other team members, causing resentment and stress.[3]

Democratic leadership balances decision-making responsibility among team members and the leader after clear roles and responsibilities have been established. Democratic leadership allows experienced nursing team members who are highly skilled, motivated, and capable to independently manage their daily routines and client care tasks. Additionally, democratic leaders not only actively participate in discussions, but also make sure to

1. Carlin, D. (2019). Democratic, authoritarian, laissez-faire: What type of leader are you? *Forbes*. https://www.forbes.com/sites/davidcarlin/2019/10/18/democratic-authoritarian-laissez-faire-what-type-of-leader-are-you/?sh=618359422a6b

2. Lewin, K., Lippitt, R., & White, R. K. (1939). Patterns of aggressive behavior in experimentally created "social climates." *Journal of Social Psychology, 10*(2), 271-301. https://doi.org/10.1080/00224545.1939.9713366

3. Carlin, D. (2019). Democratic, authoritarian, laissez-faire: What type of leader are you? *Forbes*. https://www.forbes.com/sites/davidcarlin/2019/10/18/democratic-authoritarian-laissez-faire-what-type-of-leader-are-you/?sh=618359422a6b

listen to the views of others. For example, a nurse supervisor may hold a meeting regarding an increased incidence of client falls on the unit and ask team members to share their observations regarding causes and potential solutions. The democratic leadership style often leads to positive, inclusive, and collaborative work environments that encourage team members' creativity. Under this style, the leader still retains responsibility for the final decision.[4]

Laissez-faire is a French word that translates to English as "leave alone." **Laissez-faire leadership** gives team members total freedom to perform as they please. Laissez-faire leaders do not participate in decision-making processes and rarely offer opinions. The laissez-faire leadership style can work well if team members are highly skilled and highly motivated to perform quality work. However, without the leader's input, conflict and a culture of blame may occur as team members disagree on roles, responsibilities, and policies. By not contributing to the decision-making process, the leader forfeits control of team performance.[5]

Over several decades, Lewin's original leadership styles have evolved into many styles of leadership in health care, such as passive-avoidant, transactional, transformational, servant, resonant, and authentic.[6,7] Many of

4. Carlin, D. (2019). Democratic, authoritarian, laissez-faire: What type of leader are you? *Forbes*. https://www.forbes.com/sites/davidcarlin/2019/10/18/democratic-authoritarian-laissez-faire-what-type-of-leader-are-you/?sh=618359422a6b

5. Carlin, D. (2019). *Democratic, authoritarian, laissez-faire: What type of leader are you? Forbes*. https://www.forbes.com/sites/davidcarlin/2019/10/18/democratic-authoritarian-laissez-faire-what-type-of-leader-are-you/?sh=618359422a6b

6. Northhouse, P. (2004). *Leadership: Theory and practice* (9th ed.). Sage Publications.

7. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., &

these leadership styles have overlapping characteristics. See Figure 1.5[8] for a comparison of various leadership styles in terms of engagement.



Figure 1.5 Leadership Styles

Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

8. "Full_Range_Leadership_model.jpg" by John Pons is licensed under Public Domain, CC0

Passive-avoidant leadership is similar to laissez-faire leadership and is characterized by a leader who avoids taking responsibility and confronting others. Employees perceive the lack of control over the environment resulting from the absence of clear directives. Organizations with this type of leader have high staff turnover and low retention of employees. These types of leaders tend to react and take corrective action only after problems have become serious and often avoid making any decisions at all.[9]

Transactional leadership involves both the leader and the follower receiving something for their efforts; the leader gets the job done and the follower receives pay, recognition, rewards, or punishment based on how they perform the tasks assigned to them.[10] Staff generally work independently with no focus on cooperation among employees or commitment to the organization.[11]

Transformational leadership involves leaders motivating followers to perform beyond expectations by creating a sense of ownership in reaching a shared vision.[12] It is characterized by a leader's charismatic influence over team members and includes effective communication, valued relationships, and consideration of team member input. Transformational leaders know

9. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

10. Northhouse, P. (2004). *Leadership: Theory and practice* (9th ed.). Sage Publications.

11. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

12. Northhouse, P. (2004). *Leadership: Theory and practice* (9th ed.). Sage Publications.

how to convey a sense of loyalty through shared goals, resulting in increased productivity, improved morale, and increased employee job satisfaction.[13] They often motivate others to do more than originally intended by inspiring them to look past individual self-interest and perform to promote team and organizational interests.[14] An example of transformational leadership is when a nurse attends a continuing education conference and then presents information learned to colleagues during a staff meeting.

Servant leadership focuses on the professional growth of employees while simultaneously promoting improved quality care through a combination of interprofessional teamwork and shared decision-making. Servant leaders assist team members to achieve their personal goals by listening with empathy and committing to individual growth and community-building. They share power, put the needs of others first, and help individuals optimize performance while forsaking their own personal advancement and rewards.[15]

13. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

14. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

15. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

Visit the Greenleaf Center site to learn more about What is Servant Leadership?

Resonant leaders are in tune with the emotions of those around them, use empathy, and manage their own emotions effectively. Resonant leaders build strong, trusting relationships and create a climate of optimism that inspires commitment even in the face of adversity. They create an environment where employees are highly engaged, making them willing and able to contribute with their full potential.[16]

Authentic leaders have an honest and direct approach with employees, demonstrating self-awareness, internalized moral perspective, and relationship transparency. They strive for trusting, symmetrical, and close leader–follower relationships; promote the open sharing of information; and consider others' viewpoints.[17]

See Table 1.3 for a summary of characteristics of leadership styles.

Table 1.3. Characteristics of Leadership Styles

16. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

17. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

Leadership Style	Summary of Characteristics
Authoritarian	• Demonstrates centralized decision-making • Uses power to control others • Motivates through fear or reward • Disregards needs of group members
Democratic	• Demonstrates participatory decision-making • Displays multidirectional communication • Builds close, personal relationships • Encourages members' goal attainment
Laissez-Faire or Passive-Avoidant	• Demonstrates passive, permissive, or absent decision-making
Transactional	• Allows both parties to receive something for their efforts • Motivates members with external rewards • Rewards good performance and penalizes low performance • Does not focus on team cooperation or commitment to the organization

Transformational	• Creates ownership with shared, inspiring vision • Demonstrates effective communication • Values relationships • Considers individuals' needs and abilities
Servant	• Focuses on growth and well-being of team members • Puts team members' needs and preferences first • Shares decision-making • Develops team members to their highest potential
Resonant	• Builds strong, trusting relationships • Focuses on the emotions of team members, uses empathy, and manages their own emotions effectively • Creates a climate of optimism
Authentic	• Uses an honest and direct approach • Develops close leader–follower relationships • Promotes open sharing of information • Considers others' viewpoints

Outcomes of Leadership Styles

Leadership styles affect team members, client outcomes, and the

organization. A systematic review of the literature published in 2021 showed significant correlations between leadership styles and nurses' job satisfaction. Transformational leadership style had the greatest positive correlation with nurses' job satisfaction, followed by authentic, resonant, and servant leadership styles. Passive-avoidant and laissez-faire leadership styles showed a negative correlation with nurses' job satisfaction.[18] In this challenging health care environment, managers and nurse leaders must promote technical and professional competencies of their staff, but they must also act to improve staff satisfaction and morale by using appropriate leadership styles with their team.[19]

18. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

19. Specchia, M. L., Cozzolino, M. R., Carini, E., Di Pilla, A., Galletti, C., Ricciardi, W., & Damiani, G. (2021). Leadership styles and nurses' job satisfaction. Results of a systematic review. *International Journal of Environmental Research and Public Health, 18*(4), 1552. https://doi.org/10.3390/ijerph18041552

1.4 Characteristics of Effective Leadership

Characteristics of Effective Leadership

Effective nursing leadership plays a significant role in the delivery of quality health care, subsequently impacting the success and viability of health care organizations. Nursing leaders who demonstrate effective leadership skills empower their teams, drive change, and subsequently improve client outcomes. Consider the following example to illustrate why effective leadership is needed across leadership roles at an institution.

> Sarah is an LPN/VN working in a busy long-term care facility. Over the last two months, Sarah has identified several instances of resident care that was not performed due to misunderstandings regarding responsibilities and actions by LPN/VN and UAP staff. Sarah approaches the nurse manager to discuss the need for improved communication among team members to prevent these misunderstandings from occurring to improve resident care. She proposes an initiative to implement a "daily huddle" where all team members can discuss resident updates and concerns, share ideas, and clarify the implementation of nursing tasks. The nurse manager actively listens to Sarah's concerns and implements her proposed initiative as a safety culture strategy. After implementing the strategy, the nurse manager reevaluates resident care outcomes and determines this initiative fosters improved team communication, collaboration, and coordination, resulting in improved resident care.

Table 1.4 describes characteristics of effective nursing leadership, along with examples of how leaders can demonstrate these qualities in their daily practice.[1,2]

Table 1.4. Characteristics and Examples of Effective Leadership

1. Cummings, G. G., MacGregor, T., Davey, M., Lee, H., Wong, C. A., Lo, E., & Muise, M. (2018). Characteristics of effective nursing leadership: A qualitative meta-synthesis. *Journal of Nursing Management, 26*(3), 331-340. https://doi.org/10.1111/jonm.12629

2. Van der Haar, D., Aiken, L. H., & Busse, R. (2019). Exploring the characteristics of effective nurse leaders: A qualitative study. *Journal of Nursing Management, 27*(8), 1642-1650. https://doi.org/10.1111/jonm.12934

Characteristic	Description	Example
Integrity	Outside actions align with internal beliefs, morals, and values.	A nursing leader consistently models honesty and transparency, ensuring their decisions and actions are in line with their ethical principles.
Courage	Willingness to take risks and face challenges.	A nursing leader advocates for innovative changes in client care practices, even when it involves stepping outside of their comfort zone and challenging traditional practices.
Initiative	Proactive in acting on good ideas and opportunities.	A nursing leader identifies a gap in client education and proactively develops a comprehensive program to address the issue, benefiting both clients and the nursing staff.
Energy	Efficient and effective utilization of energy and resources.	A nursing leader manages their time and energy efficiently, prioritizes tasks, and delegates responsibilities, thus ensuring the team's efforts are focused on achieving the best outcomes for clients.
Optimism	Ability to see problems as opportunities for growth.	In the face of budget cuts, a nursing leader views it as an opportunity to streamline processes and increase efficiency.
Perseverance	Persistent and determined, not giving up easily.	A nursing leader faces numerous challenges in implementing a new electronic health record system but persists, providing support, training, and encouragement to the team until successful adoption and improved workflow are achieved.
Balance	Maintaining a healthy equilibrium between work and personal life.	A nursing leader sets boundaries and encourages their team to prioritize self-care, demonstrating a healthy work-life balance by actively engaging in hobbies, spending quality time with family members and other social supports, and encouraging others to do the same.
Ability to handle stress	Managing stress in a positive and healthy manner.	A nursing leader practices stress-reducing techniques such as mindfulness, exercise, and open communication, creating a supportive environment where team members feel comfortable discussing and managing their stress levels effectively.
Communication	Effectively communicates with team members.	An effective nursing leader listens to others' perspectives and encourages shared decision-making, when feasible.

By understanding and embodying these characteristics, leaders can create a positive work environment and drive team success.

1.5 Conflict Resolution

Conflict Resolution

Teamwork promotes collaboration, enhances client care outcomes, and fosters a positive work environment. It allows team members to pool their skills, knowledge, and expertise to provide comprehensive and holistic care to clients, while also promoting efficiency and saving organizations money. A strong sense of teamwork encourages open communication, mutual support, and shared accountability among team members, leading to improved client safety and team satisfaction.

Conflict is a natural occurrence on teams. It arises when two or more individuals have opposing thoughts, ideas, feelings, perceptions, behaviors, values, opinions, or actions. It is an inevitable part of professional, social, and personal life and can lead to either constructive or destructive consequences. Constructive consequences of conflict include stimulating growth, fostering open and honest communication, increasing group cohesion and commitment to common goals, facilitating understanding and problem-solving, motivating change, and stimulating creativity. On the other hand, conflict can also have destructive consequences, such as producing hostility within a group, fostering rivalry and competition, and creating misperceptions, distrust, and frustration, resulting in group dissatisfaction with the outcome.

For health care teams to be effective, nurses must be skilled in conflict resolution. Conflicts in health care teams can arise due to differences in opinions, communication breakdowns, or varying work styles. When conflicts are left unresolved, they can lead to tension, decreased morale, and compromised client care. Nurse leaders play a crucial role in promoting effective **conflict resolution** by fostering an environment that encourages respectful dialogue and active listening. In this manner, conflicts can be addressed promptly and constructively. Through mediation and negotiation, a nurse leader can help team members find common ground, reach

compromises, and maintain harmonious working relationships.[1] When resolving conflict, the desired goal is for both parties to reach a satisfactory resolution, known as a "win-win solution." However, it is important to recognize that a win-win solution is not always possible in every situation.

To address conflicts effectively, various strategies can be employed[2]:

- **Open communication:** Leaders make communication among team members a two-way process where individuals express their thoughts, feelings, and concerns while also actively listening to the thoughts, feelings, and concerns of others.
- **Assertive communication:** Leaders encourage team members to express themselves in direct, honest, and appropriate ways that also respect the rights of others.
- **Respectful communication:** Leaders encourage team members to communicate respectfully by maintaining good eye contact, conveying empathy, being aware of nonverbal communication, and focusing on the concern rather than making personal attacks.

By creating a culture of open communication and mutual respect, a nurse leader can improve client outcomes by ensuring that team members work together cohesively, leveraging each other's strengths, and building on others' expertise. Moreover, effective conflict resolution allows for the early identification and resolution of issues, preventing conflicts from escalating

1. Haack, M. R., & Hughes, L. C. (2019). Conflict resolution styles of nurses and their impact on the work environment. *Journal of Nursing Management, 27*(2), 406-414. https://doi.org/10.1111/jonm.12668

2. Russotto, J., Tierney, L., & Stype, J. (2019). Conflict resolution strategies used by nurse managers and the impact on the staff nurse. *Journal of Nursing Administration, 49*(9), 455-461. https://doi.org/10.1097/NNA.0000000000000770

and negatively impacting the team's dynamics and client care.[3] Table 1.5 summarizes various conflict resolution approaches.

Table 1.5. Conflict Resolution Approaches[4]

3. Ambrose, M. K., Seabert, D., & Schminke, M. (2021). Conflict management and resolution strategies in healthcare organizations. In *Handbook of Conflict Management Research*. Edward Elgar Publishing. https://doi.org/10.4337/9781789908294.00020

4. Haack, M. R., & Hughes, L. C. (2019). Conflict resolution styles of nurses and their impact on the work environment. *Journal of Nursing Management, 27*(2), 406-414. https://doi.org/10.1111/jonm.12668

Conflict Resolution Approach	Description	Examples
Collaborative Problem- Solving	Parties work together to find a mutually beneficial solution.	In a health care tea engage in open dia balanced plan for c in collaborative pro
Mediation	A neutral third party facilitates communication and negotiation.	A conflict arises bet manager acts as a understand each o dialogue of all parti
Compromising	Both parties make concessions to reach a middle ground.	A conflict arises bet by adjusting the m solution. View samp
Active Listening and Assertively Communicating	Parties express their concerns and actively listen to each other while also using assertive communication.	Two team member assertively, while ac agreed-upon plan t participating in act
Escalating Up the Chain of Command	Parties involve higher-level supervisors to intervene.	A conflict between escalated to the de cohesiveness and f chain of command
Avoiding	Parties ignore or withdraw from a conflict. In the short-term, this may be effective in calming heated emotions. However, if this approach is used chronically, it can damage trust and rapport by signaling a lack of interest or commitment.[5]	A conflict arises bet agree to take a "tim using avoidance as
Accommodating	One party resolves the conflict by "giving in" to the other party. This may be useful when one party realizes they are in error or if the other party is an expert or has more experience. However, it is also crucial to be aware of when accommodating might be detrimental to you or your team's best interest.[6]	A conflict arises wh dialogue on one nu

Consider the following example conflict in a health care setting requiring conflict resolution and reflect on conflict resolution strategies that could be implemented.

Scenario: Conflict Requiring Conflict Resolution

In a long-term care facility, Sarah, an LPN/VN, and Emma, a certified nursing assistant, find themselves in a conflict regarding the delegation of tasks and workload distribution. Sarah believes that Emma is not taking on her fair share of responsibilities or providing adequate support to the residents. On the other hand, Emma feels overwhelmed by the assigned workload and believes that Sarah is not acknowledging her efforts. Both parties firmly believe they are "right" within their positions and are unwilling to compromise.

What conflict resolution strategy could be used to satisfactorily address the conflict between these two team members?

5. LinkedIn. (2023). *What are some common pitfalls or challenges of using an avoiding style in conflict management?* https://www.linkedin.com/advice/1/what-some-common-pitfalls-challenges-using-avoiding

6. Indeed. (2025). *5 major conflict management styles for managers.* https://www.indeed.com/career-advice/career-development/conflict-management

1.6 Constructive Feedback

Constructive Feedback

Providing constructive feedback is a crucial aspect of effective team communication and promotes the professional development of team members. **Constructive feedback** involves providing feedback in a manner that focuses on the behavior or performance of a team member rather than criticizing the individual. The purpose of constructive feedback is to help the team member identify areas for improvement and offer suggestions for development. By providing specific and actionable feedback, team members can gain valuable insights into areas for improvement, reflect on their actions, create personal goals, and plan strategies for personal and professional growth. Constructive feedback is essential for fostering a positive and supportive team environment.

Here are tips for effectively providing constructive feedback[1]:

- **Offer constructive feedback as a conversation in person and in private.** Initial identification of areas of improvement can cause the team member to feel embarrassed or upset. Address concerns in private and in a supportive manner. Be mindful of your body language and tone of voice. At the start of the conversation, let the team member know you will be sharing some constructive feedback. Giving them a few minutes' notice allows them to mentally prepare to receive the feedback. Discussing areas for improvement as a conversation helps the team member feel as though they are part of the process. Include positive feedback as part of the conversation to show the team member you appreciate the positive work they do.
- **Offer observations.** Focus on observations rather than character judgments and use "I" statements. For example, if a nurse manager

1. Indeed. (2025). *10 tips for giving constructive feedback to employees*. https://www.indeed.com/hire/c/info/constructive-feedback

observed late documentation submitted by a nurse, note the behavior by saying, “I noticed your documentation for Client A was entered late,” rather than, “You never manage your time well.”

- **Be specific and objective.** Clearly articulate the behavior or performance that requires improvement by providing concrete examples to support observations. This allows the team member to understand the full extent of the issue and make positive changes.
- **Show sincerity.** Be sincere in your feedback. Receiving constructive feedback can make team members feel very vulnerable. Knowing that you care about them, and you are sincere in your efforts to help them improve will motivate them to make the suggested changes.
- **Offer solutions and suggestions for improvement.** Provide guidance, resources, or additional training opportunities to support the team member’s growth and development.
- **Focus on the impact of the behavior or performance on the team or project outcomes.** Explain why you are sharing constructive feedback. Emphasize the importance of addressing the issue to enhance individual and team effectiveness.
- **Deliver feedback in a timely manner.** Address the concern as soon as possible, rather than letting it linger and potentially affect team dynamics or project progress.
- **Actively listen and encourage participation.** Give the team member time to process the information and formulate questions. Allow time for follow-up questions and encourage them to contribute to the solution.

By incorporating constructive feedback into team dynamics, team members can collectively work towards achieving personal and organizational goals. It is crucial for nurse leaders to create a culture where feedback is welcomed and seen as an opportunity for growth rather than criticism or a personal attack. Nurse leaders encourage open communication and active listening and create a supportive atmosphere where team members feel comfortable providing and receiving feedback. Strategies that promote open communication channels, such as routine feedback sessions, peer feedback, and performance evaluations, can facilitate continuous improvement,

ultimately contributing to the overall success of the team and the organization.

Examples of Constructive Feedback in a Professional Context

- **Time Management:** If a team member consistently misses deadlines, constructive feedback can be provided to address the issue and promote the development of improved time management skills.
    - Sample verbiage: “Our goal is to support your growth and success as a team member. We recognize that sometimes challenges arise that can impact one’s ability to meet deadlines. However, consistency in missing deadlines can have a negative impact on team projects and overall productivity. It’s essential for us to work together to find a solution that will benefit both you and the team. Let’s schedule a meeting to discuss a few suggestions to help improve your time management skills and consistently meet deadlines.”
- **Unclear Communication:** When a team member’s communication style is unclear or ineffective, constructive feedback on improving clarity and active listening skills can enhance their communication with the team.
    - Sample verbiage: “Sometimes team members have trouble understanding what you are asking of them. In the future, it would be helpful to ask them to rephrase what you asked to ensure that everyone is clear about your

request."

- **Performance of a Skill or Task:** When a team member struggles with a particular task or skill, offering constructive feedback on areas for improvement and suggesting training or mentorship opportunities can support their professional development.
    - Sample verbiage: "I've noticed you do a great job starting IVs but have been struggling with inserting urinary catheters. Next time you receive an order to insert a urinary catheter, I would be happy to assist and guide you through it."
- **Disruptive Behavior During Team Meetings:** When a team member demonstrates disruptive behavior during team meetings, providing feedback on the impact of their behavior and suggesting alternative approaches can help foster a positive and productive team environment.
    - Sample verbiage: "I've noticed when we discuss upcoming changes in the department, you tend to loudly express your frustration during team meetings. This impacts our ability to bring about positive change because it changes the mood of everyone involved at the meetings. We ask that you wait to ask questions or state opinions during meetings until you've heard all of the information presented. We want to be sure we hear your concerns. If you continue to feel frustrated, we would be happy to discuss your concerns outside of department meeting time."

1.7 Managing the Nursing Team

Managing the Nursing Team

Managing care provided by the nursing team is an important skill of nurse leaders to ensure safe, quality, client-centered care in complex and often challenging health care environments. While many nursing students focus on developing clinical skills and knowledge during their educational journey, the importance of learning management and leadership skills should not be minimized. Newly licensed nurses in clinical practice often find themselves in situations requiring effective nursing leadership and management skills.

Nurses must first have a good understanding of the **Nurse Practice Act (NPA)** in the state in which they are employed to know their legal scope of practice, as well as the scope of practice of other members on the nursing team. The NPA contains regulations established by the state legislature that are enforced by the Board of Nursing. The **Board of Nursing (BON)** is the state-specific licensing and regulatory body that sets standards for safe nursing care and issues nursing licenses to qualified candidates. A good understanding of the state NPA ensures adherence to legal standards of care when performing, assigning, and delegating nursing responsibilities. Additionally, a clear understanding of the scope of each team member's role promotes an efficient and well-coordinated approach to client care.

Wisconsin Nurse Practice Act

Let's examine the roles and scope of practice for members of the nursing team according to the state-specific regulations in the Wisconsin Nurse Practice Act (NPA).

According to the NPA, a **registered nurse (RN)** "utilizes the nursing process in the execution of general nursing procedures in the maintenance of health, prevention of illness, or care of the ill. The nursing process consists of the steps of assessment, planning, intervention, and evaluation."[1]

1. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for*

The role of the **licensed practical/vocational nurse (LPN/VN)** is defined as the "performance of acts in basic patient situations."[2] In the performance of acts in basic patient situations, the LPN/VN shall, under the general supervision of an RN or the direction of a provider, do the following[3]:

- Accept only patient care assignments which the LPN/VN is competent to perform.
- Provide basic nursing care.
- Record nursing care given and report to the appropriate person changes in the condition of a patient.
- Consult with a provider in cases where an LPN/VN knows or should know a delegated act may harm a patient.
- Perform the following other acts when applicable:
    - **Assist** with the collection of data.
    - **Assist** with the development and revision of a nursing care plan.
    - **Reinforce** the teaching provided by an RN provider and provide basic health care instruction.
    - **Participate** with other health team members in meeting basic patient needs.

Basic Nursing Care

In this description of the LPN/VN role and standards of care, **basic nursing**

registered nurses and licensed practical nurses.
https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

2. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses*.
https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

3. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses*.
https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

care is defined as "care that can be performed following a defined nursing procedure with minimal modification in which the responses of the patient to the nursing care are predictable." A **basic patient situation** is defined as a situation "determined by an RN, physician, podiatrist, dentist, or optometrist that meets the following three conditions[4]:

- The patient's clinical condition is predictable.
- Medical or nursing orders are not changing frequently and do not contain complex modifications.
- The patient's clinical condition requires only basic nursing care.

Review an example of basic nursing care in the following box.

Example of "Basic Nursing Care" in a "Basic Patient Situation"

In a long-term care facility, an LPN/VN is responsible for providing care to a resident named Mrs. Anderson, who has been diagnosed with type 2 diabetes. Mrs. Anderson's diabetes is well-managed and stable, with no recent fluctuations in her blood sugar levels. Her medication regimen consists of oral medications taken daily, and her diet plan is consistent.

The LPN/VN's role in Mrs. Anderson's "basic nursing care" involves administering her daily medications, measuring and recording her blood sugar levels prior to meals, and ensuring she follows her prescribed diet.

4. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses.* https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

Complex Patient Situation

The Wisconsin NPA further states that in the performance of acts in complex patient situations, the LPN/VN shall meet these previously defined standards, as well as perform delegated acts beyond basic nursing care under the direct supervision of an RN or provider. **Direct supervision** is defined as "immediate availability to continually coordinate, direct, and inspect at first hand the practice of another."

A **complex patient situation** is defined as, "an act determined by an RN, physician, podiatrist, dentist, or optometrist where one or more of the following conditions exist in a given situation[5]:

- The patient's clinical condition is not predictable.
- Medical or nursing orders are likely to involve frequent changes or complex modifications.
- The patient's clinical condition indicates care that is likely to require modification of nursing procedures in which the responses of the patient to the nursing care are not predictable.

Review an example of how a "basic patient situation" becomes a "complex patient situation" in the following box.

Example of a "Complex Patient Situation"

In a long-term care facility, an LPN/VN is responsible for providing care to Mrs. Anderson, a resident with type 2 diabetes. Over the past week, Mrs. Anderson has been experiencing

5. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses.* https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

frequent and unexpected fluctuations in her blood sugar levels. Her physician has modified her medication regimen several times over the past few days to better control her condition. Additionally, Mrs. Anderson's clinical condition now requires modifications to the standard nursing procedures because her responses to the care provided are not predictable.

In this "complex patient situation," the LPN/VN collaborates closely with the RN and the health care provider to adjust Mrs. Anderson's care plan in real-time based on her changing clinical condition. The LPN/VN administers medications, monitors blood sugar levels, and adjusts her diet plan per the updated medical orders. The LPN/VN works under the direct supervision of the RN or health care provider to ensure that Mrs. Anderson receives the necessary and responsive care to manage her complex diabetes condition effectively.

Scope of Practice in Wisconsin

See Table 1.7a for a summary of educational preparation and scope of practice for RNs and LPN/VNs according to Wisconsin's Nurse Practice Act, as well as an overview of tasks performed by certified nursing assistants (CNAs), a type of unlicensed assistive personnel (UAP).

Table 1.7a. Roles and Responsibilities of Nursing Team Members in Wisconsin[6,7]

6. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses*. https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

7. Wisconsin State Legislature. (2023). *Chapter DHS129*. https://docs.legis.wisconsin.gov/code/admin_code/dhs/110/129/ii/07

	Registered Nurse (RN)	Licensed Practical Nurse (LPN)	Ce
Education and Licensure or Certification	Completes an accredited nursing program (diploma, associate degree, or bachelor's degree) and successfully passes the NCLEX-RN.	Completes a state-approved practical nursing program and successfully passes the NCLEX-PN.	Co pa

Scope of Practice	• Provides comprehensive nursing care according to the standards of the nursing process, including complex situations where the client's condition is not predictable. • Assesses and analyzes clients' health status, including laboratory and diagnostic results. • Develops, implements, and revises nursing care plans. • Administers medications (all routes). • Administers blood transfusions. • Assigns and delegates tasks to LPN/VNs and UAPs under defined conditions with appropriate supervision. • Advocates for client rights and overall well-being with the interprofessional health care team. • Ensures compliance with legal and ethical standards. • Plans and provides client health teaching and health promotion. • Provides therapeutic communication.	• Provides basic nursing care in basic patient situations to clients with predictable clinical conditions. • Provides nursing care in complex patient situations under the direct supervision of an RN or provider. • Assists with the collection of client data. • Assists with the development and revision of a nursing care plan. • Reinforces the teaching provided by an RN and provides basic health care instruction. • Participates with other health team members in meeting basic client needs. • Administers medications under supervision (generally including the routes of oral, topical, and injections). • Provides wound care and dressing changes.

		• Provides therapeutic communication.

Find Nurse Practice Acts and other nursing regulatory information around the world at the NSCBN's Global Regulatory Atlas web page.

Read more about the Wisconsin's Nurse Practice Act and the standards and scope of practice for RNs and LPNs at Wisconsin's Legislative Code Chapter N 6 PDF.

Read more about scope of practice, skills, and practices of nurse aides in Wisconsin at DHS 129.07 Standards for Nurse Aide Training Programs web page.

Managing Client Care as a Member of the Interprofessional Health Care Team

Collaboration with other interprofessional team members is a key aspect of managing nursing care. Nurses work closely with physicians, therapists, social workers, and other health care professionals to develop and implement comprehensive care plans. Effective communication, coordination, and teamwork are essential to ensure that all members of the health care team are aligned in their efforts and contribute their expertise for the best possible outcomes for clients.

Nurses and charge nurses may participate in interprofessional team conferences where they contribute their insights, advocate for clients, and ensure that their needs are met holistically. They may also serve as liaisons when establishing community resources for clients being discharged home, ensuring a smooth transition and continuity of care.

1.8 Delegation and Supervision

Delegation

Nurses may assign or delegate client care to other members of the nursing team based on federal regulations and their scope of practice as defined by that state's Nurse Practice Act (NPA). RNs may assign or delegate client care to other RNs, LPN/VNs, and/or UAP. LPNs may delegate care to other LPN/VNs or UAP.

When making assignments and delegating tasks to nursing team members, it is essential for nurses to keep in mind specific tasks that can and cannot be delegated to other nursing team members based on federal and/or state regulations. For example, in Wisconsin the NPA states, "In the supervision and direction of delegated acts, an RN shall do all of the following:

(a) Delegate tasks commensurate with educational preparation and demonstrated abilities of the person supervised.
(b) Provide direction and assistance to those supervised.
(c) Observe and monitor the activities of those supervised.
(d) Evaluate the effectiveness of acts performed under supervision."

Examples of tasks that generally cannot be delegated are described in Table 1.8a.

Table 1.8a. Examples of Tasks Outside the Scope of Practice of Nursing Team Members

Nursing Team Member	Tasks That Cannot Be Delegated
LPN/VN	• Cannot create nursing care plans, analyze client assessment data, establish nursing diagnoses or expected outcomes, or evaluate the effectiveness of a nursing care plan. (However, LPN/VNs can collect data and contribute to the development and revision of a client's nursing care plan in collaboration with the RN.) • Cannot administer high-risk medications (such as heparin and chemotherapeutic medications). • Cannot titrate medications. (Titrate refers to adjusting the dosage of medication until the desired effects are achieved.) • Cannot independently provide client education. (However, they can implement client education that has been planned by the RN.) • Cannot perform admission assessments or initial postoperative assessments. • Cannot discharge clients.

Unlicensed Assistive Personnel (UAP)	• Cannot complete tasks requiring clinical judgement and/or professional knowledge. For example, a nursing assessment of a client's skin cannot be delegated to UAP. However, UAP are encouraged to report concerns about skin breakdown and other potential signs and symptoms to a licensed nurse. • Cannot delegate tasks. • Cannot provide client education but can reinforce education previously provided. For example, UAP can encourage a client to keep their nasal cannula in place while eating. • Cannot complete tasks that require clinical expertise unless advanced training has been received and written agency policy allows, such as[1]: ◦ Administering medications and injections ◦ Inserting Foley catheters ◦ Administering tube feedings ◦ Performing wound care or dressing changes

There has been significant national debate over the difference between "assignment" and "delegation" over the past few decades. In 2019 the National Council of State Boards of Nursing (NCSBN) and the American Nurses Association (ANA) published updated joint National Guidelines on Nursing Delegation.[2] These guidelines apply to all levels of nursing licensure (advanced practice registered nurses [APRN], registered nurses [RN], and licensed practical/vocational nurses [LPN/VN]) when delegating when there is

1. State of Wisconsin Department of Health Services. (2023). *Medication administration by unlicensed assistive personnel (UAP): Guidelines for registered nurses delegating medication administration to unlicensed assistive personnel*. https://www.dhs.wisconsin.gov/publications/p01908.pdf

2. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

no specific guidance provided by the state's Nurse Practice Act (NPA).[3] It is important to note that states have different laws and rules/regulations regarding delegation, so it is the responsibility of all licensed nurses to know what is permitted in their jurisdiction.

The National Guidelines on Nursing Delegation defines a **delegatee** as an RN, LPN/VN, or UAP who is delegated a nursing responsibility by either an APRN, RN, or LPN/VN, is competent to perform the task, and verbally accepts the responsibility.[4] **Delegation** is allowing a delegatee to perform a specific nursing activity, skill, or procedure that is beyond the delegatee's traditional role and not routinely performed, but the individual has obtained additional training and validated their competence to perform the delegated responsibility.[5] However, the licensed nurse still maintains accountability for overall client care. **Accountability** is defined as being answerable to oneself and others for one's own choices, decisions, and actions as measured against a standard. Therefore, if a nurse does not feel it is appropriate to delegate a certain responsibility to a delegatee, the delegating nurse should perform the activity themselves.[6]

3. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

4. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

5. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

6. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

Delegation is summarized in the National Guidelines on Nursing Delegation as the following[7]:

- A delegatee is allowed to perform a specific nursing activity, skill, or procedure that is outside the traditional role and basic responsibilities of the delegatee's current job.
- The delegatee has obtained the additional education and training and validated competence to perform the care/delegated responsibility. The context and processes associated with competency validation will be different for each activity, skill, or procedure being delegated. Competency validation should be specific to the knowledge and skill needed to safely perform the delegated responsibility, as well as to the level of the practitioner (e.g., RN, LPN/VN, AP) to whom the activity, skill, or procedure has been delegated. The licensed nurse who delegates the "responsibility" maintains overall accountability for the client, but the delegatee bears the responsibility for completing the delegated activity, skill, or procedure.
- The licensed nurse cannot delegate nursing clinical judgment or any activity that will involve nursing clinical judgment or critical decision-making to AP.
- Nursing responsibilities are delegated by a licensed nurse who has the authority to delegate, and the delegated responsibility is within the delegator's scope of practice.

An example of delegation is medication administration that is delegated by a licensed nurse to UAP with additional training in some agencies, according to agency policy. This task is outside the traditional role of AP, but the delegatee has received additional training for this delegated responsibility and has completed competency validation in completing this task accurately.

7. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

An example illustrating the difference between assignment and delegation is assisting clients with eating. Feeding clients is typically part of the routine role of AP. However, if a client has recently experienced a stroke (i.e., cerebrovascular accident) or is otherwise experiencing swallowing difficulties (e.g., dysphagia), this task cannot be assigned to AP because it is not considered routine care. Instead, the RN should perform this task themselves or delegate it to an AP who has received additional training on feeding assistance.

The delegation process is multifaceted. See Figure 1.3[8] for an illustration of the intersecting responsibilities of the employer/nurse leader, licensed nurse, and delegatee with two-way communication that protects the safety of the public. "Delegation begins at the administrative/nurse leader level of the organization and includes determining nursing responsibilities that can be delegated, to whom, and under what circumstances; developing delegation policies and procedures; periodically evaluating delegation processes; and promoting a positive culture/work environment. The licensed nurse is responsible for determining client needs and when to delegate, ensuring they are available to the delegatee if questions arise, evaluating outcomes, and maintaining accountability for delegated responsibility. Finally, the delegatee must accept activities based on their competency level, maintain competence for delegated responsibility, and maintain accountability for delegated activity."[9]

8. "Delegation.png" by Meredith Pomietlo for Chippewa Valley Technical College is licensed under CC BY 4.0

9. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

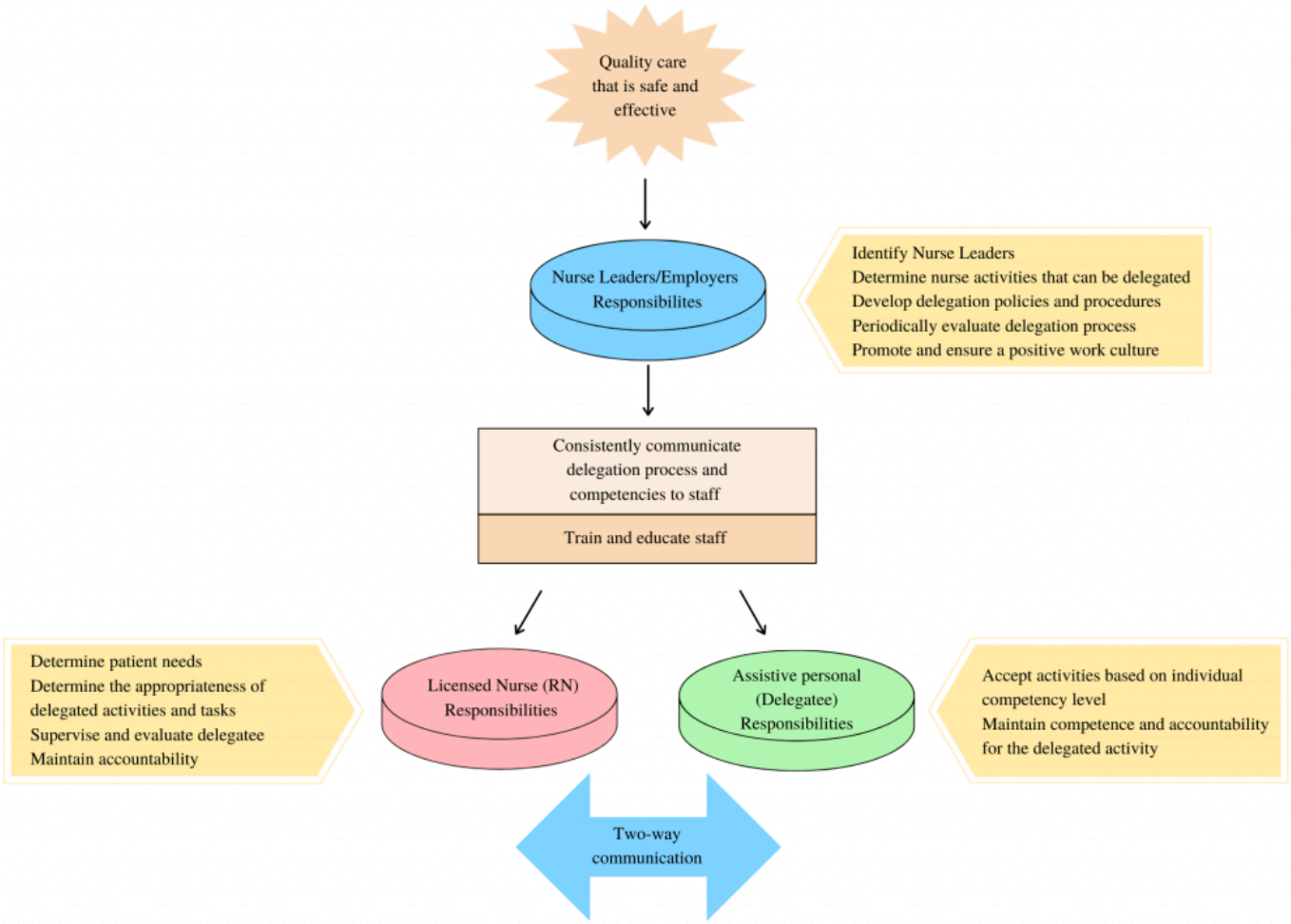


Figure 1.3 Multifaceted Delegation Process

Five Rights of Delegation

How does the nurse determine what tasks can be delegated, when, and to whom? According to the National Council of State Boards of Nursing (NCSBN), RNs should use the **five rights of delegation** to ensure proper and

appropriate delegation: right task, right circumstance, right person, right directions and communication, and right supervision and evaluation[10]:

- **Right task:** The activity falls within the delegatee's job description or is included as part of the established policies and procedures of the nursing practice setting. The facility needs to ensure the policies and procedures describe the expectations and limits of the activity and provide any necessary competency training.

- **Right circumstance:** The health condition of the client must be stable. If the client's condition changes, the delegatee must communicate this to the licensed nurse, and the licensed nurse must reassess the situation and the appropriateness of the delegation.[11]

- **Right person:** The licensed nurse, along with the employer and the delegatee, is responsible for ensuring that the delegatee possesses the appropriate skills and knowledge to perform the activity.[12]

- **Right directions and communication:** Each delegation situation should be specific to the client, the nurse, and the delegatee. The licensed nurse is expected to communicate specific instructions for the delegated activity to the delegatee; the delegatee, as part of two-way

10. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

11. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

12. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

communication, should ask any clarifying questions. This communication includes any data that need to be collected, the method for collecting the data, the time frame for reporting the results to the licensed nurse, and additional information pertinent to the situation. The delegatee must understand the terms of the delegation and must agree to accept the delegated activity. The licensed nurse should ensure the delegatee understands they cannot make any decisions or modifications in carrying out the activity without first consulting the licensed nurse.[13]

- **Right supervision and evaluation:** The licensed nurse is responsible for monitoring the delegated activity, following up with the delegatee at the completion of the activity, and evaluating client outcomes. The delegatee is responsible for communicating client information to the licensed nurse during the delegation situation. The licensed nurse should be ready and available to intervene as necessary. The licensed nurse should ensure appropriate documentation of the activity is completed.[14]

Simply stated, the licensed nurse determines the right person is assigned the right tasks for the right clients under the right circumstances. When determining what aspects of care can be delegated, the licensed nurse uses clinical judgment while considering the client's current clinical condition, as well as the abilities of the health care team member. The RN must also consider if the circumstances are appropriate for delegation. For example, although obtaining routine vital signs on stable clients may be appropriate to delegate to assistive personnel, obtaining vital signs on an unstable client is not appropriate to delegate.

13. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

14. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

After the decision has been made to delegate, the nurse assigning the tasks must communicate appropriately with the delegatee and provide the right directions and supervision. Communication is key to successful delegation. Clear, concise, and closed-loop communication is essential to ensure successful completion of the delegated task in a safe manner. During the final step of delegation, also referred to as **supervision**, the nurse verifies and evaluates that the task was performed correctly, appropriately, safely, and competently. See Table 1.8 for additional questions to consider for each "right" of delegation.

Table 1.8. Rights of Delegation[15]

15. NCSBN. (n.d.). *Delegation*. https://www.ncsbn.org/nursing-regulation/practice/delegation.page

Rights of Delegation	Description	Questions to Consider When Delegating
Right Task	A task that can be transferred to a member of the nursing team for a specific client.	• Is this task legally appropriate to delegate to this team member according to the state's Nurse Practice Act and written agency policy and procedures? • Has the team member been trained and demonstrated competency in performing this task? • Does the team member feel comfortable and willing to perform the task?
Right Circumstances	The client is stable.	• Is there enough staffing to support delegation in this circumstance? • What is the client's current status? • What are the client's current needs?
Right Person	The person delegating the task has the appropriate scope of practice to do so. The task is also appropriate for this delegatee's skills and knowledge.	• Is the delegatee suitable to meet the client's needs? • Is the delegatee willing to accept the delegated task? • Has the delegatee demonstrated competence to perform the task?

Right Directions and Communication	The task or activity is clearly defined and described.	• Have clear communication and instructions been given regarding the task? • Did the instructions include data that need to be collected, the method for collecting the data, the time frame for reporting the results to the licensed nurse, and additional information pertinent to the situation? • Does the delegatee understand what needs to be done? • Is the delegatee aware of what should be reported and when it needs to be reported? • Has the delegatee accepted the delegated task? • Has the time frame to complete the task been defined? • Does the delegatee understand they cannot make any decisions or modifications in carrying out the activity without first consulting the licensed nurse? • Was closed-loop communication used?

Right Supervision and Evaluation	The RN appropriately monitors the delegated activity, evaluates client outcomes, and follows up with the delegatee at the completion of the activity.	• When and how will the RN connect with the delegatee to discuss the completion of the activity and communication of client information? • How often should the RN directly or indirectly observe the team member's performance? • When will the RN evaluate client outcomes? • When will the RN provide feedback to the team member? • Has documentation of the activity been completed?

Keep in mind that any nursing intervention that requires specific nursing knowledge, clinical judgment, or use of the nursing process can only be delegated to another RN. Examples of these types of tasks include initial preoperative or admission assessments, client teaching, and creation and evaluation of a nursing care plan. See Figure 1.4[16] for an algorithm based on the 2019 National Guidelines for Nursing Delegation that can be used when deciding if a nursing task can be delegated.[17]

16. "Delegation Decision Tree.png" by Meredith Pomietlo for Chippewa Valley Technical College is licensed under CC BY 4.0

17. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

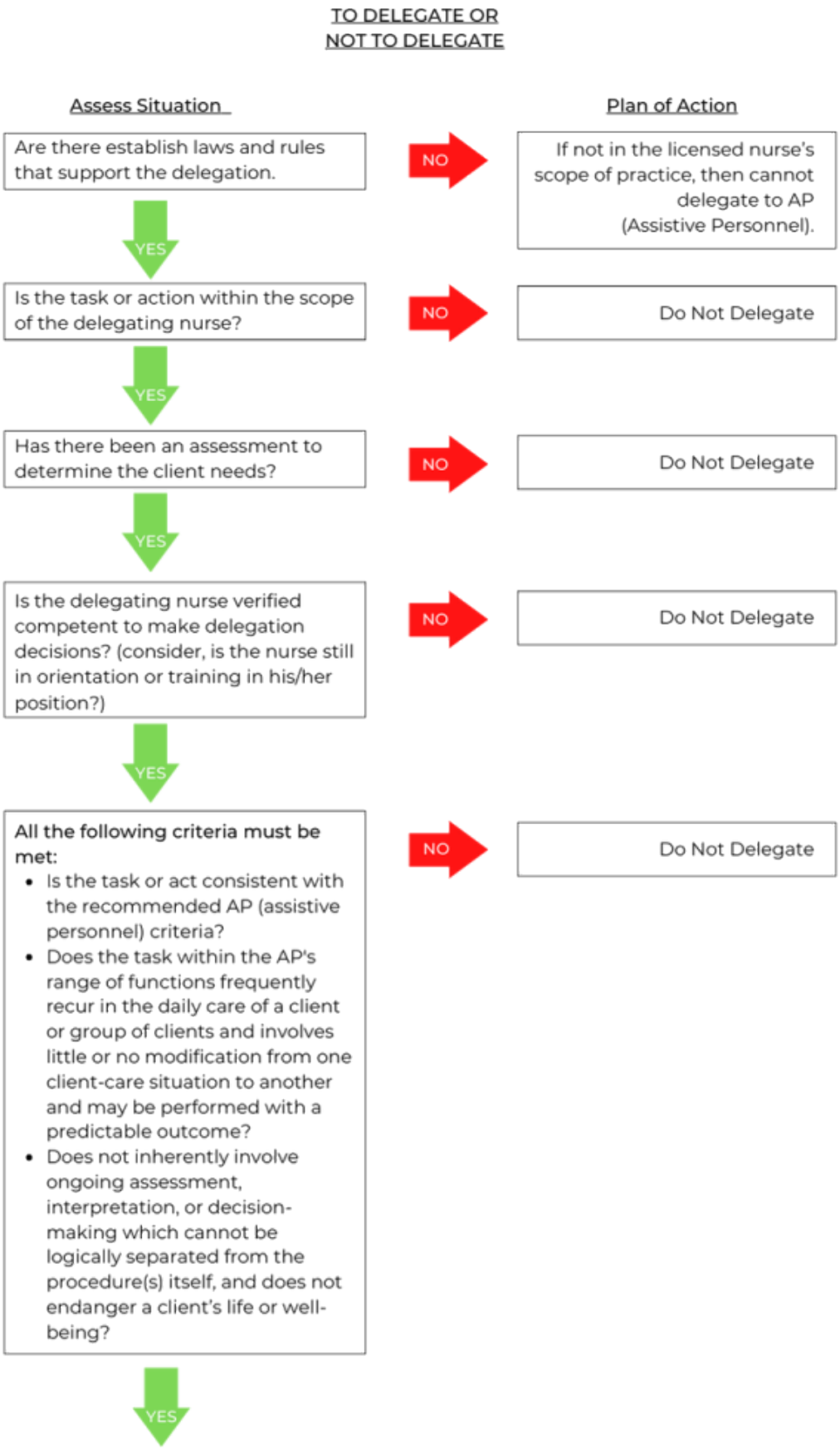


Figure 1.4 Delegation Algorithm

Responsibilities of the Licensed Nurse

The licensed nurse has several responsibilities as part of the delegation process. According to the National Guidelines on Nursing Delegation, any decision to delegate a nursing responsibility must be based on the needs of the client or population, the stability and predictability of the client's condition, the documented training and competence of the delegatee, and the ability of the licensed nurse to supervise the delegated responsibility and its outcome with consideration to the available staff mix and client acuity. Additionally, the licensed nurse must consider the state Nurse Practice Act regarding delegation and the employer's policies and procedures prior to making a final decision to delegate. Licensed nurses must be aware that delegation is at the nurse's discretion, with consideration of the particular situation. The licensed nurse maintains accountability for the client, while the delegatee is responsible for the delegated activity, skill, or procedure. If, under the circumstances, a nurse does not feel it is appropriate to delegate a certain responsibility to a delegatee, the delegating nurse should perform the activity.[18]

1. The licensed nurse must determine when and what to delegate based on the practice setting, the client's needs and condition, the state's/jurisdiction's provisions for delegation, and the employer's policies and procedures regarding delegating a specific responsibility. The licensed nurse must determine the needs of the client and whether those needs are matched by the knowledge, skills, and abilities of the delegatee and can be performed safely by the delegatee. The licensed nurse cannot delegate any activity that requires clinical reasoning, nursing judgment, or critical decision-making. The licensed nurse must ultimately make the final decision whether an activity is appropriate to delegate to the delegatee based on the "Five Rights of Delegation."

18. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

- **Rationale:** The licensed nurse, who is present at the point of care, is in the best position to assess the needs of the client and what can or cannot be delegated in specific situations.[19]

2. The licensed nurse must communicate with the delegatee who will be assisting in providing client care. This should include reviewing the delegatee's assignment and discussing delegated responsibilities, including information on the client's condition/stability, any specific information pertaining to a certain client (e.g., no blood draws in the right arm), and any specific information about the client's condition that should be communicated back to the licensed nurse by the delegatee.

- **Rationale:** Communication must be a two-way process involving both the licensed nurse delegating the activity and the delegatee being delegated the responsibility. Evidence shows that the better the communication between the nurse and the delegatee, the more optimal the outcome. The licensed nurse must provide information about the client and care requirements. This includes any specific issues related to any delegated responsibilities. These instructions should include any unique client requirements. The licensed nurse must instruct the delegatee to regularly communicate the status of the client.[20]

3. The licensed nurse must be available to the delegatee for guidance and questions, including assisting with the delegated responsibility, if necessary, or performing it themselves if the client's condition or other circumstances warrant doing so.

19. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

20. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

- **Rationale:** Delegation calls for nursing judgment throughout the process. The final decision to delegate rests in the hands of the licensed nurse as they have overall accountability for the client.[21]

4. The licensed nurse must follow up with the delegatee and the client after the delegated responsibility has been completed.

- **Rationale:** The licensed nurse who delegates the "responsibility" maintains overall accountability for the client, while the delegatee is responsible for the delegated activity, skill, or procedure.[22]

5. The licensed nurse must provide feedback information about the delegation process and any issues regarding delegatee competence level to the nurse leader. Licensed nurses in the facility need to communicate to the nurse leader responsible for delegation any issues arising related to delegation and any individual whom they identify as not being competent in a specific responsibility or unable to use good judgment and decision-making.

- **Rationale:** This will allow the nurse leader responsible for delegation to develop a plan to address the situation.[23]

21. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

22. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

23. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

The decision of whether or not to delegate or assign is based on the RN's judgment concerning the condition of the client, the competence of the nursing team member, and the degree of supervision that will be required of the RN if a task is delegated.[24]

Responsibilities of the Delegatee

Everyone on the nursing team is responsible for the well-being of clients. While the nurse is ultimately accountable for the overall care provided to a client, the delegatee shares the responsibility for the client and is fully responsible for the delegated activity, skill, or procedure.[25] The delegatee has the following responsibilities:

1. The delegatee must accept only the delegated responsibilities that they are appropriately trained and educated to perform and feel comfortable doing given the specific circumstances in the health care setting and client's condition. The delegatee should confirm acceptance of the responsibility to carry out the delegated activity. If the delegatee does not believe they have the appropriate competency to complete the delegated responsibility, then the delegatee should not accept the delegated responsibility. This includes informing the nursing leadership if they do not feel they have received adequate training to perform the delegated responsibility, do not perform the procedure frequently enough to do it safely, or their knowledge and skills need updating.

- **Rationale:** The delegatee shares the responsibility to keep clients safe,

24. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

25. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

and this includes only performing activities, skills, or procedures in which they are competent and comfortable doing.[26]

2. The delegatee must maintain competency for the delegated responsibility.

- **Rationale:** Competency is an ongoing process. Even if properly taught, the delegatee may become less competent if they do not frequently perform the procedure. Given that the delegatee shares the responsibility for the client, the delegatee also has a responsibility to maintain competency.[27]

3. The delegatee must communicate with the licensed nurse in charge of the client. This includes any questions related to the delegated responsibility and follow-up on any unusual incidents that may have occurred while the delegatee was performing the delegated responsibility, any concerns about a client's condition, and any other information important to the client's care.

- **Rationale:** The delegatee is a partner in providing client care. They are interacting with the client/family and caring for the client. This information and two-way communication are important for successful delegation and optimal outcomes for the client.[28]

26. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

27. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

28. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

4. Once the delegatee verifies acceptance of the delegated responsibility, the delegatee is accountable for carrying out the delegated responsibility correctly and completing timely and accurate documentation per facility policy.

- **Rationale:** The delegatee cannot delegate to another individual. If the delegatee is unable to complete the responsibility or feels as though they need assistance, the delegatee should inform the licensed nurse immediately so the licensed nurse can assess the situation and provide support. Only the licensed nurse can determine if it is appropriate to delegate the activity to another individual. If at any time the licensed nurse determines they need to perform the delegated responsibility, the delegatee must relinquish responsibility upon request of the licensed nurse.[29]

Responsibilities of the Employer/Nurse Leader

The employer and nurse leaders also have responsibilities related to safe delegation of client care:

1. The employer must identify a nurse leader responsible for oversight of delegated responsibilities for the facility. If there is only one licensed nurse within the practice setting, that licensed nurse must be responsible for oversight of delegated responsibilities for the facility.

- **Rationale:** The nurse leader has the ability to assess the needs of the facility, understand the type of knowledge and skill needed to perform a specific nursing responsibility, and be accountable for maintaining a safe environment for clients. They are also aware of the knowledge, skill level, and limitations of the licensed nurses and AP. Additionally, the nurse

29. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

leader is positioned to develop appropriate staffing models that take into consideration the need for delegation. Therefore, the decision to delegate begins with a thorough assessment by a nurse leader designated by the institution to oversee the process.[30]

2. The designated nurse leader responsible for delegation, ideally with a committee (consisting of other nurse leaders) formed for the purposes of addressing delegation, must determine which nursing responsibilities may be delegated, to whom, and under what circumstances. The nurse leader must be aware of the state Nurse Practice Act and the laws/rules and regulations that affect the delegation process and ensure all institutional policies are in accordance with the law.

- **Rationale:** A systematic approach to the delegation process fosters communication and consistency of the process throughout the facility.[31]

3. Policies and procedures for delegation must be developed. The employer/nurse leader must outline specific responsibilities that can be delegated and to whom these responsibilities can be delegated. The policies and procedures should also indicate what may not be delegated. The employer must periodically review the policies and procedures for delegation to ensure they remain consistent with current nursing practice trends and that they are consistent with the state Nurse Practice Act. (Institution/employer policies can be more restrictive, but not less restrictive.)

- **Rationale:** Policies and procedures standardize the appropriate method

30. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

31. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

of care and ensure safe practices. Having a policy and procedure specific to delegation and delegated responsibilities eliminates questions from licensed nurses and AP about what can be delegated and how they should be performed.[32]

4. The employer/nurse leader must communicate information about delegation to the licensed nurses and AP and educate them about what responsibilities can be delegated. This information should include the competencies of delegatees who can safely perform a specific nursing responsibility.

- **Rationale:** Licensed nurses must be aware of the competence level of staff and expectations for delegation (as described within the policies and procedures) to make informed decisions on whether or not delegation is appropriate for the given situation. Licensed nurses maintain accountability for the client. However, the delegatee has responsibility for the delegated activity, skill, or procedure.

In summary, delegation is the transfer of the nurse's responsibility for a task while retaining professional accountability for the client's overall outcome. The decision to delegate is based on the nurse's judgment, the act of delegation must be clearly defined by the nurse, and the outcomes of delegation are an extension of the nurse's guidance and supervision. Delegation, when rooted in mutual respect and trust, is a key component to an effective health care team.

Supervision

The licensed nurse has the responsibility to supervise, monitor, and evaluate the nursing team members who have received delegated tasks, activities, or

32. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

procedures. As previously noted, the act of supervision requires the nurse to assess the staff member's ability, competency, and experience prior to delegating. After the nurse has made the decision to delegate, supervision continues in terms of coaching, supporting, assisting, and educating as needed throughout the task to assure appropriate care is provided.

The nurse is accountable for client care delegated to other team members. Communication and supervision should be ongoing processes throughout the shift within the nursing care team. The nurse must ensure quality of care, appropriateness, timeliness, and completeness through direct and indirect supervision. For example, an LPN/VN may directly observe the UAP reposition a client or assist them to the bathroom to assure both client and staff safety are maintained. Through direct and indirect supervision of delegation, quality client care and compliance with standards of practice and facility policies can be assured.

Supervision also includes providing constructive feedback to the nursing team member. Constructive feedback is supportive and identifies solutions to areas needing improvement. It is provided with positive intentions to address specific issues or concerns as the person learns and grows in their role. Constructive feedback includes several key points:

- Was the task, activity, care, or procedure performed correctly?
- Were the expected outcomes involving delegation for that client achieved?
- Did the team member utilize effective and timely communication?
- What were the challenges of the activity and what aspects went well?
- Were there any problems or specific concerns that occurred and how were they managed?

After these questions have been addressed, the nurse creates a plan for future delegation with the nursing team member. This plan typically includes the following:

- Recognizing difficulty of the nursing team member in initiating or completing the delegated activities.
- Observing the client's responses to actions performed by the nursing

team member.

- Following up in a timely manner on any problems, incidents, or concerns that arose.
- Creating a plan for providing additional training and monitoring outcomes of future delegated tasks, activities, or procedures.
- Consulting with appropriate nursing administrators per agency policy if the client's safety was compromised.

1.9 Prioritization Strategies

Prioritization Strategies

Prioritization is the ability to assess a client or a group of clients and determine what is critical, what is important, and what is time-sensitive to establish a preferential order of nursing actions. Prioritization plays a crucial role in allowing nurses to navigate the multitude of demands and responsibilities they face in the health care setting. Without effective prioritization strategies, nurses can become overwhelmed by the constant time pressures and competing tasks, leading to feelings of frustration, inadequacy, and burnout. Furthermore, time scarcity can have serious consequences for client safety, as rushed or missed nursing activities can result in adverse events and increased mortality rates. By implementing appropriate prioritization strategies, nurses can better manage their time and ensure that critical interventions are addressed promptly, thus enhancing client outcomes and reducing the risk of errors.

Prioritization also impacts client satisfaction and ultimately the reimbursement levels provided by Medicare, Medicaid, and insurance companies to health care institutions. Missed or rushed nursing activities due to poor prioritization can negatively affect client satisfaction scores. By effectively prioritizing care for the nursing team, nurse leaders can improve client satisfaction, strengthen the institution's financial standing, and contribute to overall quality improvement efforts.

Developing the skill of prioritization is an ongoing process that requires continuous learning and experience. Prioritization frameworks provide nurses with a structured approach to identifying priority client problems and implementing appropriate interventions. By understanding and utilizing these frameworks, nurses can better manage the complexity of the health care environment and make informed decisions about allocating their time and resources. Through education and practice, nurses can enhance their ability to prioritize effectively, ultimately improving client outcomes and their own professional satisfaction.

Prioritizing care is a management skill performed by nurses providing

direct client care to their assigned clients, as well as by charge nurses prioritizing care for a group of clients across the nursing team. Staff nurses determine the order in which each of their assigned clients should be assessed and their needs addressed. Charge nurses assign and prioritize client care across the nursing team based on acuity and urgency while also reassigning care throughout the shift as client needs change. This skill requires the ability to assess and analyze the ever-changing clinical situation, allocate nursing team resources appropriately as client needs change, and make sound clinical decisions in a fast-paced environment. In this manner, effective prioritization across the nursing team ensures that each client receives safe, timely, and quality care, thus minimizing potential risks and complications and also distributing the workload across the nursing team equitably.

Prioritization of care for multiple clients while also performing daily nursing tasks can feel overwhelming in today's fast-paced health care system. Because of the rapid and ever-changing conditions of clients and the structure of one's workday, nurses must use organizational frameworks to prioritize actions and interventions. These frameworks can help ease anxiety, enhance personal organization and confidence, and ensure client safety. A variety of prioritization frameworks will be discussed in this section.

Acuity

Acuity and intensity are foundational concepts for prioritizing nursing care and interventions. **Acuity** refers to the level of client care that is required based on the severity of a client's illness or condition. For example, acuity may include characteristics such as unstable vital signs, oxygenation therapy, high-risk IV medications, multiple drainage devices, or uncontrolled pain. A "high-acuity" client requires several nursing interventions and frequent nursing assessments.

Intensity addresses the time needed to complete nursing care and interventions such as providing assistance with activities of daily living (ADLs), performing wound care, or administering several medication passes. For example, a "high-intensity" client generally requires frequent or long periods

of psychosocial, educational, or hygiene care from nursing staff members. High-intensity clients may also have increased needs for safety monitoring, familial support, or other needs.[1]

Many health care organizations structure their staffing assignments based on acuity and intensity ratings to help provide equity in staff assignments. Acuity helps to ensure that nursing care is strategically divided among nursing staff. An equitable assignment of clients benefits both the nurse and the client by helping to ensure that care needs do not overwhelm nursing staff, and safe, quality care is provided.

Organizations use a variety of systems when determining client acuity with rating scales based on nursing care delivery, client stability, and care needs. See an example of a client acuity tool published in the *American Nurse* in Table 1.9.[2] In this example, ratings range from 1 to 4, with a rating of 1 indicating a relatively stable client requiring minimal individualized nursing care and intervention. A rating of 2 reflects a client with a moderate risk who may require more frequent intervention or assessment. A rating of 3 is attributed to a complex client who requires frequent intervention and assessment. This client might also be a new admission or someone who is confused and requires more direct observation. A rating of 4 reflects a high-risk client. For example, this individual may be experiencing frequent changes in vital signs, may require complex interventions such as the administration of blood transfusions, or may be experiencing significant

1. Oregon Health Authority. (2021). *Hospital nurse staffing interpretive guidance on staffing for acuity & intensity*. Public Health Division, Center for Health Protection. https://www.oregon.gov/oha/PH/PROVIDERPARTNERRESOURCES/HEALTHCAREPROVIDERSFACILITIES/HEALTHCAREHEALTHCAREREGULATIONQUALITYIMPROVEMENT/Documents/NSABLegislativeReport2021.pdf

2. Ingram, A., & Powell, J. (2018). Patient acuity tool on a medical surgical unit. *American Nurse*. https://www.myamericannurse.com/patient-acuity-medical-surgical-unit/

uncontrolled pain. An individual with a rating of 4 requires more direct nursing care and intervention than a client with a rating of 1 or 2.[3]

Table 1.9. Example of an Acuity Tool[4]

3. Kidd, M., Grove, K., Kaiser, M., Swoboda, B., & Taylor, A. (2014). A new patient-acuity tool promotes equitable nurse-patient assignments. *American Nurse Today, 9*(3), 1-4. https://www.myamericannurse.com/a-new-patient-acuity-tool-promotes-equitable-nurse-patient-assignments/

4. Ingram, A., & Powell, J. (2018). Patient acuity tool on a medical surgical unit. *American Nurse*. https://www.myamericannurse.com/patient-acuity-medical-surgical-unit/

	1: Stable Client	2: Moderate-Risk Client	3: Complex Client	4: High-Risk Client
Assessment	• Q8h VS • A & O X 4	• Q4h VS • CIWA < 8	• Q2h VS • Delirium • CIWA > 8	• Unstable VS
Respiratory	• Stable on RA	• O2 < 2L NC	• O2 > 2L NC	• O2 via mask
Cardiac	• VS	• Temp < 98.7 F • Pacemaker/ AICD • HR > 130	• Change in BP • Temp > 100.3 F	• Unstable rhythm • Afib
Medications	• PO/IVPB	• TPN, heparin infusion, blood glucose, PICC for blood draws	• CBI • 1 unit blood transfusion • Fluid bolus	• > 1 unit blood transfusion • Chemotherapy
Drainage Devices	• < 2 JP, hemovac, neph tube	• Chest to water seal • NG tube	• Chest tube to suction • Drain measured Q2 hrs	• Drain measured Q1 hr • CT > 100 mL/2 hrs

Pain Management	• Pain well-managed with PO or IV meds Q4 hrs	• PCA, nerve block • Nausea/ Vomiting	• Q2h pain management	• Uncontrolled pain with multiple pain devices
Admit/ Transfer/ Discharge	• Stable transfer, routine discharge	• Discharge to outside facility	• New admission, discharge to hospice	• Complicated post-op
ADLs and Isolation	• Independent	• Assist with ADLs • Two-person assist out of bed • Isolation	• Turns Q2h • Bedrest • Respiratory isolation	• Paraplegic • Total care
Client Score	**Most = 1**	**Two or > = 2**	**Any = 3**	**Any = 4**

Read more about using an acuity tool on a medical-surgical unit.

Rating scales may vary among institutions, but the principles of the rating system remain the same. Organizations include various client care elements when constructing their staffing plans for each unit. Read more information about staffing models and acuity in the following box.

Staffing Models and Acuity

Organizations that base staffing on acuity systems attempt to equitably assign clients to nursing staff according to their acuity ratings. This means that when comparing client assignments across nurses on a unit, similar acuity team scores should be seen with the goal of achieving equitable and safe division of workload across the nursing team. For example, one nurse should not have a total acuity score of 6 for their client assignments while another nurse has a score of 15. If this situation occurred, the variation in scoring reflects a discrepancy in workload balance and would likely be perceived by nursing peers as unfair. Using **acuity-rating staffing models** is helpful to reflect the individualized nursing care required by different clients.

Alternatively, nurse staffing models may be determined by staffing ratio. **Ratio-based staffing models** are more straightforward in nature, where each nurse or UAP is assigned care for a set number of clients during their shift. Ratio-based staffing models may be useful for administrators creating budget requests based on the number of staff required for client care but can lead to an inequitable division of work across the nursing team when client acuity is not considered. Increasingly complex clients require more time and interventions than others, so a blend of both ratio and acuity-based staffing is helpful when determining staffing assignments.[5]

5. Welton, J. M. (2017). Measuring patient acuity. *JONA: The Journal of Nursing Administration, 47*(10), 471. https://doi.org/10.1097/nna.0000000000000516

As a practicing nurse, you will be oriented to the elements of acuity ratings within your health care organization, but it is also important to understand how you can use these acuity ratings for your own prioritization and task delineation. Let's consider the Scenario A in the following box to better understand how acuity ratings can be useful for prioritizing nursing care.

Scenario A

You report to work at 6 a.m. for your nursing shift on a busy medical-surgical unit. Prior to receiving the handoff report from your night shift nursing colleagues, you review the unit staffing grid and see that you have been assigned to four clients to start your day. The clients have the following acuity ratings:**Client A:** 45-year-old client with paraplegia admitted for an infected sacral wound, with an acuity rating of 4.

Client B: 87-year-old client with pneumonia with a low-grade fever of 99.7 F and receiving oxygen at 2 L/minute via nasal cannula, with an acuity rating of 2.

Client C: 63-year-old client who is postoperative Day 1 from a right total hip replacement and is receiving pain management via a PCA pump, with an acuity rating of 2.

Client D: 83-year-old client admitted with a UTI who is finishing an IV antibiotic cycle and will be discharged home today, with an acuity rating of 1.

Based on the acuity rating system, your client assignment load receives an overall acuity score of 9. Consider how you might use their acuity ratings to help you prioritize your care. Based on what is known about the clients related to their acuity rating, whom might you identify as your care priority? Although this can feel like a challenging question to answer because of the many unknown elements in the situation using acuity numbers alone,

Client A with an acuity rating of 4 would be identified as the care priority requiring assessment early in your shift.

Although acuity can be a useful tool for determining care priorities, it is important to recognize the limitations of this tool and consider how other client needs impact prioritization.

Maslow's Hierarchy of Needs

A second prioritization framework is Maslow's Hierarchy of Needs. When thinking back to your first nursing or psychology course, you may recall a historical theory of human motivation based on various levels of human needs called Maslow's Hierarchy of Needs. **Maslow's Hierarchy of Needs** reflects foundational human needs with progressive steps moving towards higher levels of achievement. This hierarchy of needs is traditionally represented as a pyramid with the base of the pyramid serving as essential needs that must be addressed before one can progress to another area of need.[6] See Figure 1.5[7] for an illustration of Maslow's Hierarchy of Needs.

6. Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396. https://doi.org/10.1037/h0054346

7. "Maslow's_hierarchy_of_needs.svg" by J. Finkelstein is licensed under CC BY-SA 3.0

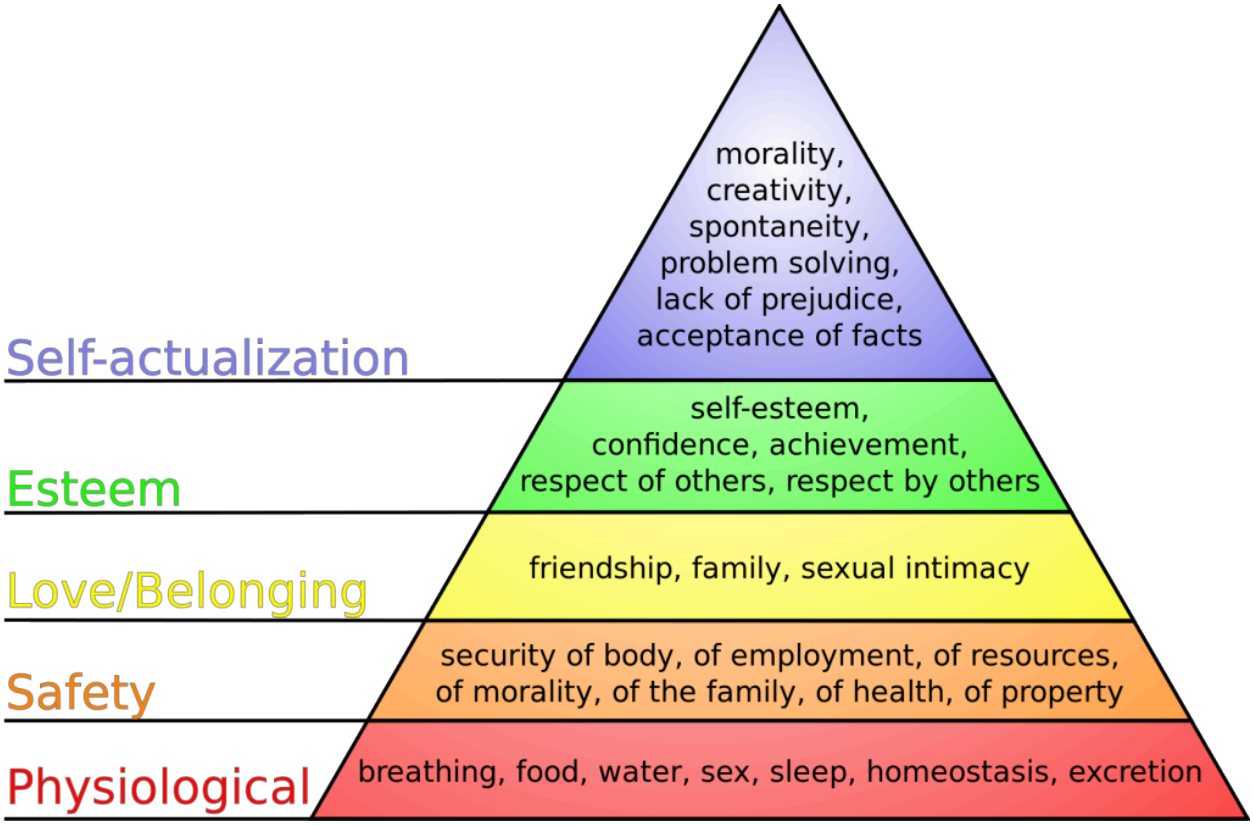


Figure 1.5 Maslow's Hierarchy of Needs

Maslow's Hierarchy of Needs places physiological needs as the foundational base of the pyramid.[8] Physiological needs include oxygen, food, water, sex, sleep, homeostasis, and excretion. The second level of Maslow's hierarchy reflects safety needs. Safety needs include elements that keep individuals safe from harm. An example of safety needs in health care includes fall precautions. The third level of Maslow's hierarchy reflects emotional needs such as love and a sense of belonging. These needs are often reflected in an individual's relationships with family members and friends. The top two levels of Maslow's hierarchy include esteem and self-actualization. An example of addressing these needs in a health care setting is helping an individual build self-confidence in performing blood glucose checks that leads to improved self-management of their diabetes.

8. Stoyanov, S. (2017). *An analysis of Abraham Maslow's A Theory of Human Motivation* (1st ed.). Routledge. https://doi.org/10.4324/9781912282517

So how does Maslow's theory impact prioritization? To better understand the application of Maslow's theory to prioritization, consider Scenario B in the following box.

Scenario B

You are an emergency response nurse working at a local shelter in a community that has suffered a devastating hurricane. Many individuals have relocated to the shelter for safety in the aftermath of the hurricane. Much of the community is still without electricity and clean water, and many homes have been destroyed. You approach a young woman who has a laceration on her scalp that is bleeding through her gauze dressing. The woman is weeping as she describes the loss of her home stating, "I have lost everything! I just don't know what I am going to do now. It has been a day since I have had water or anything to drink. I don't know where my sister is, and I can't reach any of my family to find out if they are okay!"

Despite this relatively brief interaction, this woman has shared with you a variety of needs. She has demonstrated a need for food, water, shelter, homeostasis, and family. As the nurse caring for her, it might be challenging to think about where to begin her care. These thoughts could be racing through your mind:

Should I begin to make phone calls to try and find her family? Maybe then she would be able to calm down.

Should I get her on the list for the homeless shelter so she wouldn't have to worry about where she will sleep tonight?

She hasn't eaten in a while; I should probably find her something to eat.

All these needs are important and should be addressed at some point, but Maslow's hierarchy provides guidance on what

needs must be addressed first. Use the foundational level of Maslow's pyramid of physiological needs as the top priority for care. The woman is bleeding heavily from a head wound and has had limited fluid intake. As the nurse caring for this client, it is important to immediately intervene to stop the bleeding and restore fluid volume. Stabilizing the client by addressing her physiological needs is required before undertaking additional measures such as contacting her family. Imagine if instead you made phone calls to find the client's family and didn't address the bleeding or dehydration – you might return to a severely hypovolemic client who has deteriorated and may be near death. In this example, prioritizing emotional needs above physiological needs can lead to significant harm to the client.

Although this is a relatively straightforward example, the principles behind the application of Maslow's hierarchy are essential. Addressing physiological needs before progressing toward additional need categories concentrates efforts on the most vital elements to enhance client well-being. Maslow's hierarchy provides the nurse with a helpful framework for identifying and prioritizing critical client care needs.

ABCs

Airway, breathing, and circulation, otherwise known by the mnemonic "**ABCs**," is another prioritization framework that assists nurses in prioritization. Like Maslow's Hierarchy of Needs framework, using the ABCs guides nursing decision-making based on the most critical needs for preserving human life. If a client does not have a patent airway, is unable to breathe, or has inadequate circulation, very little of what else we do matters. The client's ABCs are reflected in Maslow's foundational level of physiological needs and direct critical nursing actions and timely interventions. Let's consider Scenario C in

the following box regarding prioritization using the ABCs and the physiological base of Maslow's hierarchy.

Scenario C

You are a nurse on a busy cardiac floor charting your morning assessments on a computer at the nurses' station. Down the hall from where you are charting, two of your assigned clients are resting comfortably in Room 504 and Room 506. Suddenly, both call lights ring from the rooms, and you answer them via the intercom at the nurses' station.

Room 504 has an 87-year-old male who has been admitted with heart failure, weakness, and confusion. He has a bed alarm for safety and has been ringing his call bell for assistance appropriately throughout the shift. He requires assistance to get out of bed to use the bathroom. He received his morning medications, which included a diuretic about 30 minutes previously, and now reports significant urge to void and needs assistance to the bathroom.

Room 506 has a 47-year-old woman who was hospitalized with new onset atrial fibrillation with rapid ventricular response. The client underwent a cardioversion procedure yesterday that resulted in successful conversion of her heart back into normal sinus rhythm. She is reporting via the intercom that her "heart feels as though it is doing that fluttering thing again," and she is having chest pain with breathlessness.

Based upon these two client scenarios, it might be difficult to determine whom you should see first. Both clients are demonstrating needs in the foundational physiological level of Maslow's hierarchy and require assistance. To prioritize between these clients' physiological needs, the nurse can apply the

principles of the ABCs to determine intervention. The client in Room 506 reports both breathing and circulation issues, warning indicators that action is needed immediately. Although the client in Room 504 also has an urgent physiological elimination need, it does not overtake the critical one experienced by the client in Room 506. The nurse should immediately assess the client in Room 506 while also calling for assistance from a team member to assist the client in Room 504.

CURE

Prioritizing what should be done and when it can be done can be a challenging task when several clients all have physiological needs. Recently, there has been professional acknowledgement of the cognitive challenge for novice nurses in differentiating these physiological needs. To expand on the principles of prioritizing using the ABCs, the **CURE hierarchy** has been introduced to help novice nurses better understand how to manage competing client needs. The CURE hierarchy uses the acronym "CURE" to guide prioritization based on identifying the differences among Critical needs, Urgent needs, Routine needs, and Extras.[9]

"Critical" client needs require immediate action. Examples of critical needs align with the ABCs and Maslow's physiological needs, such as symptoms of respiratory distress, chest pain, and airway compromise. No matter the complexity of their shift, nurses can be assured that addressing clients' critical needs is the correct prioritization of their time and energies.

After critical client care needs have been addressed, nurses can then

9. Kohtz, C., Gowda, C., & Guede, P. (2017). Cognitive stacking: Strategies for the busy RN. *Nursing2021, 47*(1), 18-20. https://doi.org/10.1097/01.nurse.0000510758.31326.92

address “urgent” needs. Urgent needs are characterized as needs that cause client discomfort or place the client at a significant safety risk.[10]

The third part of the CURE hierarchy reflects “routine” client needs. Routine client needs can also be characterized as “typical daily nursing care” because the majority of a standard nursing shift is spent addressing routine client needs. Examples of routine daily nursing care include actions such as administering medication and performing physical assessments.[11] Although a nurse’s typical shift in a hospital setting includes these routine client needs, they do not supersede critical or urgent client needs.

The final component of the CURE hierarchy is known as “extras.” Extras refer to activities performed in the care setting to facilitate client comfort but are not essential.[12] Examples of extra activities include providing a massage for comfort or washing a client’s hair. If a nurse has sufficient time to perform extra activities, they contribute to a client’s feeling of satisfaction regarding their care, but these activities are not essential to achieve client outcomes.

Let’s apply the CURE mnemonic to client care in the following box.

If we return to Scenario C regarding clients in Room 504 and 506, we can see the client in Room 504 is having urgent needs. He is experiencing a physiological need to urgently use the restroom and may also have safety concerns if he does not receive assistance and attempts to get up on his own because of weakness. He is on a bed alarm, which reflects safety considerations related to his potential to get out of bed without assistance. Despite these urgent indicators, the client in Room 506 is experiencing a critical

10. Kohtz, C., Gowda, C., & Guede, P. (2017). Cognitive stacking: Strategies for the busy RN. *Nursing2021, 47*(1), 18-20. https://doi.org/10.1097/01.nurse.0000510758.31326.92

11. Kohtz, C., Gowda, C., & Guede, P. (2017). Cognitive stacking: Strategies for the busy RN. *Nursing2021, 47*(1), 18-20. https://doi.org/10.1097/01.nurse.0000510758.31326.92

12. Kohtz, C., Gowda, C., & Guede, P. (2017). Cognitive stacking: Strategies for the busy RN. *Nursing2021, 47*(1), 18-20. https://doi.org/10.1097/01.nurse.0000510758.31326.92

need and takes priority. Recall that critical needs require immediate nursing action to prevent client deterioration. The client in Room 506 with a rapid, fluttering heartbeat and shortness of breath has a critical need because without prompt assessment and intervention, their condition could rapidly decline and become fatal.

Data Cues

In addition to using the previously identified frameworks and tools to assist with priority setting, nurses must also look at their clients' data cues to help them identify care priorities. **Data cues** are pieces of significant clinical information that direct the nurse toward a potential clinical concern or a change in condition. For example, have the client's vital signs worsened over the last few hours? Is there a new laboratory result that is concerning? Data cues are used in conjunction with prioritization frameworks to help the nurse holistically understand the client's current status and where nursing interventions should be directed. Common categories of data clues include acute versus chronic conditions, actual versus potential problems, unexpected versus expected conditions, information obtained from the review of a client's chart, and diagnostic information.

ACUTE VERSUS CHRONIC CONDITIONS

A common data cue that nurses use to prioritize care is considering if a condition or symptom is acute or chronic. **Acute conditions** have a sudden and severe onset. These conditions occur due to a sudden illness or injury, and the body often has a significant response as it attempts to adapt. **Chronic conditions** have a slow onset and may gradually worsen over time. The difference between an acute versus a chronic condition relates to the body's adaptation response. Individuals with chronic conditions often experience less symptom exacerbation because their body has had time to adjust to the illness or injury. Let's consider an example of two clients admitted to the medical-surgical unit complaining of pain in Scenario D in the following box.

Scenario D

As part of your client assignment on a medical-surgical unit, you are caring for two clients who both ring the call light and report pain at the start of the shift. Client A was recently admitted with acute appendicitis, and Client B was admitted for observation due to osteoarthritis. Not knowing any additional details about the clients' conditions or current symptoms, which client would receive priority in your assessment? Based on using the data cue of acute versus chronic conditions, Client A with a diagnosis of acute appendicitis would receive top priority for assessment over a client with chronic pain due to osteoarthritis. Clients experiencing acute pain require immediate nursing assessment and intervention because it can indicate a change in condition. Acute pain also elicits physiological effects related to the stress response, such as elevated heart rate, blood pressure, and respiratory rate, and should be addressed quickly.

ACTUAL VERSUS POTENTIAL PROBLEMS

Nursing diagnoses and the nursing care plan have significant roles in prioritization when interpreting assessment data cues. **Actual problems** refer to a clinical problem that is actively occurring with the client. A **potential problem** indicates the client may potentially experience a problem, but they do not have current signs or symptoms of the problem actively occurring.

Consider an example of prioritizing actual and potential problems in Scenario E in the following box.

Scenario E

A 74-year-old woman with a previous history of chronic obstructive pulmonary disease (COPD) is admitted to the hospital for pneumonia. She has generalized weakness, a weak cough, and crackles in the bases of her lungs. She is receiving IV antibiotics, fluids, and oxygen therapy. The client can sit at the side of the bed and ambulate with the assistance of staff, although she requires significant encouragement to ambulate.

Nursing diagnoses are established for this client as part of the care planning process. One nursing diagnosis for this client is *Ineffective Airway Clearance*. This nursing diagnosis is an actual problem because the client is currently exhibiting signs of poor airway clearance with an ineffective cough and crackles in the lungs. Nursing interventions related to this diagnosis include coughing and deep breathing, administering nebulizer treatments, and evaluating the effectiveness of oxygen therapy. The client also has the nursing diagnosis *Risk for Skin Breakdown* based on her weakness and lack of motivation to ambulate. Nursing interventions related to this diagnosis include repositioning every two hours and assisting with ambulation twice daily.

The established nursing diagnoses provide cues for prioritizing care. For example, if the nurse enters the client's room and discovers the client is experiencing increased shortness of breath, nursing interventions to improve the client's respiratory status receive top priority before attempting to get the client to ambulate.

Although there may be times when risk diagnoses may supersede actual problems, reviewing "actual" nursing diagnoses can provide clues to assist with prioritization.

UNEXPECTED VERSUS EXPECTED CONDITIONS

In a similar manner to using acute versus chronic conditions as a cue for prioritization, it is also important to consider if a client's signs and symptoms are "expected" or "unexpected" based on their overall condition.**Unexpected conditions** are findings that are not likely to occur in the normal progression of an illness, disease, or injury. **Expected conditions** are findings that are likely to occur or are anticipated in the course of an illness, disease, or injury. Unexpected findings often require immediate action by the nurse.

Let's apply this tool to the two clients previously discussed in Scenario D. As you recall, both Client A (with acute appendicitis) and Client B (with weakness and diagnosed with osteoarthritis) are reporting pain. Acute pain typically receives priority over chronic pain. But what if both clients are also reporting nausea and have an elevated temperature? Although these symptoms must be addressed in both clients, they are "expected" symptoms with acute appendicitis (and typically addressed in the treatment plan) but are "unexpected" for the client with osteoarthritis. Critical thinking alerts you to the unexpected nature of these symptoms in Client B, so they receive priority for assessment and nursing interventions.

HANDOFF REPORT/CHART REVIEW

Additional data cues that are helpful in guiding prioritization come from information obtained during a handoff nursing report and review of the client's chart. These data cues can be used to establish a client's baseline status and prioritize new clinical concerns based on abnormal assessment findings. Let's consider Scenario F in the following box based on cues from a handoff report and how it might be used to help prioritize nursing care.

Scenario F

Imagine you are receiving the following handoff report from the night shift nurse for a client admitted to the medical-surgical unit with pneumonia:

At the beginning of my shift, the client was on room air with an oxygen saturation of 93%. She had slight crackles in both of her posterior lungs. At 0530, the client rang the call light to go to the bathroom. As I escorted her to the bathroom, she appeared slightly short of breath. Upon returning the client to bed, I rechecked her vital signs and found her oxygen saturation at 88% on room air and respiratory rate of 20. I listened to her lung sounds and noticed more persistent crackles and coarseness than at bedtime. I placed the client on 2 L/minute of oxygen via nasal cannula. Within 5 minutes, her oxygen saturation increased to 92%, and she reported increased ease in respiration.

Based on the handoff report, the night shift nurse provided substantial clinical evidence that the client may be experiencing a change in condition. Although these changes could be attributed to lack of lung expansion that occurred while the client was sleeping, there is enough information to indicate to the oncoming nurse that follow-up assessment and interventions should be prioritized for this client because of potentially worsening respiratory status. In this manner, identifying data cues from a handoff report can assist with prioritization.

Now imagine the night shift nurse had not reported this information during the handoff report. Is there another method for identifying potential changes in client condition? Many nurses develop a habit of reviewing their clients' charts at the start of every shift to identify trends and "baselines" in client condition. For example, a chart review reveals a client's heart rate on admission was 105 beats per minute. If the client continues to have a heart rate in the low 100s, the nurse is not likely to be concerned if today's vital signs reveal a heart rate in the low 100s.

Conversely, if a client's heart rate on admission was in the 60s and has remained in the 60s throughout their hospitalization, but it is now in the 100s, this finding is an important cue requiring prioritized assessment and intervention.

DIAGNOSTIC INFORMATION

Diagnostic results are also important when prioritizing care. In fact, the National Patient Safety Goals from The Joint Commission include prompt reporting of important test results. Newly reported abnormal results may indicate a client's change in condition. They are typically flagged in a client's chart or are reported directly by phone to the nurse by the laboratory as they become available. For example, a hemoglobin level of 5 mg/dL or new infiltrates on a chest X-ray should be reported to the provider and may require additional nursing interventions. Let's consider Scenario G in which you are the nurse providing care for five medical-surgical clients.

Scenario G

You completed morning assessments on your assigned five clients. Client A previously underwent a total right knee replacement and will be discharged home today. You are about to enter Client A's room to begin discharge teaching when you receive a phone call from the laboratory department, reporting a critical hemoglobin of 6.9 gm/dL on Client B. Rather than enter Client A's room to perform discharge teaching, you immediately reprioritize your care. You call the primary provider to report Client B's critical hemoglobin level and determine if additional intervention, such as a blood transfusion, is required.

1.10 Time Management

Principles of Time Management

There are five major principles of **time management** in nursing, including prioritizing how, where, and when to allocate time; remaining goal-oriented; using organizational strategies; promoting teamwork; and reflecting on the effectiveness of one's time management.

Prioritizing How, Where, and When to Allocate Time

Time management in nursing involves effectively utilizing one's time to ensure efficient and high-quality client care. Nurses must consider how, where, and when to allocate their time. Daily schedules must be carefully planned, taking into account the urgency of client needs, the importance of other job-related tasks, and the availability of resources. By strategically allocating time, nurses can ensure that they are present when and where they are needed most, optimizing their contribution to client care.

Remaining Goal-Oriented

Remaining goal-oriented is another key aspect of nursing time management. With numerous tasks and responsibilities demanding attention, nurses must identify the most critical priorities and align their efforts accordingly. Establishing clear goals helps maintain focus and prevents time from being wasted on less important tasks. By prioritizing tasks based on client needs, urgency, and potential impact on client outcomes, nurses can ensure that their time is spent in the most effective and meaningful ways.

Using Organizational Strategies

There are a variety of strategies that nurses use to organize their day. Successful nurses find an organizational strategy that works for them and use it consistently to plan their shift and make adjustments as necessary.

For example, creating a task list and crossing off tasks as they are accomplished allows nurses to track progress and ensures that no task is overlooked. By physically or digitally crossing off completed tasks, nurses can visually see their productivity and maintain a clear overview of their remaining responsibilities. This practice also promotes a sense of satisfaction and helps manage stress levels, as nurses can see tangible evidence of their efforts and achievements. It also provides a sense of accomplishment.

Continuously documenting task completion and client data throughout the day is essential for effective time management and accurate client care and documentation. Nursing students must develop a habit of recording relevant information promptly, ensuring that documentation is up-to-date and comprehensive. By documenting in real-time, nurses minimize the risk of missing critical details or making errors due to delayed or rushed documentation. This practice also supports the continuity of care and facilitates communication among the health care team.

Estimating the amount of time needed for each task is a valuable skill that helps nurses allocate their time appropriately. By having a realistic understanding of the time required for different activities, nurses can better plan their schedules and avoid overcommitting themselves. Accurate time estimation enables nurses to allocate sufficient time for complex or time-consuming tasks while avoiding unnecessary delays. This skill is honed through experience and self-reflection, allowing nurses to become more efficient in their time management.

Completing one task before starting another is a fundamental principle of effective time management in nursing. Multitasking may seem tempting, especially when faced with numerous responsibilities, but it often leads to decreased productivity and increased errors. By focusing on one task at a time, nurses can give their full attention and effort, ensuring better outcomes and reducing the need for rework. Completing tasks sequentially also helps nurses maintain a clear mental map of their progress and prevents tasks from falling through the cracks.

Promoting Teamwork

Working as a team and fostering collaboration are vital for efficient time management in nursing. Nurses should actively communicate and coordinate with their colleagues, sharing responsibilities and supporting each other. Collaboration enhances efficiency by leveraging the collective skills and knowledge of the team, allowing tasks to be accomplished more quickly and effectively. By sharing the workload and working together towards shared goals, nurses can optimize their use of time and improve overall client care.

Reflecting

Evaluating and reflecting on one's time management practices are a continuous process that contributes to professional growth and improvement. Nurses should regularly assess their time management strategies and seek feedback from peers.

View the following examples of a nurse who struggles with time management and a nurse who uses time manage strategies successfully.

Time Management Examples

Example of Poor Time Management

Aracely is a registered nurse working in a busy emergency department. She often finds herself overwhelmed with the demands of her job and struggles to manage her time effectively. Aracely frequently gets sidetracked by non-urgent tasks and finds it challenging to prioritize her responsibilities. She often starts multiple tasks simultaneously, leading to incomplete or delayed tasks. Aracely frequently forgets to document client information in real-time, resulting in backlogged paperwork and potential errors. Due to her time management struggles, Aracely frequently feels stressed and

finds it challenging to provide optimal client care within the allocated time.

Example of Successful Time Management

Jacy is an experienced nurse working in a surgical unit. She is known for his exceptional time management skills, which allow her to provide efficient and high-quality client care. Jacy begins each shift by reviewing her schedule and creating a to-do list and prioritizing tasks based on client acuity and urgency. She estimates the time needed for each task and allocates her resources accordingly. Jacy focuses on completing one task before moving on to the next, ensuring that she gives her undivided attention and effort. She collaborates effectively with her colleagues, sharing responsibilities and supporting each other to optimize time utilization. Jacy maintains meticulous documentation throughout her shift, ensuring accuracy and continuity of care. At the end of each shift, she takes time to evaluate her time management strategies, reflecting on areas for improvement and incorporating feedback from her peers. Jacy's effective time management skills enable her to provide exceptional client care while maintaining a balanced workload and minimizing stress.

1.11 Learning Activities

Learning Activities

Leadership Case Study – Delegation and Prioritization (Case Study answers are located in the Answer Key at the end of the book.)

You are the RN caring for these six clients on the day shift. The following table is information you gathered from the morning handoff report. You are working with an LPN/VN and a CNA on your team. Both team members are competent and have worked on the unit for longer than three years.

Room 102 – Female age 77

- Diabetic, 1st day post op ORIF left hip
- Vital signs every 2 hours
    - 0400: T 99.2F, HR 88, RR 24, BP 144/88
- Pedal pulses not palpable on left foot and left foot is cooler but cap refill is present
- Dressings are clean and dry
- IV: D5.25 NS @ 100 mL/hr
- Clear liquid diet – poor intake due to nausea
- Foley: Drained 125 mL of concentrated urine
- Sliding Scale Insulin QID
- Turn every 2 hours, record I&O

Room 107 – Male age 42

- Asthmatic bronchitis
- Vital signs every 4 hours
    - 0400: T 100.4F, RR 24, pulse ox 92%
- O2 @ 2L per nasal cannula
- Coughing thick colorless mucus
- Sputum specimen sent to lab for C&S
- Nauseated but taking clear liquids
- Resp therapy does nebulizer QID
- IV antibiotics QID, IV needs to be changed this shift.
- Voiding in urinal
- ABGs ordered for 0800
- I&O
- Minimal assist

Room 103 – Male age 65	Room 108 – Male age 52
• Gastric resection yesterday • Vital signs hourly ranges: BP systolic 88-102, diastolic 44-62, HR 90-106, RR 22-24, afebrile • NG to low intermittent suction – 675 mL sanguineous drainage • IV: Lactated ringers @ 150 mL/hr • IV antibiotics every 6 hours • Unable to void – cathed at 0430 with 250 mL • Coughs and deep breathes poorly • Oxygen at 2L via nasal cannula	• Stable client admitted on night shift from recovery for post-op colon resection without a colostomy • Post-op vitals every hour, all WNL • Record urine output every 2 hours • IV: D5/.45 NS with 20 mEq KCL at 125 mL/hr • NG irrigations every 4 hours PRN • IV Pepcid every 12 hours, IV Push • PCA morphine • Mark and reinforce dressing • Oxygen at 2L via nasal cannula • Oximetry every 4 hours • IS every hour while awake

Room 105 – Female age 42	Room 110 – Female age 76
• Admitted at 0600 • Scheduled for breast biopsy today • Vital signs on admission: BP 128/82, HR 88, RR 22, Temp 98.5F oral • NPO since midnight • Up ad lib • Pre-op checklist is completed • IV: Lactated ringers at 100 mL/hr • Pre-op antibiotic and IM meds due at 0800	• Admitted yesterday afternoon with COPD with pneumonia • O2 @ 3L via nasal cannula • Vital signs every 4 hours: ◦ 0400: Temp 99F oral, RR 22 at rest, BP 106/54, pulse ox 93% on 3L NC • IV antibiotics every 4 hours • Clear liquid diet • Up in chair for 20 mins BID • Significant dyspnea on exertion • Requires complete assistance with ADLs

1. What type of staffing model is being used in this scenario?
2. Which tasks can be delegated to the LPN/VN?
3. Which tasks cannot be delegated to the LPN/VN?
4. Which tasks can be safely delegated to the CNA?
5. Identify the highest priority client to see first. What are your top three priority tasks? Provide your rationale.
6. Plan your shift: Prioritize the remaining five clients in the

order you will see first and your top three priority tasks for each.

Clients in the prioritized order you will see them and the rationale for doing so	Top 3 priority tasks for each client

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Test your knowledge on leadership styles using this NCLEX Next Generation-style question. You may reset and resubmit your answers to this question an unlimited number of times.[1]

1. "Leadership Drop Down Dyad" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

I Glossary

Accountability: Being answerable to oneself and others for one's own choices, decisions, and actions as measured against a standard.[1] (Chapter 1.8)

Actual versus potential nursing problems: A prioritization strategy that considers the type of nursing problem when prioritizing care. Actual problems refer to a clinical problem that is actively occurring with the client. A risk problem indicates the client may potentially experience a problem, but they do not have current signs or symptoms of the problem actively occurring. (Chapter 1.9)

Acuity: The level of client care that is required based on the severity of a client's illness or condition. For example, acuity may include characteristics such as unstable vital signs, oxygenation therapy, high-risk IV medications, multiple drainage devices, or uncontrolled pain. A "high acuity" client requires several nursing interventions and frequent nursing assessments. (Chapter 1.9)

Acuity-rating staffing models: A strategy for making client assignments to equitably assign clients to nursing staff according to their acuity ratings. This means that when comparing client assignments across the nursing team on a unit, similar acuity team scores should be seen with the goal of achieving equitable and safe division of workload across the nursing team. (Chapter 1.9)

Acute versus chronic conditions: A prioritization strategy that considers acute versus chronic medical conditions. Acute conditions have a sudden and severe onset. These conditions occur due to a sudden illness or injury, and the body often has a significant response as it attempts to adapt. Chronic conditions have a slow onset and may gradually worsen over time. (Chapter 1.9)

Airway, breathing, and circulation (ABCs): A prioritization strategy, similar to Maslow's Hierarchy of Needs, that guides nursing decision-making based on the most critical needs for preserving human life. (Chapter 1.9)

1. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

Authentic leaders: Leaders who have an honest and direct approach with employees, demonstrating self-awareness, internalized moral perspective, and relationship transparency. They strive for trusting, symmetrical, and close leader–follower relationships; promote the open sharing of information; and consider others' viewpoints. (Chapter 1.3)

Authoritarian leadership: The leader has full power. Authoritarian leaders tell team members what to do and expect team members to execute their plans. (Chapter 1.3)

Basic nursing care: "Care that can be performed following a defined nursing procedure with minimal modification in which the responses of the patient to the nursing care are predictable."[2] (Chapter 1.7)

Basic patient situation: "A situation determined by an RN, physician, podiatrist, dentist, or optometrist that meets the following three conditions[3]:

- The patient's clinical condition is predictable.
- Medical or nursing orders are not changing frequently and do not contain complex modifications.
- The patient's clinical condition requires only basic nursing care." (Chapter 1.7)

Bedside Handoff Report Checklist: Similar to an ISBARR report but contains additional information to ensure continuity of care across nursing shifts. (Chapter 1.2)

Board of Nursing (BON): A state-specific licensing and regulatory body that sets standards for safe nursing care and issues nursing licenses to qualified candidates. (Chapter 1.7)

2. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses.* https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

3. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses.* https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

Closed-loop communication: A communication strategy used to ensure that information conveyed by the sender is heard by the receiver and completed. Closed-loop communication is especially important during emergency situations when verbal orders are being provided as treatments are immediately implemented. (Chapter 1.2)

Complex patient situation: "An act determined by an RN, physician, podiatrist, dentist, or optometrist where one or more of the following conditions exist in a given situation[4]:

- The patient's clinical condition is not predictable.
- Medical or nursing orders are likely to involve frequent changes or complex modifications.
- The patient's clinical condition indicates care that is likely to require modification of nursing procedures in which the responses of the patient to the nursing care are not predictable." (Chapter 1.7)

Conflict resolution: Respectful dialogue and active listening to address conflicts promptly and constructively. Through mediation and negotiation, a nurse leader can help team members find common ground, reach compromises, and maintain harmonious working relationships. (Chapter 1.5)

Constructive feedback: Providing feedback to team members in a manner that focuses on their behavior or performance rather than criticism of the individual. The purpose of constructive feedback is to help the team member identify areas for improvement and offer suggestions for development. By providing specific and actionable feedback, team members can gain valuable insights into their strengths and weaknesses, reflect on their actions, create personal goals, and plan strategies for personal and professional growth. (Chapter 1.6)

Culture of safety: An organizational culture that embraces error reporting

4. Wisconsin Administrative Code. (2024). *Chapter N 6 standards of practice for registered nurses and licensed practical nurses.* https://docs.legis.wisconsin.gov/code/admin_code/n/6.pdf

by employees with the goal of identifying systemic causes of problems that can be addressed to improve client safety. According to The Joint Commission, a culture of safety includes the following components[5]:

- **Just Culture:** A culture where people feel safe raising questions and concerns and report safety events in an environment that emphasizes a nonpunitive response to errors and near misses. Clear lines are drawn by managers between human error, at-risk, and reckless employee behaviors.
- **Reporting Culture:** People realize errors are inevitable and are encouraged to speak up for client safety by reporting errors and near misses. For example, nurses complete an "incident report" according to agency policy when a medication error occurs, or a client falls. Error reporting helps the agency manage risk and reduce potential liability.
- **Learning Culture:** People regularly collect information and learn from errors and successes while openly sharing data and information and applying best evidence to improve work processes and client outcomes. (Chapter 1.2)

CURE hierarchy: An acronym for a prioritization strategy based on identifying the differences among Critical needs, Urgent needs, Routine needs, and Extras.[6] (Chapter 1.9)

Data cues: Pieces of significant clinical information that direct the nurse toward a potential clinical concern or a change in condition. (Chapter 1.9)

Delegatee: An RN, LPN/VN, or AP who is delegated a nursing responsibility

5. The Joint Commission. (2021). The essential role of leadership in developing a safety culture. *Sentinel Event Alert*, *Issue 57.* https://www.jointcommission.org/resources/sentinel-event/sentinel-event-alert-newsletters/sentinel-event-alert-57-the-essential-role-of-leadership-in-developing-a-safety-culture/

6. Kohtz, C., Gowda, C., & Guede, P. (2017). Cognitive stacking: Strategies for the busy RN. *Nursing2023, 47*(1), 18-20. https://doi.org/10.1097/01.nurse.0000510758.31326.92

by either an advanced practice registered nurse (APRN), RN, or LPN/VN, is competent to perform the task, and verbally accepts the responsibility.[7] (Chapter 1.8)

Delegation: States have different laws and rules/regulations regarding delegation. Delegation is generally defined as allowing a delegatee to perform a specific nursing activity, skill, or procedure that is beyond the delegatee's traditional role and not routinely performed, but the individual has obtained additional training and validated their competence to perform the delegated responsibility.[8] However, the licensed nurse still maintains accountability for overall client care.[9]

In Wisconsin, the NPA states, "In the supervision and direction of delegated acts, an RN shall do all of the following:

- Delegate tasks commensurate with educational preparation and demonstrated abilities of the person supervised.
- Provide direction and assistance to those supervised.
- Observe and monitor the activities of those supervised.
- Evaluate the effectiveness of acts performed under supervision." (Chapter 1.8)

Democratic leadership: The leader balances decision-making responsibility between team members and the leader. Democratic leaders actively

7. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

8. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

9. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

participate in discussions, but also make sure to listen to the views of others. (Chapter 1.3)

Direct supervision: Immediate availability to continually coordinate, direct, and inspect at first hand the practice of another. (Chapter 1.7)

Five rights of delegation: A method to ensure proper and appropriate delegation, including right task, right circumstance, right person, right directions and communication, and right supervision and evaluation.[10] (Chapter 1.8)

Handoff report: A transfer and acceptance of client care responsibility achieved through effective communication. It is a real-time process of passing client specific information from one caregiver to another, or from one team of caregivers to another, for the purpose of ensuring the continuity and safety of the client's care. (Chapter 1.2)

Intensity: The time needed to complete nursing care and interventions such as providing assistance with activities of daily living (ADLs), performing wound care, or administering several medication passes. For example, a "high-intensity" client generally requires frequent or long periods of psychosocial, educational, or hygiene care from nursing staff members. High-intensity clients may also have increased needs for safety monitoring, familial support, or other needs.[11] (Chapter 1.9)

I-PASS: A mnemonic used to provide structured communication among interprofessional team members. I-PASS stands for **I**llness severity, **P**atient

10. American Nurses Association and NCSBN. (2019). *National guidelines for nursing delegation*. https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

11. Oregon Health Authority. (2021, April 29). *Hospital nurse staffing interpretive guidance on staffing for acuity & intensity*. Public Health Division, Center for Health Protection. https://www.oregon.gov/oha/PH/PROVIDERPARTNERRESOURCES/HEALTHCAREPROVIDERSFACILITIES/HEALTHCAREHEALTHCAREREGULATIONQUALITYIMPROVEMENT/Documents/NSABLegislativeReport2021.pdf

summary, **A**ction list, **S**ituation awareness and contingency plans, and **S**ynthesis by receiver. (Chapter 1.2)

ISBARR: A common format used by health care team members to exchange client information; the mnemonic stands for **I**ntroduction, **S**ituation, **B**ackground, **A**ssessment, **R**equest/Recommendation, and **R**epeat back. (Chapter 1.2)

Laissez-faire leadership: The leader gives team members total freedom to perform as they please. Laissez-faire leaders do not participate in decision-making processes and rarely offer opinions. (Chapter 1.3)

Licensed practical/vocational nurse (LPN/VN): A nurse who has completed a state-approved practical nursing program, successfully passed the NCLEX-PN, and received an LPN or LVN license. LPN/VNs perform basic nursing care for stable clients under the supervision of an RN. (Chapter 1.1, Chapter 1.7)

Maslow's Hierarchy of Needs: A prioritization strategy based on foundational human needs with progressive steps moving towards higher levels of achievement. This hierarchy of needs is traditionally represented as a pyramid with the base of the pyramid serving as essential needs that must be addressed before one can progress to another area of need.[12] (Chapter 1.9)

Nurse Practice Act (NPA): Nursing regulations established by each state's legislature that are enforced by the Board of Nursing. (Chapter 1.7)

Nursing assistants (NAs): A type of unlicensed assistive personnel (UAP) trained to function in a supportive role, regardless of title, to whom a nursing responsibility may be delegated.[13] In some states, nursing assistants must complete a state-approved nursing assistant training program and successfully pass the state competency evaluation to become a certified nurse assistant (CNA) to work in long-term care centers. NAs provide basic care and help clients with activities of daily living. (Chapter 1.1)

12. Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396. https://doi.org/10.1037/h0054346

13. National Council of State Boards of Nursing (2023). *NCLEX-RN test plan.* https://www.nclex.com/files/2023_RN_Test%20Plan_English_FINAL.pdf

Nursing team: The nursing team includes registered nurses (RNs), licensed practical/vocational nurses (LPN/VNs), and assistive personnel (AP).[14] (Chapter 1.1)

Passive-avoidant leadership: Similar to laissez-faire leadership; the leader avoids taking responsibility and confronting others. (Chapter 1.3)

Prioritization: The ability to assess a client or a group of clients and determine what is critical, what is important, and what is time-sensitive to establish a preferential order of nursing actions. (Chapter 1.9)

Ratio-based staffing models: A strategy for making client assignments where each nurse or UAP is assigned care for a set number of clients during their shift. (Chapter 1.9)

Registered nurse (RN): A nurse who has completed a required program of study, successfully passed the NCLEX-RN, and received an RN nursing license. RNs utilize the nursing process in the execution of general nursing procedures in the maintenance of health, prevention of illness, or care of the ill. The nursing process consists of the steps of assessment, diagnosis, outcome identification, planning, implementation of interventions, and evaluation. (Chapter 1.1, Chapter 1.7)

Resonant leaders: Leaders who are in tune with the emotions of those around them, use empathy, and manage their own emotions effectively. Resonant leaders build strong, trusting relationships and create a climate of optimism that inspires commitment even in the face of adversity. (Chapter 1.3)

Servant leadership: The leader focuses on the professional growth of employees while simultaneously promoting improved quality care through a combination of interprofessional teamwork and shared decision-making. (Chapter 1.3)

Supervision: After delegating a task to another nursing team member, the nurse verifies and evaluates that the task was performed correctly, appropriately, safely, and competently. (Chapter 1.8)

Time management: Time management in nursing helps nurses organize

14. American Nurses Association & NCSBN. (2019). *National guidelines for nursing delegation.*https://www.ncsbn.org/public-files/NGND-PosPaper_06.pdf

and prioritize client care, internal administrative tasks, educational responsibilities, and personal needs and obligations. (Chapter 1.10)

Transactional leadership: Both the leader and the follower receive something for their efforts; the leader gets the job done and the follower receives pay, recognition, rewards, or punishment based on how well they perform the tasks assigned to them. (Chapter 1.3)

Transformational leadership: The leader motivates followers to perform beyond expectations by creating a sense of ownership in reaching a shared vision. It is characterized by a leader's charismatic influence over team members and includes effective communication, valued relationships, and consideration of team member input. (Chapter 1.3)

Unexpected versus expected conditions: A prioritization strategy that considers if a client's signs and symptoms are "expected" or "unexpected" based on their overall condition. Unexpected conditions are findings that are not likely to occur in the normal progression of an illness, disease, or injury. Expected conditions are findings that are likely to occur or are anticipated in the course of an illness, disease, or injury. Unexpected findings often require immediate action by the nurse. (Chapter 1.9)

Unlicensed assistive personnel (UAP): Any unlicensed personnel trained to function in a supportive role, regardless of title, to whom a nursing responsibility may be delegated.[15] UAPs provide basic care and help clients with activities of daily living. (Chapter 1.1)

15. National Council of State Boards of Nursing (2023). *NCLEX-RN test plan.* https://www.nclex.com/files/2023_RN_Test%20Plan_English_FINAL.pdf

PART II

CHAPTER 2 PERIOPERATIVE CARE

2.1 Perioperative Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in perioperative care
- Identify the legal aspects of perioperative care
- Identify life span considerations of the surgical client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in the perioperative setting
- Integrate common pharmacological and nonpharmacological measures for perioperative care

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https://wtcs.pressbooks.pub/healthalts/?p=77#h5p-36

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A client's surgical experience is known as **perioperative care** and

encompasses three phases: preoperative, intraoperative, and postoperative. Each phase requires careful attention to ensure client safety, optimal surgical outcomes, and effective recovery.

The evolution of surgery has witnessed a shift from traditional operating room suites to specialty procedural areas such as an “Endoscopy Lab.” This transition has been driven by various factors, including cost and reimbursement considerations. Health care institutions are constantly seeking ways to optimize resources and enhance efficiency, leading to the development of specialized areas for specific procedures.

Technological advancements have also played a significant role in shaping the modern surgical landscape. One notable advancement is the increased utilization of robotics in surgery. Robotic systems provide surgeons with enhanced precision, control, and visualization, enabling them to perform complex procedures with greater accuracy and minimal invasiveness. This has led to a rise in **minimally invasive surgeries**, where smaller incisions are made, resulting in reduced trauma, faster recovery, and improved client outcomes.

An impact of these advancements is the decrease in overall length of stay for surgical clients. **Length of stay** is a clinical metric that measures the time elapsed between a client’s admission and discharge. With the adoption of minimally invasive surgeries and improved postoperative care, clients are now able to leave the hospital sooner than ever before. Instead of being admitted, many clients are now observed in specialized observation units, allowing for close monitoring and timely interventions if needed.

This chapter will introduce topics related to the surgical experience and provide an overview of nursing care provided during the perioperative period.

2.2 Basic Concepts Related to Surgery

Urgency of Surgeries

Surgeries may be classified according to their urgency of completion[1]:

- **Elective:** Elective surgeries are scheduled in advance based on the client's and surgeon's preferences. The surgery occurs at a planned time, and client outcomes are not significantly affected if the surgery is delayed. Examples of elective surgeries include tonsillectomy, hernia repair, cataract surgery, scheduled cesarean section, and plastic surgery.
- **Urgent:** Urgent surgeries are necessary for the client's health and generally performed within 24 to 48 hours of medical diagnosis of an acute condition. They are performed for acute onset of distressing symptoms or for the survival of limb(s) or organ(s). Examples of urgent surgeries include appendectomy, amputation, and colon resection.
- **Emergent:** Emergent surgeries are performed immediately to preserve the client's life. Examples of emergent surgeries include control of hemorrhage, trauma repair, tracheostomy, cardiac bypass for a myocardial infarction (heart attack) if other treatments aren't effective, or an emergency cesarean section if the mother or baby are in distress.

Types of Surgeries

Surgeries can be categorized based on their purpose, such as diagnostic, curative, restorative, palliative, cosmetic, reconstructive, exploratory, transplantation, neurosurgery, cardiovascular, orthopedic, obstetric and gynecological, and urological procedures.[2] Each category encompasses

1. Vera, M. (2024) *12 surgery (perioperative client) nursing care plans.* Nurselabs. https://nurseslabs.com/surgery-perioperative-client-nursing-care-plans/
2. American College of Surgeons. (n.d.). *What are the surgical specialties?* https://www.facs.org/for-medical-professionals/education/online-guide-to-

specific surgical interventions aimed at addressing different medical conditions and client needs. Table 2.2a highlights the diversity and breadth of surgical procedures performed within various specialties.

Table 2.2a. Types of Surgeries[3]

choosing-a-surgical-residency/guide-to-choosing-a-surgical-residency-for-medical-students/faqs/specialties/

3. American College of Surgeons. (n.d.). *What are the surgical specialties?* https://www.facs.org/for-medical-professionals/education/online-guide-to-choosing-a-surgical-residency/guide-to-choosing-a-surgical-residency-for-medical-students/faqs/specialties/

Surgery Type	Definition	Examples
Diagnostic surgery	Performed to obtain a definitive diagnosis or to assess the extent of a disease or condition.	Breast biopsy, lymph node biopsy, or endoscopy for gastrointestinal evaluation
Curative surgery	Performed to remove or treat the cause of a disease, providing a cure or permanent resolution.	Appendectomy, cholecystectomy (gallbladder removal), or tonsillectomy
Reconstructive/Restorative surgery	Aimed at restoring function and improving the quality of life, often involving replacing a body part.	Total knee replacement (TKR), hip replacement, cataract surgery, breast reconstruction following mastectomy, skin grafting for burn clients, or scar revision
Palliative surgery	Performed to alleviate symptoms, reduce pain, or improve the client's comfort without curing the disease.	Tumor debulking or pleurodesis (procedure performed on pleural space to prevent recurrent pleural effusions)
Cosmetic surgery	Performed primarily to enhance or alter a person's appearance.	Liposuction, rhinoplasty (i.e., "nose job"), breast augmentation, or facelift
Exploratory surgery	Performed to visualize and inspect internal organs and structures to diagnose or assess health conditions.	Laparoscopy to investigate abdominal pain, arthroscopy to examine joint structures, or endoscopy for gastrointestinal evaluation
Transplantation surgery	Performed to replace a failed organ or tissue with a healthy organ or tissue from a donor.	Kidney transplantation, liver transplantation, or heart transplantation
Neurosurgery	Performed to treat conditions affecting the nervous system, brain, and spinal cord.	Craniotomy for brain tumor removal, spinal fusion surgery, or deep brain stimulation for Parkinson's disease

Surgery Type	Definition	Examples
Cardiovascular surgery	Performed to treat conditions related to the heart and/or blood vessels, often to improve blood flow.	Coronary artery bypass grafting (CABG), heart valve replacement, or pacemaker implantation
Orthopedic surgery	Performed to treat conditions related to the musculoskeletal system, dealing with bones, joints, muscles, ligaments, and tendons.	Fracture fixation, carpal tunnel release, or ligament reconstruction
Obstetric/Gynecological surgery	Performed to treat conditions related to pregnancy, childbirth, and female reproductive organs.	Cesarean section, hysterectomy, or tubal ligation
Urological surgery	Performed to treat conditions related to the urinary system and male reproductive organs.	Prostatectomy, nephrectomy, or bladder augmentation

Surgical Settings

There are various surgical settings in which procedures take place, including inpatient and outpatient/ambulatory settings. Other less common areas for surgical procedures include outpatient clinics and emergency departments. No matter the specific surgical setting, nursing staff have a critical role in preparing the client for surgery, providing care during and after the procedure, and ensuring the client has adequate support and resources on discharge.

Inpatient Setting

In an **inpatient setting**, the client is admitted to the hospital either the day before the surgery or on the same day of the procedure. The client may already be an inpatient receiving treatment for a different condition when surgery becomes necessary. The inpatient setting allows for close monitoring

and immediate access to medical care. This setting is suitable for clients who require more extensive surgery, have complex medical conditions, or need postoperative care that necessitates a longer hospital stay.

Outpatient/Ambulatory Surgery

Outpatient/ambulatory surgery includes procedures where the client goes to the surgical area on the day of the surgery and returns home the same day, commonly known as same-day surgery. The outpatient/ambulatory setting provides clients with the convenience of returning home to familiar surroundings and the comfort of being with family members.

Ambulatory surgery procedures may occur in a hospital or a specialized Ambulatory Surgery Center (ASC). ASCs are specialized facilities dedicated to performing outpatient surgeries. ASCs are equipped with the necessary resources and equipment for a wide range of surgical interventions, and they often offer a more streamlined experience compared to traditional hospital settings.

Outpatient procedures may also be performed in Same-Day Surgery Units (SDSU). SDSUs are sections within hospitals or specialized clinics that focus on performing same-day surgeries. These units are specifically designed for clients who require surgery but do not need to stay overnight. They provide a supportive and comfortable environment for clients to undergo their procedures and receive immediate postoperative care before being discharged home.

Outpatient Clinic

In **outpatient clinic surgical settings**, surgeries are performed in health care facilities where clients receive medical care or procedures without requiring hospitalization. While not exclusively dedicated to surgical procedures, outpatient clinics often perform minor surgeries or procedures that do not require an overnight stay. For example, cyst removal may be performed in an outpatient clinic, and suturing of a minor laceration may occur in urgent care.

Emergency Department (ED)

In certain cases, surgical procedures may need to be performed in the **emergency department surgical setting**. These are typically urgent or emergency surgeries that are necessary to address critical conditions or life-threatening situations. The ED is equipped to handle immediate surgical interventions to stabilize clients and address acute surgical needs.

Surgical Team

The surgical environment involves a diverse team of highly skilled personnel, each playing a crucial role in ensuring the smooth and safe execution of surgical procedures. Table 2.2b provides an overview of surgical team members and their respective roles and responsibilities.

Table 2.2b. Surgical Team Members[4]

4. Johns Hopkins Medicine. (n.d.). *Surgical team*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/the-surgical-team

Staff Member	Role and Responsibilities
Surgeon	Leads the surgical team, performs the procedure, and makes critical decisions during the surgery. Explains benefits and risks of surgery to the client and obtains informed consent. Reviews the preoperative history and physical that were performed by the primary health care provider (for planned surgeries) or hospitalist (for urgent/unplanned surgeries) and updates treatment plan as indicated.
Anesthesiologist, Certified Nurse Anesthetist (CRNA), and Certified Sedation RN	Anesthesiologists and CRNAs administer general anesthesia, monitor the client's response to anesthesia, including vital signs and overall well-being during the surgery, and ensure adequate airway and oxygenation. Certified Sedation RNs provide moderate sedation in many settings for clients with lower risk, such as plastic surgery clinics, gastrointestinal (GI) labs, and oral surgery clinics.[5]
Surgical Assistant	Surgical assistants, also called surgical first assistants, help surgeons with tasks such as making incisions, placing clamps, and closing surgical sites. A surgical assistant may be another surgeon, physician, physician assistant, resident, advanced practice nurse, or a certified registered nurse first assistant.[6]
Surgical Technologist	Surgical technologists prepare operating rooms, arrange equipment, monitor and maintain the sterile field, and help surgeons and first assistants during surgeries.[7]

5. American Association of Moderate Sedation Nurses. (n.d.). *Registered nurse (CSRM) scope of practice: Certification sedation registered nurse (CSRN) scope of practice*. https://aamsn.org/resources/pdfs/sedation-related-pdfs/registered-nurse-csrn-scope-of-practice

6. Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook. (2023). *Surgical Assistants and Technologists*. https://www.bls.gov/ooh/healthcare/surgical-technologists.htm

7. Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook. (2023). *Surgical Assistants and Technologists*. https://www.bls.gov/ooh/healthcare/surgical-technologists.htm

Perioperative Nurse	Sometimes called a surgical or an operating room nurse, this specialized nurse cares for patients before, during, and after surgery. In the operating room, the perioperative nurse may serve as a scrub nurse, selecting and passing instruments and supplies used for the operation, or as a circulating nurse, managing the overall nursing care in the operating room and helping to maintain a safe, comfortable environment.[8] Specific responsibilities of a perioperative nurse include the following[9]: • Working with clients prior to surgery to complete paperwork and helping answer questions or calm fears about surgery • Monitoring a client's condition during and after surgery • Managing the overall nursing care in the operating room to help maintain a safe and comfortable environment (sometimes referred to as a circulating nurse) • Documenting client vitals and physical assessment data before, during, and after surgery • Educating clients on best practices for recovery, including pain management and keeping wounds clean • Cleaning surgical equipment and operating rooms to maintain a sterile environment Certified perioperative nurse (CNOR) is a specialty certification available for registered nurses working in perioperative services, with most of their time spent intraoperatively.

Anesthesia

Anesthesia is a critical component of the intraoperative environment. It aims to reduce or temporarily eliminate sensory perception, commonly referred to as "negative sensation." Anesthetic agents are carefully administered to

8. Mayo Clinic College of Medicine and Science. (n.d.). *Perioperative nurse*. https://college.mayo.edu/academics/explore-health-care-careers/careers-a-z/perioperative-nurse/

9. Mayo Clinic College of Medicine and Science. (n.d.). *Perioperative nurse*. https://college.mayo.edu/academics/explore-health-care-careers/careers-a-z/perioperative-nurse/

induce a partial or total loss of sensory perception, which can occur with or without the loss of consciousness.[10]

The main purpose of anesthesia is to achieve several key goals, including blocking nerve impulses, decreasing reflexes, increasing muscle relaxation, and controlling the level of consciousness (LOC) during the surgical procedure. By blocking nerve impulses, anesthesia effectively numbs the sensory nerves, preventing the transmission of pain signals to the brain. This allows the surgical team to perform necessary interventions without causing unnecessary discomfort to the client. Anesthesia also reduces reflexes, thus preventing involuntary movements that could interfere with surgical precision and increase the risk of complications. Muscle relaxation is also essential, as it facilitates surgical access and manipulation while reducing the risk of muscle spasms or other involuntary contractions during the procedure.[11]

One of the crucial aspects of anesthesia is its ability to control the level of consciousness. Depending on the type of surgery and the client's specific needs, the anesthesia provider can adjust the depth of anesthesia to maintain the desired level of consciousness, ranging from complete unconsciousness (resulting from general anesthesia) to a semiconscious or awake state (resulting from local or regional anesthesia). This level of control allows for optimal client safety and comfort during surgery, as well as a smooth transition to the postoperative phase. Keep in mind that anesthetic agents are metabolized in the liver and excreted in the kidneys, necessitating close monitoring of dosage and client response to ensure their safe and effective use throughout the intraoperative period.[12]

10. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

11. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

12. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

The selection of the most suitable type of anesthesia depends on the client's medical condition, the complexity of the surgery, the surgeon's preference, and the client's comfort and safety. The anesthesia provider works closely with the surgical team to determine the best approach, ensuring a smooth and successful surgical experience for the client.

Various types of anesthesia administration are as follows:

- **General Anesthesia:** General anesthesia induces a state of unconsciousness and loss of sensation throughout the entire body. It is commonly used for extensive surgeries and procedures where the client needs to be completely unaware and pain-free. General anesthesia can be delivered through inhalation (inhaled gases) or IV injection (intravenous drugs). It requires specialized monitoring and airway management.[13]
- **Local Anesthesia:** Local anesthesia is used to numb a specific area of the body, typically near the surgical site. It is administered through the injection or application of anesthetic agents directly to the nerves or tissues in the targeted area. Local anesthesia allows clients to remain conscious during the procedure while being free of pain and discomfort in the localized region.[14]
- **Regional Anesthesia:** Regional anesthesia involves numbing a larger area of the body, such as an entire limb or a section of the body, by blocking the nerve signals in that region. Common types of regional anesthesia include epidural anesthesia (often used for childbirth) and spinal anesthesia (used for lower abdominal and lower extremity surgeries). Regional anesthesia can be combined with sedation to keep the client relaxed and comfortable during the surgery.[15]

13. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

14. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

- **Conscious Sedation:** Conscious sedation, also known as moderate sedation or twilight anesthesia, is a state where the client remains conscious but deeply relaxed and pain-free. It is commonly used for minor surgical procedures or diagnostic tests. In conscious sedation, a combination of sedative and analgesic drugs is administered to create a calm and drowsy state.[16]
- **Monitored Anesthesia Care (MAC):** MAC involves the administration of IV sedation and pain management for clients undergoing certain procedures. The anesthesia provider continuously monitors the client's vital signs and level of consciousness throughout the procedure.[17]

Each of these types of anesthesia is further described in the following subsections.

The selection of anesthesia is a complex decision-making process, involving the collaboration of the anesthesia provider, surgeon, and other health care team members to ensure the best possible outcome for the client during and after the surgical procedure. The selection of the most appropriate anesthesia type for a surgical procedure involves a comprehensive evaluation of various factors, including the client's medical condition, the surgical site, safety considerations, pain management goals, and the client's response to anesthesia. See Table 2.2c for characteristics affecting the selection of anesthesia.

Table 2.2c. Characteristics Affecting the Selection of Anesthesia

15. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

16. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

17. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Characteristic	Consideration for Anesthesia Selection
Client History & Surgeon Preference	The client's medical history, current health status, and the surgeon's preference are taken into account to determine the most appropriate type of anesthesia.
Body Area	The location and extent of the surgical procedure influence the choice of anesthesia. General anesthesia is commonly used for extensive surgeries, while local or regional anesthesia may be preferred for specific body areas.
Safety Issues	Any preexisting medical conditions, allergies, or potential risks are carefully evaluated to ensure client safety during the administration of anesthesia.
Emergent Surgery	In emergency situations, the need for rapid onset and predictable control of anesthesia may influence the type of anesthesia selection. General anesthesia is often chosen for emergency surgeries.
Pain Management Goals	The expected postoperative pain level is considered when determining the appropriate anesthesia type. General anesthesia provides complete pain relief, while local or regional anesthesia may require supplementary pain management techniques postoperatively.
Fasting Status	The client's fasting status is crucial for certain types of anesthesia. General anesthesia requires an empty stomach to reduce the risk of aspiration, whereas local anesthesia can be administered regardless of the client's eating status.
Position for Surgery	The client's surgical position is taken into account; for some procedures, specific positions may limit the choice of anesthesia type.
Need for Client Cooperation & Movement	If the surgical procedure requires client cooperation and movement during surgery, a type of anesthesia that allows for a semiconscious or awake state may be preferred.
Client's Previous Response to Anesthesia	The client's response to previous anesthesia experiences is considered, as some individuals may have specific preferences or adverse reactions to certain anesthesia types.

General Anesthesia

General anesthesia can be administered through various methods to achieve a controlled state of unconsciousness and analgesia during surgical procedures. The two primary forms of general anesthesia are inhalation and IV injection. Inhalation anesthesia involves the client inhaling volatile agents like sevoflurane or desflurane, which are mixed with oxygen and delivered through a mask or an endotracheal tube. IV injection anesthesia, on the other hand, requires the direct injection of anesthetic agents, such as propofol or thiopental, into the client's bloodstream.[18]

In modern practice, a common approach to general anesthesia is referred to as balanced anesthesia. This method combines the use of both IV drugs and inhalation agents to achieve specific effects. For instance, thiopental may be used for induction to rapidly induce unconsciousness; nitrous oxide for

18. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

amnesia to prevent the client from remembering the procedure; morphine for analgesia to manage pain; and pancuronium as a neuromuscular blocking agent for relaxing muscles, facilitating surgical access, and reducing movements during the procedure. Additionally, adjuncts to general anesthetic agents, such as hypnotics, opioid analgesics, and neuromuscular blocking agents are often utilized to enhance the overall anesthesia process. These adjuncts help fine-tune the anesthesia delivery, improve client comfort, and provide a stable and controlled intraoperative environment.[19]

See Figure 2.1[20] for an image of administration of general anesthesia.

19. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

20. "Pacific-partnership-2012_594038.jpg" by U.S. Navy photo by Mass Communication Specialist 3rd Class Michael Feddersen is licensed in the Public Domain." The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement."

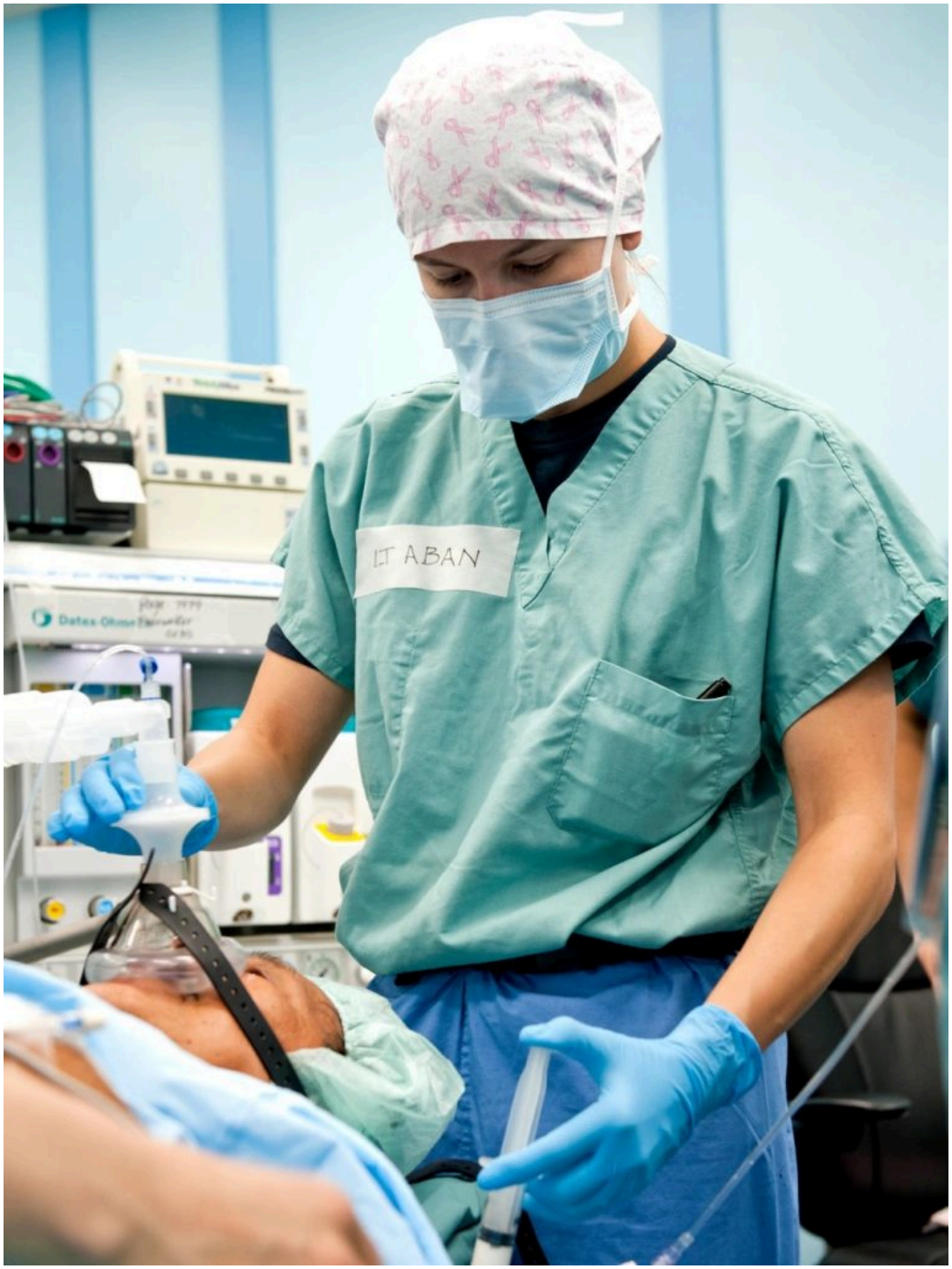


Figure 2.1 Administration of General Anesthesia

Potential Complications From General Anesthesia

Anesthesia is generally considered safe, but complications can occur, varying in severity from minor issues to life-threatening events.

MALIGNANT HYPERTHERMIA

One rare but serious complication is **malignant hyperthermia (MH)**, an acute, inherited muscle disorder triggered by certain drugs used for general anesthesia, specifically inhaled anesthetic agents or the muscle relaxant succinylcholine. MH begins in skeletal muscles exposed to these specific agents, leading to increased calcium levels in muscle cells and heightened muscle metabolism. This results in elevated serum calcium and potassium levels, increased metabolic rate, acidosis, cardiac dysrhythmias, and a high body temperature. MH can manifest at different times during or after anesthesia induction, and early indications include tachycardia, muscle rigidity (particularly of the jaw and upper chest), hypotension, and tachypnea. Detecting MH early is critical for the client's survival, as it can lead to severe complications and even death. Nurses can help detect a client's risk for malignant hyperthermia by asking preoperative questions about previous reactions to anesthesia or family history of anesthesia reactions. The most sensitive indication is an unexpected rise in the end-tidal carbon dioxide (ETCO2) level with a decrease in oxygen saturation. A late sign is an extremely elevated body temperature, sometimes reaching temperatures as high as 111.2°F. Immediate action is essential, and the entire surgical team must be prepared to administer dantrolene sodium, a skeletal muscle relaxant, which is considered the drug of choice for treating MH.[21,22]

21. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

22. Rosenbaum, H. K., & Rosenberg, H. (2022). Malignant hyperthermia: Diagnosis and management of acute crisis. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

View a supplementary YouTube video[23] about noticing and treating malignant hyperthermia: Diagnosing and Treating Malignant Hyperthermia.

OVERDOSE

Anesthesia medications are carefully calculated and administered based on a client's individual characteristics and expected metabolism. However, complications can arise if a client's metabolism and drug elimination are slower than anticipated. This is more likely to occur in older adults or those with preexisting liver or kidney problems. Anesthesia overdose can lead to adverse effects, ranging from minor discomfort to serious complications. Proper monitoring and precise dosage administration are essential to avoid such issues and ensure client safety.[24]

UNRECOGNIZED HYPOVENTILATION

One of the critical aspects of anesthesia care is maintaining adequate ventilation to ensure proper gas exchange. Unrecognized hypoventilation, where the client fails to effectively exchange oxygen and carbon dioxide (CO2), can lead to serious consequences, including cardiac arrest, permanent brain damage, or death. Continuous monitoring of end-tidal carbon dioxide (ETCO2) levels is crucial for detecting changes in CO2 levels in the expired air.

23. Beaumont Health. (2017, June 2). *Diagnosing and treating malignant hyperthermia* [Video]. YouTube. All rights reserved. https://youtu.be/cXa5ej-CszQ?si=M-Tog1hYPowHEt6P

24. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

This monitoring helps identify hypoventilation early and allows immediate intervention to correct the issue and prevent complications.[25,26]

COMPLICATIONS OF INTUBATION

Intubation, the process of placing a breathing tube into the client's airway, is a common practice during general anesthesia. See Figure 2.2[27] for an illustration of intubation with an endotracheal tube. However, intubation can cause potential complications. Clients may experience minor issues such as a sore throat after intubation. In more severe cases, complications can include broken or injured teeth and dental caps, swollen lips, and vocal cord trauma. Intubation can be challenging, especially in clients with anatomical variations or underlying diseases. Improper neck extension during intubation can also lead to injury. Anesthesia providers must exercise caution and expertise during this procedure to minimize the risk of complications and ensure client comfort and safety.[28,29]

25. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

26. Steadman, J., Catalani, B., Sharp, C., & Cooper, L. (2017). Life-threatening perioperative anesthetic complications: Major issues surrounding perioperative morbidity and mortality. *Trauma Surgery & Acute Care Open, 2*(1), e000113. https://doi.org/10.1136/tsaco-2017-000113

27. "Endotracheal_Tube.png" by BruceBlaus is licensed under CC BY-SA 4.0

28. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

29. Steadman, J., Catalani, B., Sharp, C., & Cooper, L. (2017). Life-threatening perioperative anesthetic complications: Major issues surrounding perioperative morbidity and mortality. *Trauma Surgery & Acute Care Open, 2*(1), e000113. https://doi.org/10.1136/tsaco-2017-000113

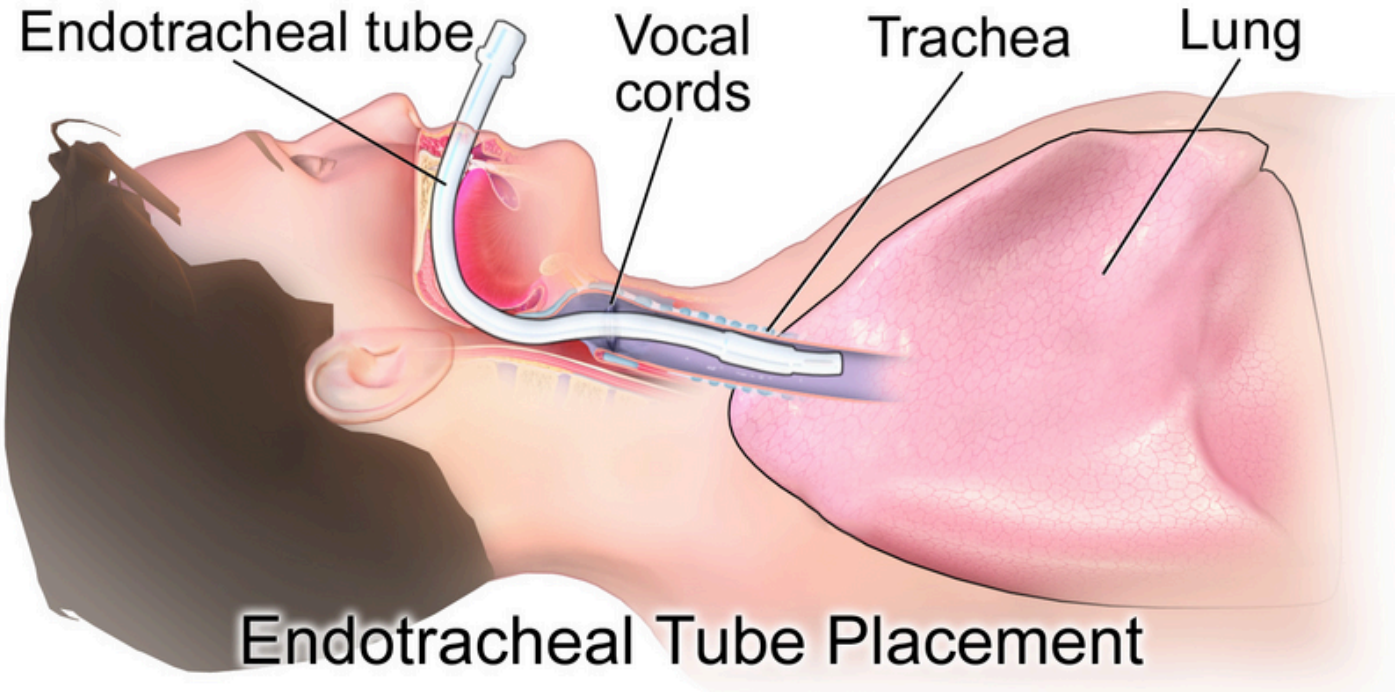


Figure 2.2 Intubation With an Endotracheal Tube

Local Anesthesia

Local anesthesia is a valuable technique used to disrupt sensory impulse transmission and reduce sensory perception in a limited area of the body. It is administered topically or through local infiltration, making it an effective option for minor surgical procedures or for providing pain relief during medical interventions. Unlike general anesthesia, local anesthesia allows the client to remain conscious and responsive throughout the procedure, enhancing client cooperation and communication. This form of anesthesia is commonly used in outpatient settings, as it allows for a faster recovery and reduced risk of complications compared to more invasive approaches.[30]

Topical application of local anesthesia involves applying anesthetic agents

30. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

directly to the skin or mucous membranes. This method numbs the superficial tissues and is particularly useful for minor procedures like suturing small wounds or inserting intravenous (IV) lines. For example, topical or intradermal lidocaine may be applied to numb the area before starting an IV, reducing the pain and discomfort associated with the needle insertion. Additionally, local infiltration involves injecting the anesthetic agent directly into the tissues surrounding the targeted area. This method provides deeper anesthesia and is commonly used for procedures like dental work, minor joint surgeries, and skin biopsies.[31] See Figure 2.3[32] for an image of local anesthesia used during a dental procedure.



Figure 2.3 Local Anesthesia During a Dental Procedure

31. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

32. "DentalLocalAnesthesia11-26-05.jpg" by Dozenist is licensed under CC BY-SA 3.0

Although local anesthesia is generally considered safe and is tolerated well by most clients, there are some risks. These include the potential for allergic reactions, ranging from mild skin irritation to anaphylaxis. Systemic toxicity may be an additional risk. Potential complications of local anesthesia are described in Table 2.2d.

Table 2.2d. Potential Complications of Local Anesthesia[33,34]

Complication	Description
Allergic Reactions	Some individuals may be allergic to the local anesthetic agent, leading to mild to severe reactions, including anaphylaxis.
Systemic Toxicity	Inadvertent absorption of the anesthetic into the bloodstream can cause systemic toxicity with symptoms like dizziness, seizures, and cardiac disturbances.
Nerve Injury	Local anesthetic injection can occasionally cause nerve injury, resulting in temporary or rare permanent changes in sensation or function in the affected area.
Hematoma Formation	Injections into areas with blood vessels may lead to hematoma formation, particularly in regions with abundant blood supply.
Infection	There is a small risk of infection at the injection site, although proper sterile technique can reduce this risk.

Regional Anesthesia

Regional anesthesia is a type of local anesthesia that involves blocking multiple peripheral nerves in a specific body region. It provides excellent pain relief and anesthesia for a targeted area without causing unconsciousness, making it particularly useful when a client cannot or prefers not to undergo general anesthesia. Regional anesthesia is often employed in various surgical and medical procedures, ranging from minor surgeries like dental or plastic

33. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

34. American Society of Anesthesiologists. (n.d.). *Local anesthesia*. https://www.asahq.org/madeforthismoment/anesthesia-101/types-of-anesthesia/local-anesthesia/

surgery to more extensive interventions like joint replacements or chronic pain management.[35]

There are several types of regional blocks. **Field blocks** involve a series of local anesthetic injections around the operative field. It is commonly used in dental and plastic surgery to provide anesthesia to a specific area. **Nerve blocks** involve the injection of a local anesthetic into or around a single nerve or a group of nerves in the involved area. This type of block is commonly used in limb surgeries and chronic pain management. **Spinal blocks** require injecting an anesthetic agent into the cerebrospinal fluid (CSF) in the subarachnoid space, providing anesthesia for lower abdominal surgeries, pelvic procedures, and hip and knee surgeries. **Epidural blocks** involve injecting the anesthetic agent into the epidural space, offering anesthesia for vaginal, perineal, hip, and lower extremity surgeries.[36] See Figure 2.4[37] for an illustration of administration of an epidural block.

35. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

36. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

37. "Epidural-anesthesia.png" by Leila Kafshdooz, Houman Kahroba, Tayebeh Kafshdooz, Roghayeh Sheervalilou & Hojjat Pourfathi is licensed under CC BY 4.0

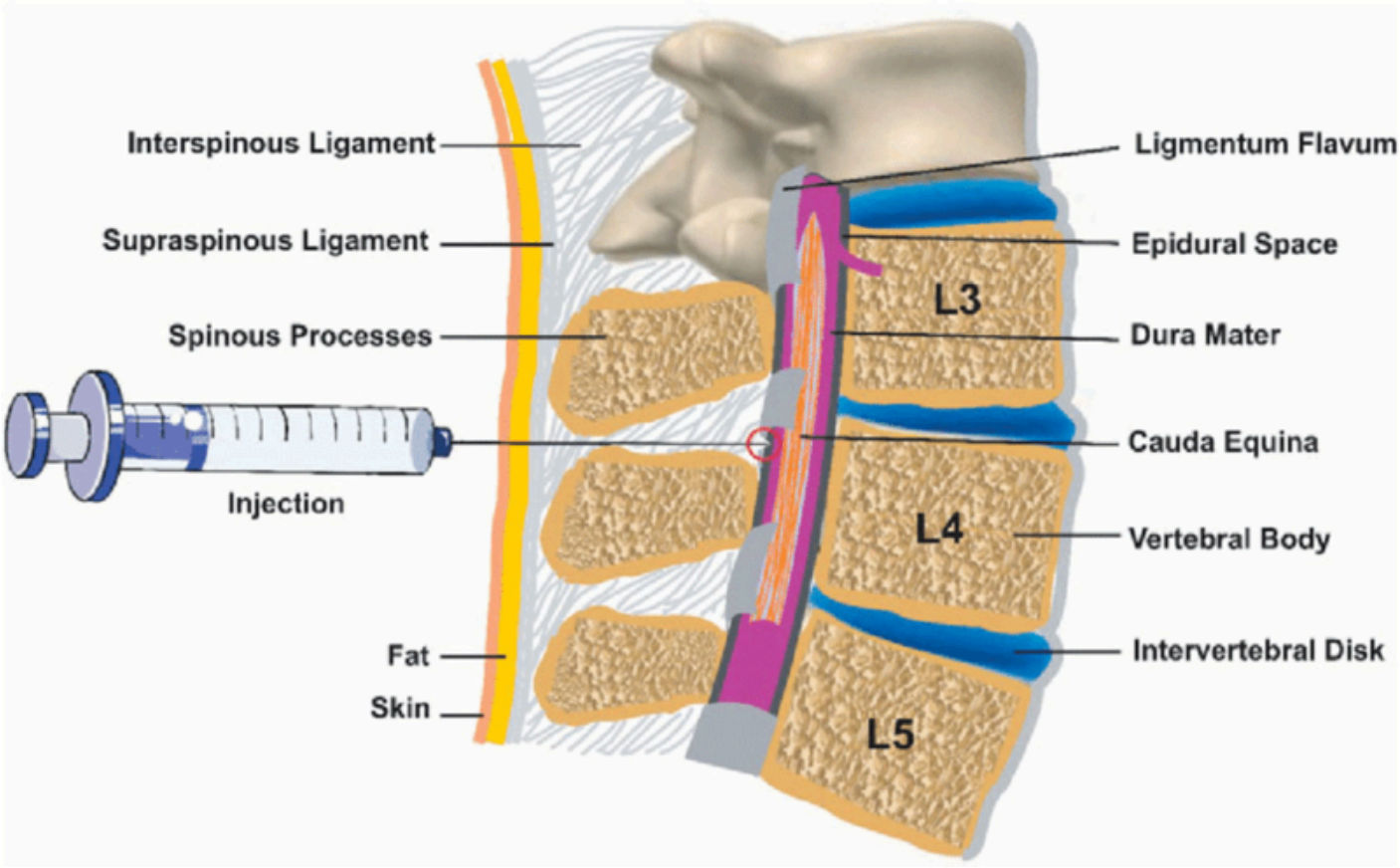


Figure 2.4 Epidural Block

The complications of regional anesthesia can vary depending on the specific type of block used, the client's individual factors, and the skill and experience of the anesthesia provider. Potential complications of regional anesthesia are described in Table 2.2f.

Table 2.2f. Potential Complications of Regional Anesthesia[38, 39]

38. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

39. Jeng, C. L., & Rosenblatt, M. A. (2023). Overview of peripheral nerve blocks. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Complication	Description
Spinal Headache	A headache that develops due to leakage of cerebral spinal fluid (CSF) after injection of anesthesia into the subarachnoid space. Usually resolves on its own, but in some cases may require an epidural blood patch to stop the leak.
Nerve Injury	Rare but serious, nerve injury can occur during regional anesthesia due to trauma to nerves or the effects of the anesthetic agent on nerve function.
Infection	Any breach of the skin during regional anesthesia can lead to infection at the injection site, although adherence to aseptic techniques can minimize the risk.
Systemic Toxicity	Absorption of local anesthetic into the bloodstream during regional blocks can cause systemic toxicity with symptoms like dizziness, seizures, and cardiac issues.
Bleeding and Hematoma	Needle insertion may cause bleeding or hematoma formation, leading to localized swelling and pressure that may affect nerve function or wound healing.
Respiratory Compromise	In certain regional blocks, the anesthetic agent can affect respiratory muscle function, leading to breathing difficulties, especially in clients with respiratory issues.
Allergic Reactions	While rare, some clients may experience allergic reactions to the local anesthetic agent, ranging from mild rashes to severe anaphylaxis, requiring immediate attention.

Conscious Sedation

Conscious sedation, also known as “moderate sedation,” is a form of anesthesia administered through intravenous (IV) delivery of sedative, hypnotic, and opioid drugs to reduce the client’s level of consciousness. During conscious sedation, the client remains conscious and responsive but experiences a state of deep relaxation and drowsiness. This form of anesthesia is commonly used for minor surgical procedures, diagnostic tests, or other

medical interventions where the client requires pain management and anxiety reduction without the need for complete unconsciousness.[40]

The administration of conscious sedation is typically performed by a credentialed registered nurse (RN) with specialized training in airway management, IV drug delivery, and Advanced Cardiac Life Support (ACLS). The most commonly used drugs for conscious sedation include etomidate, diazepam, midazolam, meperidine, fentanyl, alfentanil, and morphine sulfate. The goal of conscious sedation is to achieve a state where the client is sleepy but can be easily aroused and respond to verbal commands.[41]

Continuous monitoring is essential during conscious sedation to ensure the client's safety and well-being. The RN closely monitors the client's airway, level of consciousness, oxygen saturation, carbon dioxide (CO2) levels, electrocardiogram (ECG), and vital signs, typically at 15- to 30-minute intervals post-procedure until the client returns to their baseline state. The action of the sedative and opioid drugs used for conscious sedation is relatively short, allowing for a rapid return to daily activities (ADLs) once the procedure is completed. To prevent aspiration, clients are advised not to consume any oral intake until at least 30 minutes after the conscious sedation procedure. Conscious sedation provides effective pain management and relaxation while minimizing the risks associated with general anesthesia, making it a safe and widely utilized option for appropriate medical procedures.[42,43]

40. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

41. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

42. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

43. Crego, N. (2016). Procedural sedation practice: A review of current nursing standards. *Journal of Nursing Regulations, 6*(1), 50-56. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8923528/

Conscious sedation is generally safe when administered by trained and experienced health care professionals. Potential complications of conscious sedation are described in Table 2.2f.

Table 2.2f. Potential Complications of Conscious Sedation[44,45]

Complication	Description
Respiratory Depression	Slow and shallow breathing can occur during conscious sedation, particularly with the use of opioids or sedative drugs, potentially leading to decreased blood oxygen levels and hypoxia.
Airway Obstruction	Relaxed throat muscles or airway positioning may cause airway obstruction in clients under conscious sedation. Maintaining a clear airway is crucial to prevent respiratory distress or choking.
Hypotension and Bradycardia	Certain medications used in conscious sedation can cause a drop in blood pressure (hypotension) and a decrease in heart rate (bradycardia), which can be problematic, especially for clients with preexisting cardiovascular conditions.
Allergic Reactions	Allergic responses to medications used in conscious sedation may range from mild skin rashes to severe anaphylaxis, necessitating immediate medical intervention.
Oversedation or Under Sedation	Achieving the right level of sedation can be challenging, leading to either oversedation (unresponsiveness or unconsciousness) or under sedation (anxiety and discomfort) in some clients.
Nausea and Vomiting	Certain medications used during conscious sedation, especially opioids, can cause nausea and vomiting in some clients.
Delayed Recovery	While conscious sedation allows for a rapid return to daily activities, some clients may experience delayed recovery, feeling groggy or tired after the procedure.

44. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

45. Crego, N. (2016). Procedural sedation practice: A review of current nursing standards. *Journal of Nursing Regulations, 6*(1), 50-56. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8923528/

Monitored Anesthesia

Monitored anesthesia care (MAC) is a type of anesthesia used to provide a safe and comfortable experience for clients undergoing certain medical procedures or surgeries. Unlike general anesthesia, which renders the client completely unconscious, MAC anesthesia involves the administration of intravenous (IV) sedative and pain-relieving medications to achieve a state of "moderate sedation." During MAC anesthesia, the client remains conscious and responsive, but in a deeply relaxed and drowsy state. The anesthesia provider carefully monitors the client's vital signs, level of consciousness, and response to the medications throughout the procedure.[46,47]

MAC anesthesia is commonly used for minor surgical procedures, endoscopic examinations, or diagnostic tests that do not require complete unconsciousness. It is particularly beneficial for clients who may not tolerate or prefer not to undergo general anesthesia. By avoiding the risks associated with deeper levels of anesthesia, such as respiratory depression or airway complications, MAC anesthesia provides a safer alternative while still providing adequate pain relief and client comfort.[48,49]

The anesthesia provider, typically an anesthesiologist or certified registered nurse anesthetist (CRNA), administers a combination of sedatives and analgesics tailored to each client's individual needs. These medications produce a state of conscious sedation, allowing clients to follow verbal

46. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

47. Rosero, E. B. (2023). Monitored anesthesia care in adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

48. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

49. Rosero, E. B. (2023). Monitored anesthesia care in adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

commands and respond to stimuli while minimizing anxiety and discomfort. The level of sedation can be adjusted throughout the procedure to maintain the desired level of comfort and cooperation. After the procedure, clients generally recover quickly and can often resume their daily activities shortly thereafter. Overall, MAC anesthesia offers a balanced approach to anesthesia, combining client safety with optimal pain management and reduced risk, making it a valuable choice for appropriate medical interventions.[50] As with any medical procedure, MAC anesthesia comes with potential risks, and these complications should be diligently managed by skilled health care professionals. Potential complications of MAC anesthesia are summarized in Table 2.2g.

Table 2.2g. Potential Complications of MAC[51,52]

Complication	Description
Respiratory Depression	Sedative medications used in MAC anesthesia can cause respiratory depression, resulting in slow or shallow breathing and reduced blood oxygen levels, potentially leading to hypoxia.
Airway Obstruction	Clients under MAC anesthesia may experience airway obstruction due to relaxed throat muscles or positional changes. Maintaining a clear airway is essential to prevent respiratory distress and choking.
Hypotension and Bradycardia	MAC anesthesia medications can lead to changes in blood pressure and heart rate, causing hypotension (low blood pressure) and bradycardia (slow heart rate), particularly in clients with preexisting cardiovascular conditions.
Delayed Recovery	While MAC anesthesia offers a faster recovery compared to general anesthesia, some clients may still experience delayed recovery, feeling groggy or tired after the procedure.
Allergic Reactions	Some clients may have allergic reactions to the medications used in MAC anesthesia, ranging from mild skin rashes to severe anaphylaxis, requiring immediate medical attention.
Nausea and Vomiting	Certain medications used during MAC anesthesia, especially opioids, may cause nausea and vomiting in some clients.
Oversedation or Under Sedation	Achieving the appropriate level of sedation can be challenging, leading to either oversedation (unresponsiveness) or under sedation (inadequate relaxation), which require careful monitoring and adjustment during the procedure.

50. Rosero, E. B. (2023). Monitored anesthesia care in adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

51. Falk, S. A., & Fleisher, L. A. (2023). Overview of anesthesia. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

52. Rosero, E. B. (2023). Monitored anesthesia care in adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Surgical Safety

Surgical safety checklists are used during surgery to emphasize that client safety is the primary concern for all personnel involved in surgical care. It serves as a reminder that the well-being and safety of the client should always take precedence throughout the entire perioperative period. The **World Health Organization (WHO) Surgical Safety Checklist** serves as a standardized framework that helps health care teams ensure critical safety measures are consistently implemented before, during, and after surgery. The checklist emphasizes the importance of communication, teamwork, and adherence to safety protocols.[53]

Examples of items on the surgical safety checklist include the following[54]:

- **Confirm client identity:** Client identity is verified by cross-checking their name, date of birth, and other identifying information. This step helps prevent wrong-client procedures.
- **Verify surgical site is marked:** The correct surgical site is identified and marked before the procedure. Site marking is particularly important for surgeries involving multiple anatomical structures or when there is a risk of confusion. Read more information about site marking from The Joint Commission using the information in the box below.
- **Ensure documentation is reviewed:** Necessary imaging and documentation (e.g., X-rays, consent forms) are available and reviewed.
- **Monitor pulse oximeter:** A pulse oximeter is a device used to monitor oxygen levels in the blood. It is used for continuous monitoring of the client's oxygenation status during surgery.

53. World Health Organization. (2023). *WHO surgical safety checklist*. https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

54. World Health Organization. (2023). *WHO surgical safety checklist*. https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

- **Verify anesthesia safety:** Client allergies and any special requirements related to anesthesia are verified, as well as confirmation of the availability and proper functioning of necessary anesthesia equipment and medications. The client's airway management plan is reviewed.
- **Administer prophylactic antibiotics:** Appropriate administration of prophylactic antibiotics within the recommended time frame is verified before incision takes place.
- **Count instruments, sponges, and needles:** Accurate counting of surgical instruments, sponges, and needles is verified before and after the procedure to prevent retention of foreign objects.
- **Team briefing:** A preprocedural briefing is conducted with the surgical team to review critical information, discuss potential risks or concerns, and ensure everyone is on the same page.[55]

> Read more about the universal protocol to prevent wrong site, wrong procedure, and wrong person surgery in a PDF from The Joint Commission: Universal Protocol Poster.

Research has shown the WHO Surgical Safety Checklist improves client outcomes, reduces complications, and enhances teamwork and communication in the operating room.[56] By following the checklist, health care teams can minimize errors, ensure compliance with essential safety

55. World Health Organization. (2023). *WHO surgical safety checklist*. https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

56. World Health Organization. (2023). *WHO surgical safety checklist*. https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

measures, and ultimately enhance the overall quality and safety of surgical care.

In addition to the WHO Surgical Safety Checklist, adverse events like wrong-site surgery, falls, pressure ulcers, and other adverse events are reportable to regulatory bodies like the Centers for Medicare and Medicaid Services (CMS).[57] This increased accountability places responsibility on health care facilities to implement measures to promote client safety and prevent adverse events. The WHO Surgical Safety Checklist aligns with this focus on accountability by providing a structured approach to enhance client safety and reduce the occurrence of preventable adverse events.[58]

> View the WHO Surgical Safety Checklist: Surgical Safety Checklist PDF.

Surgical Hand Scrub

Nurses and other members of the surgical team are responsible for performing a thorough surgical hand scrub using an antiseptic solution. This process is crucial to eliminate microorganisms from the hands and forearms before donning sterile gloves and gowns to maintain aseptic conditions

57. Centers for Medicare & Medicaid Services. (2008). *Surgery on the wrong body part*. https://www.cms.gov/medicare-coverage-database/view/ncacal-decision-memo.aspx?proposed=Y&ncaid=222

58. World Health Organization. (2023). *WHO surgical safety checklist*. https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

during the surgery and prevent infection.[59] Review information about performing a surgical scrub in the following box.

Surgical Scrub[60]

A surgical scrub does not make the skin sterile, but it significantly reduces the risk of infection by eliminating a large number of organisms on the skin.
Key steps of a surgical scrub include the following:

Remove Jewelry: Before beginning the scrub, any rings, watches, bracelets, or other jewelry on the hands and forearms are removed. These items can harbor microorganisms and interfere with proper handwashing.

Trim Nails and Remove Artificial Nails: Short and natural nails are preferred. Long or artificial nails can harbor bacteria and reduce the effectiveness of handwashing.

Prerinse with Water: The hands and forearms are prerinsed with water to remove dirt and debris from the skin surface.

Apply Antiseptic Solution: An antiseptic solution, usually chlorhexidine or povidone-iodine, is applied to the hands and

59. Benze, C., Spruce, L., & Graph, L. (2021). *Perioperative nursing: Scope and standards of practice.* AORN. https://www.aorn.org/docs/default-source/guidelines-resources/periop-nursing-scope-standards-of-practice.pdf?sfvrsn=c532cdee_1

60. Anderson, D. J., & Sexton, D. J. (2022). Overview of control measures for prevention of surgical site infection in adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

forearms. The scrub begins by focusing on the nails and cuticles and then moves up the arms.

Scrub Thoroughly: The hands and forearms are scrubbed thoroughly, paying attention to all areas, including the spaces between fingers, the back of hands, and up to two inches above the elbows. The scrub should last for the recommended duration, typically around 2 to 5 minutes, depending on the facility's policy.

Allow Water to Run Off Arms: While scrubbing, the hands and arms are held in a way that allows the water to flow from the fingertips downward, preventing contamination from higher, less clean areas.

Assist With Gowning and Gloving: After completing the scrub, the surgical team member is assisted in donning a sterile gown and sterile gloves by another team member who has not performed the scrub. This ensures that the sterile field is not compromised during the process. It is vital for team members to be mindful of the boundaries of the sterile gown and the sterile field throughout the surgical procedure. The sleeves of the gown are considered sterile up to two inches above the elbows, the front of the gown is considered sterile from chest level down, and the back of the gown is considered nonsterile.

Perform Routine Hand Cultures: In some settings, health care workers may undergo routine hand cultures to detect potential sources of infections. This helps monitor the effectiveness of hand hygiene practices and identify areas for improvement.

View a supplementary YouTube video[61] from Johns Hopkins Medicine on performing a surgical scrub: Anatomical Surgical Hand Scrub.

Informed Consent

Informed consent is a key concept for maintaining autonomy for surgical clients. **Informed consent** ensures an active, shared decision-making process between the health care provider and the recipient of care, empowering clients to participate in decisions about their treatment and surgical procedures. Adequate disclosure is a key aspect of informed consent, whereby clients are provided with comprehensive information about the nature of the surgery, the individuals involved in the procedure (including students), available treatment options, and the associated risks of each option. Additionally, clients should be informed about the potential risks associated with anesthesia.[62]

To ensure the validity of consent, three conditions must be met. First, there should be adequate disclosure by the surgeon/physician of the diagnosis, risks, outcomes, and nature and purpose of the treatment/surgery, as well as the prognosis if the treatment is not instituted. Second, clients must demonstrate understanding and comprehension of the information provided

61. John Hopkins Medicine. (2018, December 14). *Anatomical surgical hand scrub* [Video]. YouTube. All rights reserved. https://youtu.be/WpZqLbWL0c0?si=asgQlMdlnlxPb7LE

62. Ryan, M., & Sinha, M. S. (2023). Informed procedural consent. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

before receiving any sedating preoperative medications. Lastly, consent must be given voluntarily, without any form of persuasion or coercion.[63]

While the responsibility of obtaining signed consent lies with the surgeon, nurses play a crucial role in the process by assisting in obtaining and witnessing the client's signature as valid consent according to these conditions. Nurses can also contribute by clarifying facts presented by the physician and dispelling any myths or misconceptions that the client or family may have about the surgery. If a client remains unclear about the surgery after clarification by the nurse, the nurse will refer the client back to the surgeon for further education.

It is important to note that in medical emergencies where immediate intervention is necessary to safeguard the client's health, the need to obtain consent may be overridden. However, consent should be obtained as soon as possible after the emergency situation has been addressed.[64]

Keep in mind that once a client has received any type of sedation, they cannot sign informed consent. For this reason, multiple consents may be performed prior to undergoing a procedure, such as signing a consent for a possible open-heart surgery if undergoing a catheterization in the Cardiac Cath Lab.

Clients have the right to withdraw their consent before undergoing surgery, and health care providers must respect their decision in such cases. Consent

63. Ryan, M., & Sinha, M. S. (2023). Informed procedural consent. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

64. American Medical Association. (n.d.). *AMA Code of Medical Ethics: 2.1.1 informed consent*. https://code-medical-ethics.ama-assn.org/sites/default/files/2022-08/2.1.1.pdf

should be an ongoing process, allowing clients to make informed choices about their health care.[65,66]

Life Span Considerations

Older Adult Considerations

- Older adults have increased risk of surgical complications due to factors such as delayed immune system response, delayed wound healing, delayed renal excretion, decreased muscle mass, increased risk of dehydration, and decreased physiological reserve.
- The risk for hypoventilation is increased following surgery. Nursing considerations include end-tidal CO2 monitoring to identify hypoventilation.
- Older clients have a decreased immune system and potential for delayed wound healing.
- Age-related changes to the kidneys and liver may delay the elimination of anesthesia or analgesics as clients age.
- Many older adults have chronic health problems impacting their cardiovascular, renal, hepatic, and respiratory systems, making them more vulnerable to fluid and electrolyte imbalances.
- Nursing considerations may include renal or hepatic doses of preoperative and postoperative medications due to underlying medical conditions.
- Unfamiliar surroundings, decreased hearing and vision, forgetfulness, and anxiety about surgery may impact an elderly client's ability to remember

65. Ryan, M., & Sinha, M. S. (2023). Informed procedural consent. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

66. American Medical Association. (n.d.). *AMA Code of Medical Ethics: 2.1.1 informed consent*. https://code-medical-ethics.ama-assn.org/sites/default/files/2022-08/2.1.1.pdf

and understand surgical instructions. Advocating for another family member to be present is an appropriate nursing recommendation.
- Fragile skin and less subcutaneous tissue make skin breakdown a potential complication. Nursing considerations include integumentary assessments and musculoskeletal position changes.[67]

Pediatric Considerations

- Age-appropriate language, family dynamics, and assessment of a client's developmental stage are unique pediatric nursing considerations.
- Preoperative anxiety and fear of parental separation require nursing assessment and planning for potential preanesthetic medications to reduce symptomatology.
- A comprehensive care plan emphasizing patience, empathy, knowledge, skill, and common sense practiced by the multidisciplinary team acknowledges pediatric needs.
- Use of an induction room (safe space) where clients remain clothed and aren't subject to procedures or skills (IVs, laboratory draws, etc.) is a nonpharmacologic anxiety-reducing strategy.
- Alternative methods to verify identity with peers or family members may be necessary due to lack of speech.[68]

67. Baquero, G.A. & Rich, M.W. (2015). Perioperative care in older adults. *Journal of Geriatric Cardiology, 12*(5), 465-9. https://doi.org/10.11909/j.issn.1671-5411.2015.05.018

68. Baquero, G.A. & Rich, M.W. (2015). Perioperative care in older adults. *Journal of Geriatric Cardiology, 12*(5), 465-9. https://doi.org/10.11909/j.issn.1671-5411.2015.05.018

2.3 Preoperative Nursing Care

The preoperative surgical period refers to the phase of client care that occurs before a surgical procedure. It is a critical time when health care professionals, including nurses, play a crucial role in preparing clients physically and emotionally for surgery. The **preoperative period** begins when the client is scheduled for surgery and ends at the time of transfer to the surgical suite. During this time, the nurse serves as an educator, advocate, and promoter of health and safety. The nurse ensures a culture of safety by implementing evidence-based practices, adhering to protocols, and maintaining open communication with the client and the health care team.[1,2,3]

As an educator, the nurse reinforces information already provided to the client by the surgeon regarding the surgical procedure, potential risks and benefits, preoperative preparations, and postoperative expectations. By reinforcing this information, the nurse ensures the client understands the reason for the surgery and addresses any concerns or questions they may have. By empowering the client with knowledge, the nurse promotes active participation in decision-making and ensures informed consent. If the nurse does not believe the client has provided adequate informed consent, the surgeon should be notified before the procedure occurs. If a power of

1. Mathenge, C. (2020). The importance of the perioperative nurse. *Community Eye Health, 33*(110), 44-45. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8115701/

2. ACORN. (n.d.). *Nursing roles.* https://www.acorn.org.au/nursing-roles

3. Hicks, R. W. (2021). Looking into perioperative nurses' other roles. *AORN Journal, 114*(4), 290-293. https://doi.org/10.1002/aorn.13514

attorney (POA) for health care has been activated, the POA should be contacted for informed consent.[4,5,6]

The nurse also acts as an advocate for the client, ensuring their rights, preferences, and safety are respected throughout the perioperative period. This involves advocating for proper client identification, verifying surgical site marking, and ensuring that all necessary safety measures are in place. The nurse collaborates with the interdisciplinary team to address any potential risks or complications and advocates for the client's best interests.[7,8,9]

Communication and collaboration are essential within the health care team, as emphasized by The Joint Commission's National Patient Safety Goals (NPSG). The nurse actively participates in effective communication and collaboration by sharing relevant client information, clarifying orders, and addressing any potential gaps or discrepancies. This promotes teamwork,

4. Mathenge, C. (2020). The importance of the perioperative nurse. *Community Eye Health, 33*(110), 44-45. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8115701/

5. ACORN. (n.d.). *Nursing roles.* https://www.acorn.org.au/nursing-roles

6. Hicks, R. W. (2021). Looking into perioperative nurses' other roles. *AORN Journal, 114*(4), 290-293. https://doi.org/10.1002/aorn.13514

7. Mathenge, C. (2020). The importance of the perioperative nurse. *Community Eye Health, 33*(110), 44-45. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8115701/

8. ACORN. (n.d.). *Nursing roles.* https://www.acorn.org.au/nursing-roles

9. Hicks, R. W. (2021). Looking into perioperative nurses' other roles. *AORN Journal, 114*(4), 290-293. https://doi.org/10.1002/aorn.13514

enhances client safety, and facilitates seamless transitions between different phases of care.[10,11,12]

Applying the Nursing Process to Preoperative Care

The following are the nursing priorities during the preoperative surgical period[13]:

- Perform preoperative assessments to evaluate the client's overall health status and identify potential risks or contraindications for surgery.
- Collaborate with the health care team to develop a comprehensive perioperative plan for the client, including preoperative preparation and postoperative care.
- Provide health teaching about the surgery/procedure, expected outcomes, and postoperative recovery process.
- Ensure informed consent is obtained prior to administration of preoperative medication administration and the surgical procedure.
- Administer preoperative medications as prescribed, such as premedication for anxiety or prophylactic antibiotics.

10. Mathenge, C. (2020). The importance of the perioperative nurse. *Community Eye Health, 33*(110), 44-45. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8115701/

11. ACORN. (n.d.). *Nursing roles*. https://www.acorn.org.au/nursing-roles

12. Hicks, R. W. (2021). Looking into perioperative nurses' other roles. *AORN Journal, 114*(4), 290-293. https://doi.org/10.1002/aorn.13514

13. Vera, M. (2024). *12 surgery (perioperative client) nursing care plans.* Nurselabs. https://nurseslabs.com/surgery-perioperative-client-nursing-care-plans/

Assessment

PREOPERATIVE HEALTH HISTORY

The nurse assesses many factors as the client is prepared for surgery to ensure safety and optimize their surgical outcomes. A preoperative health history includes the following components[14, 15, 16]:

- **Age:** The client's age is an important factor to consider, as it can impact their physiological response to surgery. Older adults have increased risk of surgical complications due to factors such as delayed immune system response, delayed wound healing, delayed renal excretion, decreased muscle mass, increased risk of dehydration, and decreased physiological reserve. It is important to assess these factors and take appropriate measures to mitigate the associated risks. Pediatric clients will require reduced dosages of anesthetic agents, may require specialized equipment due to reduced size, and will require different communication techniques and familiar support when transitioning into the surgical environment. Utilizing child life specialists (when available) to familiarize pediatric clients to the sights and sounds associated with the operating room can be very beneficial in reducing anxiety. **Child life specialists** are members of the health care team who work with children and their families to provide education and preparation during hospitalization.

14. American Society of Anesthesiologists. (n.d.). *Preparing for surgery: Checklist*. https://www.asahq.org/madeforthismoment/preparing-for-surgery/prep/preparing-for-surgery-checklist/

15. Cumberland, E. (2022). *Preparing for surgery? What you need to know.* Mayo Clinic Health System. https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/preparing-for-surgery-what-you-need-to-know

16. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate.* https://www.wolterskluwer.com/en/solutions/uptodate

- **Drugs and substance use:** A comprehensive medication history should be obtained, including prescription and over-the-counter (OTC) medications, supplements, and substance use. It is crucial to identify medications or substances that may interfere with anesthesia and clotting or increase the risk of complications during and after surgery. Special attention should be given to substances such as tobacco, alcohol, and marijuana, as they can have significant effects on the client's respiratory and cardiovascular systems.
- **Medical history, particularly cardiac and pulmonary conditions:** The client's medical history, particularly cardiac and pulmonary conditions, should be thoroughly evaluated. Clients with cardiac disease are at a higher risk of anesthesia-related complications and may have difficulty tolerating hemodynamic changes induced by anesthesia. For individuals at risk of cardiac complications, specific measures, such as administration of preoperative beta-blockers, may be necessary to reduce the risk of myocardial infarction (MI) during surgery. Pulmonary complications should be assessed, especially in clients with chronic obstructive pulmonary disease (COPD) or a history of smoking. Clients who smoke or have COPD may have reduced lung function, decreased gas exchange, and increased risk of anesthesia-related complications.
- **History of previous surgical procedures and anesthesia:** The client's history of previous surgeries and experiences with anesthesia should be reviewed. Previous surgical procedures and anesthesia may have an impact on the client's readiness for the current surgery. Additionally, a family history of malignant hyperthermia, a rare but life-threatening reaction to certain anesthetics, should be documented.
- **Allergies:** Allergies, particularly those related to anesthesia and surgical supplies, must be identified to prevent adverse effects. Common allergies include latex (found in gloves and other medical supplies) and medications related to anesthesia (such as propofol). Allergies must be communicated to the anesthesiologist and surgical team so that precautions and alternative options are considered.
- **Previous blood donations:** If the client has donated blood, either autologous (donating one's own blood for later use) or directed (other

donor donating blood specifically for the client's use), this must be documented. This information is important for planning potential blood product transfusions during or after surgery. Additionally, in some cases, the client may have received erythropoietin (EPO) to stimulate red blood cell production before surgery, which can reduce the need for blood transfusions.

- **Discharge planning:** Preparation for surgery also involves considering the client's postoperative care and discharge planning. The client's home environment should be evaluated to ensure it is conducive to recovery and necessary support systems are in place. Self-care abilities should be assessed to determine if additional assistance or resources will be required after surgery. Factors such as postoperative needs, follow-up appointments, transportation, and any necessary medical equipment or supplies should also be taken into account during discharge planning.[17,18,19]

> Read more information about performing a routine health history in the "Health History" chapter of Open RN *Nursing Skills, 2e*.

17. Cumberland, E. (2022). Preparing for surgery? What you need to know. Mayo Clinic Health System. https://www.asahq.org/madeforthismoment/preparing-for-surgery/prep/preparing-for-surgery-checklist/

18. Cumberland, E. (2022). Preparing for surgery? What you need to know. Mayo Clinic Health System. https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/preparing-for-surgery-what-you-need-to-know

19. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

PREOPERATIVE PHYSICAL ASSESSMENT

The primary health care provider completes a history and physical (H&P) and orders diagnostic testing and/or consults that are needed for the client to be cleared for surgery. The nurse ensures the H&P is in the chart as part of a preoperative checklist.

A nurse may also perform a final assessment just prior to surgery. Table 2.3a provides an overview of focused nursing assessments by body system. The preoperative assessments focus on various physiological and psychosocial factors that can impact surgical outcomes.[20] If any new concerns are found, the nurse notifies the surgical team to minimize potential risks.

Table 2.3a. Key Focused Preoperative Assessments[21]

20. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

21. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

System	Focused Assessments	Rationale
Cardiovascular	Check for new hypertension.	Hypertension is often undiagnosed and can affect the hemodynamic response to surgery.
	Listen to heart sounds for rate, regularity, and abnormalities.	New abnormal heart sounds may indicate underlying cardiac conditions and increase the risk of complications.
	Examine the hands and feet for temperature, color, peripheral pulses, capillary refill, and edema.	Abnormalities in temperature, color, or peripheral pulses may indicate poor circulation or vascular problems.
	Assess for previous venous thromboembolism (VTE).	Previous VTE increases the risk of developing blood clots during surgery.
Respiratory	Consider age, smoking history, and any chronic illnesses like chronic obstructive pulmonary disease (COPD).	These factors can impact respiratory function and increase the risk of complications.
	Observe respiratory rate, rhythm, depth, and overall breathing effort.	Abnormalities in respiratory parameters may indicate underlying respiratory conditions.
	Document any clubbing of the fingertips or cyanosis.	Clubbing and cyanosis may suggest chronic respiratory diseases.
	Auscultate lungs to assess for abnormal breath sounds.	Abnormal breath sounds may indicate underlying respiratory pathologies.
	Assess for obesity, as it increases the risk of obstructive sleep apnea (OSA).	Obese clients have a higher risk of developing OSA during surgery or recovery.
Renal	Inquire about urinary symptoms such as frequency, dysuria, nocturia, difficulty starting urine flow, and oliguria.	These symptoms may indicate underlying renal problems that can contribute to potential complications.
	Assess appearance and odor of urine and degree of continence.	Abnormal appearance or odor of urine or incontinence may indicate infection or renal dysfunction.
	Evaluate usual fluid intake.	Fluid intake affects renal function.
	Evaluate kidney function.	Decreased kidney function decreases the excretion of drugs and anesthetic agents and can result in prolonged drug effects.
Neurological	Assess overall mental status, level of consciousness (LOC), orientation, and ability to follow commands.	Baseline neurological status is important to establish for accurate postoperative assessments.
	Determine the client's risk for falling, especially in older adults.	Fall risk assessment helps in implementing necessary precautions.
Musculoskeletal	Inquire about a history of arthritis or surgical history for joint replacements.	Joint replacements and arthritis may affect client positioning and surgical approach.
	Assess for any unique positioning requirements (e.g., neck or chest conditions).	Unique positioning requirements should be noted to ensure client safety during surgery.
	Note the presence of any prosthetic joints, tattoos, and scar tissue.	Prosthetic joints, tattoos, and scar tissue can be affected by cautery, requiring additional care during surgery.
Nutrition	Assess nutritional status, particularly malnutrition and obesity. Observe physical signs of malnutrition, such as brittle nails, muscle wasting, or dry or flaky skin.	Malnutrition and obesity can impact wound healing and surgical outcomes.

Review information about assessing various body systems in Open RN *Nursing Skills, 2e*, including the "Cardiovascular

Assessment," "Respiratory Assessment," "Neurological Assessment," and "Musculoskeletal Assessment" chapters.

PREOPERATIVE LABORATORY ASSESSMENT

Preoperative screening plays a crucial role in ensuring client safety and optimal surgical outcomes. A comprehensive evaluation of a client's health status before undergoing surgery is essential to identify any underlying conditions or abnormalities that may impact the surgical procedure or pose risks during the operation. Prior to planned surgeries, the client's primary health care provider completes a History and Physical (H&P). Its purpose is to assess overall health and screen for potential issues in regard to surgery and anesthesia.

Laboratory tests commonly performed as part of a preoperative H&P include a complete blood count (CBC), basic metabolic panel (BMP), liver function tests (LFTs), coagulation profile (PT, PTT, and INR), urinalysis (UA), and a pregnancy test for females.[22] These tests provide valuable information about the client's blood cell counts, organ function, electrolyte balance, liver health, and clotting ability.

The nurse ensures the H&P and related preoperative lab work results are included in the client's chart as part of the preoperative checklist. By analyzing these parameters, health care professionals evaluate a client's overall health, detect any potential issues, and make informed decisions regarding the surgical approach, anesthesia management, and postoperative care. For this reason, preoperative labs serve as an important tool to optimize client care, enhance surgical safety, and minimize potential complications. Table 2.3b summarizes common preoperative lab work and its purpose. Refer to "Appendix A – Normal Reference Ranges" for a summary of common laboratory tests and their normal reference ranges.

22. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate.* www.uptodate.com

Table 2.3b. Preoperative Lab Work[23]

Lab Test	Purpose
Complete Blood Count (CBC)	Assesses overall health and detects anemia, infection, or abnormal platelet levels
Basic Metabolic Panel (BMP)	Evaluates kidney function, electrolyte levels, and glucose
Liver Function Tests (LFTs)	Assesses liver function and detects liver diseases
Coagulation Profile	Evaluates blood clotting ability
Blood Type and Rh Factor	Determines blood type compatibility for potential transfusions
Urinalysis	Screens for urinary tract infections and assesses kidney function
Chest X-ray	Assesses lung health and detects abnormalities
Electrocardiogram (ECG/EKG)	Evaluates heart's electrical activity and detects abnormalities
Pregnancy Test	Determines pregnancy status (for females of childbearing age)
Other Specialized Tests	Depending on the client's medical history and surgical procedure, additional tests such as serology, i scan), or specific biomarkers may be requested

Nursing Diagnoses

Nursing priorities for clients undergoing surgery are formulated based on the client's preoperative history and assessment data and their specific needs related to the surgery. These nursing diagnoses guide the development of individualized care plans and nursing interventions.

Common nursing diagnoses related to preoperative care include the following:

- Risk for Injury
- Risk for Bleeding
- Risk for Delayed Surgical Recovery
- Anxiety
- Fear
- Readiness for Enhanced Knowledge

23. UpToDate. (2023). Laboratory test reference ranges in adults. https://www.wolterskluwer.com/en/solutions/uptodate

Review information about creating nursing diagnoses in the "Diagnosis" section of the "Nursing Process" chapter of Open RN *Nursing Fundamentals, 2e*.

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. **Expected outcomes** are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to preoperative care are as follows:

- *The client will remain free from injury during the perioperative period.*
- *The client will verbalize three potential postoperative complications and related actions to prevent them from occurring.*
- *The client will report decreased feelings of anxiety regarding the upcoming procedure or surgery.*

Planning Preoperative Interventions

Preoperative client planning involves careful consideration of various elements to ensure a smooth and safe surgical experience.[24,25,26]

- **Informed Consent:** While the responsibility of obtaining signed consent lies with the surgeon, nurses play a crucial role in the process by assisting in obtaining and witnessing the client's signature as valid consent. Nurses can also contribute to client understanding by clarifying facts presented by the physician and dispelling any myths or misconceptions that the client or family may have about the surgery. Clients have the right to withdraw their consent before undergoing surgery, and health care providers must respect their decision in such cases. Consent should be an ongoing process, allowing clients to make informed choices about their health care.[27,28] Review additional information about informed consent in the "Basic Concepts Related to Surgery" section.

24. American Society of Anesthesiologists. (n.d.). *Preparing for surgery: Checklist*. https://www.asahq.org/madeforthismoment/preparing-for-surgery/prep/preparing-for-surgery-checklist/

25. Cumberland, E. (2022). Preparing for surgery? What you need to know. Mayo Clinic Health System. https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/preparing-for-surgery-what-you-need-to-know

26. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

27. Ryan, M., & Sinha, M. S. (2023). Informed procedural consent. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

28. American Medical Association. (n.d.). *AMA Code of Medical Ethics: 2.1.1 informed consent*. https://code-medical-ethics.ama-assn.org/sites/default/files/2022-08/2.1.1.pdf

- **NPO (Nothing by Mouth):** NPO status, which includes refraining from eating, drinking, and smoking, is crucial before surgery. It helps reduce the risk of aspiration during anesthesia by minimizing gastric secretions. Typically, clients are advised to avoid food for at least six to eight hours and clear liquids for two hours before the procedure. Adherence to NPO guidelines is stressed, as failure to comply can result in surgery cancellation to prevent complications during anesthesia.
- **Intestinal Preparation (Bowel Prep):** In some surgical procedures, such as those involving the colon, intestinal preparation may be necessary. This is often referred to as "bowel prep." Preparation involves the use of laxatives or enemas to cleanse the intestines, reducing the number of bacteria and preventing injury to the colon during surgery.
- **Administration of Regularly Scheduled Medications:** Clients who regularly take prescription and over-the-counter medications should consult with their medical physician and anesthesia provider to determine whether they should continue taking their medications before surgery. Depending on the medication, the indication for the use of the medication, and the surgery being performed, dosing may be adjusted or temporarily withheld to minimize potential complications. See Table 2.3c for a list of medications that are commonly withheld (or have adjusted dosages) prior to surgical procedures.

Table 2.3c. Medications Commonly Withheld or Have Dosage Adjustment Prior to Surgery[29,30]

29. University of Wisconsin Health. (2022). *Perioperative medication management clinical guideline*. https://www.uwhealth.org/cckm/cpg/medications/Perioperative-Medication-Management-Clinical-Pratice-Guideline—August-2022.pdf

30. Bachenheimer, B., Keith, E., & Young, D. (2016). *Medication instructions prior to surgery*. https://docslib.org/doc/9287280/medications-to-hold-prior-to-surgery

Medication Class	Examples	Rationale
ACE Inhibitors	Captopril, Lisinopril	Increase the risk of hypotension during surgery.
Angiotensin Receptor Blockers	Losartan, Valsartan	Increase the risk of hypotension during surgery.
Antacids (non-soluble)	Mylanta, Tums	May increase the risk of aspiration during surgery.
Anticoagulants	Coumadin, Eliquis	Can increase risk of bleeding during surgery. It is important to determine why the client is taking an anticoagulant, and the provider weighs the risks versus benefits.
Antihyperlipidemic Agents (non-statins)	Zetia, Fenofibrate	Can increase the risk of bowel obstruction and rhabdomyolysis.
Antiplatelets	Aspirin, Plavix	Can increase risk of bleeding during surgery. It is important to determine why the client is taking an antiplatelet, and the provider weighs the risks versus benefits.
Diuretics	Furosemide, Hydrochlorothiazide	Increase the risk of hypokalemia, as well as low blood pressure. Diuretics may be continued if the client is taking them for heart failure (as opposed to hypertension).
Herbal Supplements	Chamomile, Ginkgo Biloba	Can increase risk of bleeding and/or interfere with anesthesia.
Insulin: Intermediate and Long-Acting	NPH, Lantus	Not held, but dose is generally decreased by 50% on day of surgery to prevent hypoglycemia.
Insulin: Rapid- and Short-Acting	Lispro, Regular	Can increase the risk of hypoglycemia.
Oral Antidiabetics	Glyburide, Metformin	Can increase the risk of hypoglycemia.
NSAIDs	Ibuprofen, Naproxen	Can increase risk of bleeding during surgery.
Triptans	Sumatriptan, Rizatriptan	When taken in conjunction with other common preoperative medications (such as Zofran), serotonin syndrome can occur.

Interventions

Nurses perform many interventions during the perioperative period. Common interventions are described in the following subsections.

COLLABORATE WITH THE INTERPROFESSIONAL TEAM TO PREPARE THE CLIENT FOR SURGERY

As previously discussed, nurses are responsible for conducting preoperative assessments, gathering client history, and performing physical examinations to identify any potential risks or complications. Based on the assessment findings, nurses collaborate with the health care team to ensure the client is in optimal condition for the procedure. They collaborate and communicate effectively to ensure a smooth transition from the preoperative period to the operating room.

PROVIDE EMOTIONAL SUPPORT

Nurses provide emotional support and reassurance to clients and their families during the preoperative period. They address client fears, anxiety, and concerns by actively listening, showing empathy, and utilizing therapeutic communication techniques. Nurses create a supportive environment to alleviate anxiety, promote trust, and improve the overall surgical experience.

PERFORM PREOPERATIVE PREPARATIONS

Nurses ensure that all necessary preoperative preparations are completed. This involves arranging for diagnostic tests, preparing the surgical site, administering preoperative medications as ordered, and ensuring that the client is ready for transportation to the operating room. Nurses pay close attention to detail and adhere to infection control practices to maintain client safety.[31,32,33]

Proper skin preparation is vital in preventing surgical wound infections by eliminating or reducing the number of microorganisms on the skin. This generally entails cleansing the entire body with antiseptic wipes (i.e., chlorhexidine wipes) prior to surgery. Some providers may also require clients to shower with antiseptic soap preoperatively. After the skin is cleansed, bed linens are to be changed, and the client is placed in a clean gown.

Nurses typically complete standardized documentation referred to as a

31. American Society of Anesthesiologists. (n.d.). *Preparing for surgery: Checklist*. https://www.asahq.org/madeforthismoment/preparing-for-surgery/prep/preparing-for-surgery-checklist/

32. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

33. Cumberland, E. (2022). Preparing for surgery? What you need to know. Mayo Clinic Health System. https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/preparing-for-surgery-what-you-need-to-know

"Preoperative Checklist" when preparing a client for surgery. See an example of a preoperative checklist in the following box.

> See an example of a Preoperative/Pre Procedure Checklist.

DOCUMENT AND IMPLEMENT OTHER SAFETY MEASURES

Nurses are responsible for accurate documentation in the preoperative period. They document all assessments, interventions, and client responses according to established protocols and guidelines. Nurses also implement safety measures, such as verifying client identification, confirming surgical site markings, and conducting time-outs to prevent wrong-site surgeries.[34,35,36]

PROVIDE HEALTH TEACHING ABOUT POSTOPERATIVE PROCEDURES

Nurses teach clients about the surgical process and what to expect. They explain the procedure, address any concerns or questions, and provide instructions on preoperative preparations such as fasting, medication restrictions, and hygiene practices. Nurses ensure that clients understand the importance of following these instructions for a safe and successful surgery.

Clients may have various tubes, drains, or vascular access devices inserted

34. Mathenge, C. (2020). The importance of the perioperative nurse. *Community Eye Health, 33*(110), 44-45. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8115701/

35. ACORN. (n.d.). *Nursing roles.* https://www.acorn.org.au/nursing-roles

36. Hicks, R. W. (2021). Looking into perioperative nurses' other roles. *AORN Journal, 114*(4), 290-293. https://doi.org/10.1002/aorn.13514

before, during, and after surgery. Examples include nasogastric (NG) tubes for gastric decompression, intravenous (IV) access for administering fluids and medications, and surgical drains to remove excess fluids. Providing education about the purpose of these devices, their expected duration, and any necessary care or monitoring can help alleviate client anxiety and improve understanding.

Health teaching about anticipated postoperative care plays a vital role in promoting optimal recovery and preventing complications following surgical procedures. By providing comprehensive and tailored education, health care professionals empower clients to actively participate in their own care, minimize complications, and support a smooth recovery process. See Table 2.3d for information regarding common topics for health teaching related to surgery.[37,38,39,40]

37. American Society of Anesthesiologists. (n.d.). *Preparing for surgery: Checklist*. https://www.asahq.org/madeforthismoment/preparing-for-surgery/prep/preparing-for-surgery-checklist/

38. Cumberland, E. (2022). Preparing for surgery? What you need to know. Mayo Clinic Health System. https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/preparing-for-surgery-what-you-need-to-know,

39. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

40. Agency for Healthcare Research and Quality. (2017). *Getting ready for your ambulatory surgery*. https://www.ahrq.gov/hai/tools/ambulatory-surgery/sections/implementation/training-tools/getting-ready.html

Table 2.3d. Health Teaching About Postoperative Procedures[41,42,43,44]

41. American Society of Anesthesiologists. (n.d.). *Preparing for surgery: Checklist*. https://www.asahq.org/madeforthismoment/preparing-for-surgery/prep/preparing-for-surgery-checklist/

42. Cumberland, E. (2022). Preparing for surgery? What you need to know. Mayo Clinic Health System. https://www.mayoclinichealthsystem.org/hometown-health/speaking-of-health/preparing-for-surgery-what-you-need-to-know

43. Smetana, G. W. (2022). Preoperative medical evaluations of the healthy adult patient. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

44. Agency for Healthcare Research and Quality. (2017). *Getting ready for your ambulatory surgery*. https://www.ahrq.gov/hai/tools/ambulatory-surgery/sections/implementation/training-tools/getting-ready.html

Postoperative Procedures	Description
Prevention of Respiratory Complications	
Breathing Exercises and Incentive Spirometry (IS)	Explain and demonstrate deep breathing exercises and incentive spirometry to promote lung expansion, improve oxygenation, and prevent **atelectasis**. View a video on IS using the information in the box below this table.
Coughing and Splinting	Explain and demonstrate techniques to effectively cough and splint incision site for clearing airway secretions.
Prevention of Cardiovascular Complications	
Anti-Embolism Stockings (TED Hose)	Explain the use of compression stockings to prevent venous stasis and **Deep Vein Thrombosis (DVT)**. Teach signs of deep vein thrombosis to report to the health care provider, such as calf pain, unilateral swelling, and/or redness.
Sequential Compression Devices (SCD)	Explain devices providing intermittent compression to prevent venous stasis and DVT. Teach the signs of DVT.
Leg Exercises and Mobility	Encourage leg exercises and early mobilization to enhance blood flow and reduce cardiovascular complications, including DVT.
Infection Prevention	
Incision Care	Provide instructions on how to care for the surgical incision and how to keep it clean and dry. Teach signs of infection, dehiscence, and poor wound healing to report to the health care provider.
Hand Hygiene	Emphasize the importance of frequent handwashing or using hand sanitizer to prevent infection.
Antibiotics	Educate regarding the importance of completing the full course of postoperative antibiotics, if prescribed.
Avoiding Contamination	Provide guidance on avoiding unnecessary touching of the incision site and protecting it from contamination of potentially infectious substances.
Immunizations	Discuss the importance of staying up-to-date with recommended vaccinations.
Pain Control	
Medication Management	Provide detailed instructions on prescribed pain medications, dosage, and potential side effects.
Nonpharmacological Techniques	Explain nonpharmacological pain relief strategies.

Activity and Rest	Reinforce postoperative activity restrictions and promote safe mobility with assistive devices, as indicated. Provide guidance on balancing rest and gradually increasing activity levels.
Positioning and Support	Teach proper positioning techniques for enhanced comfort and pain reduction.
Pain Assessment	Educate clients on pain scales and encourage accurate communication of pain levels.
Prevention of Gastrointestinal and Genitourinary Complications	
Diet Advancement	Explain that it is common for bowel function to slow down or stop after surgery and the diet order will typically advance from clear liquids as bowel sounds return and the client passes flatus.
Prevention and Treatment of Constipation	Explain that constipation is common postoperatively and can be prevented and treated with early ambulation, increased fluids and a high-fiber foods as the diet is advanced postoperatively, and administration of prescribed stool softeners. Notify the health care provider if no bowel movement occurs within two or three days after surgery.
Prevention of Urinary Complications	Encourage fluids and monitor urine output and color. Notify the health care provider of low urine output or symptoms of urinary tract infection such as frequency, burning, or malodorous urine.

View a supplementary YouTube video[45] on how to use an incentive spirometer: How to Use an Incentive Spirometer.

ADMINISTER PREOPERATIVE MEDICATIONS

Preoperative medication administration is carefully tailored to the individual client based on various factors such as age, physical and psychological condition, medication history, height and weight, other medications being taken, and the specific surgical procedure. The selection of preoperative medications aims to address different aspects of the client's needs and

45. Keck Medicine of USC. (2021, March 12). *How to use an incentive spirometer* [Video]. YouTube. All rights reserved. https://youtu.be/RZweq_SKLTA?si=-o5GwLlh027nlMUI

optimize their surgical experience.[46] Be sure that informed consent has been signed before administering any medications that may alter thinking processes. Table 2.3e summarizes common preoperative medications.

Table 2.3e. Common Preoperative Medications[47,48,49]

46. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

47. Muluk, V., Cohn, S. L., & Whinney, C. (2023). Perioperative medication management. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

48. Euteneuer, F., Kampmann, S., Rienmüller, S., Salzmann, S., & Rüsch, D. (2022). Patients' desires for anxiolytic premedication – An observational study in adults undergoing elective surgery. *BMC Psychiatry, 22*, 193. https://doi.org/10.1186/s12888-022-03845-y

49. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Pre-Medication	Medications	Rationale
Anxiolytics	Diazepam (Valium)	Reduces anxiety and promotes a state of relaxation and calmness before surgery
Sedatives/Hypnotics	Midazolam (Versed)	Induces relaxation, alleviates preoperative stress, and creates a more comfortable environment for the client
Anticholinergics	Atropine	Reduces nasal and oral secretions, maintaining a clear airway during surgery
Anticholinergics	Glycopyrrolate	Prevents laryngospasm by blocking the effects of the parasympathetic nervous system, ensuring a patent airway
Vagal Blockers	Atropine	Decrease vagal-induced bradycardia, which can cause a slowing of the heart rate due to stimulation of the vagus nerve
Antiemetics	Ondansetron	Prevents postoperative nausea and vomiting
Induction Agents	Propofol	Decreases the amount of anesthetic required for the induction and maintenance of anesthesia, ensuring more stable anesthesia and outcomes
Antibiotics	Cefazolin (Ancef)	Prevents surgical site infections by administering prophylactic antibiotics approximately 60 minutes before the incision is made

To reduce anxiety, anxiolytics may be administered to help calm and relax the client.[50] Sedatives or hypnotics may also be used to promote relaxation and alleviate any preoperative stress or apprehension. These medications help create a more comfortable environment for the client and facilitate a smoother transition into the operating room.

Anticholinergics may be given to reduce nasal and oral secretions, which can help maintain a clear airway during surgery. Additionally, anticholinergics can help prevent laryngospasm, a condition where the vocal cords spasm and cause difficulty in breathing. By blocking the effects of the parasympathetic

50. Euteneuer, F., Kampmann, S., Rienmüller, S., Salzmann, S., & Rüsch, D. (2022). Patients' desires for anxiolytic premedication – An observational study in adults undergoing elective surgery. *BMC Psychiatry, 22,* 193. https://doi.org/10.1186/s12888-022-03845-y

nervous system, anticholinergics minimize secretions and help maintain a patent airway.[51,52]

Another important consideration is the use of medications to address specific physiological responses. These medications can reduce vagal-induced bradycardia, which is a slowing of the heart rate caused by stimulation of the vagus nerve. Additionally, H2 blockers may be administered to inhibit gastric secretion, reducing the risk of aspiration and other gastrointestinal complications during surgery.[53,54]

In some cases, preoperative medications can help decrease the amount of anesthetic needed for the induction and maintenance of anesthesia. This can lead to more stable anesthesia and improved client outcomes.[55,56]

Lastly, administration of antibiotics is a crucial step in preventing surgical site infections. Antibiotics are typically given approximately 60 minutes prior

51. Muluk, V., Cohn, S. L., & Whinney, C. (2023). Perioperative medication management. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

52. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

53. Muluk, V., Cohn, S. L., & Whinney, C. (2023). Perioperative medication management. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

54. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

55. Muluk, V., Cohn, S. L., & Whinney, C. (2023). Perioperative medication management. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

56. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

to the incision to ensure adequate levels are present in the client's system to combat any potential bacteria introduced during the surgical procedure.[57,58]

Overall, the selection and administration of preoperative medications are carefully determined based on individual client needs, aiming to optimize client comfort, safety, and surgical outcomes. It is important for health care professionals to closely assess each client and consider their unique circumstances when determining the appropriate preoperative medication regimen.[59,60]

Evaluation and Perform Final Checks Prior to Surgery

Evaluation focuses on the effectiveness of the nursing interventions by reviewing the client's expected outcomes to determine if they were met by the time frames indicated. During the evaluation phase, nurses use critical thinking to analyze reassessment data and determine if a client's expected outcomes have been met, partially met, or not met by the time frames established. If outcomes are not met or only partially met by the time frame indicated, the care plan should be revised. Reassessment should occur every time the nurse interacts with a client, reviews updated laboratory or

57. Muluk, V., Cohn, S. L., & Whinney, C. (2023). Perioperative medication management. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

58. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

59. Muluk, V., Cohn, S. L., & Whinney, C. (2023). Perioperative medication management. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

60. Khorsand, S. M. (2023). Maintenance of general anesthesia: Overview. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

diagnostic test results, or discusses the care plan with others on the interprofessional team.

The nurse plays a crucial role in ensuring that the client's chart preparation is finalized before surgery to facilitate a smooth and safe surgical experience. It is the nurse's responsibility to meticulously review the client's chart, ensuring that all documentation, preoperative procedures, and orders are complete and up-to-date. This includes verifying that the surgical consent form and other relevant documents are properly filled out and signed by the client. Additionally, the nurse should carefully document and promptly report any abnormal test results or findings that may impact the client's surgical course. By effectively communicating special needs and concerns to the surgical team, the nurse contributes to a comprehensive understanding of the client's condition and ensures that appropriate interventions and accommodations are in place. Through their attention to detail and proactive approach, nurses play a crucial role in ensuring that the client's chart is thoroughly prepared, minimizing potential risks and maximizing the overall quality of care during the surgical process.

Prior to surgery, it is essential to finalize the preparation of the client to ensure a safe and efficient surgical experience. The nurse plays a key role in this process by ensuring that the client is appropriately dressed in a hospital gown, which allows for easy access to the surgical site while maintaining their privacy. To prevent loss or damage, the nurse ensures that no valuables are on the client and advises them to tape their rings in place if they cannot be removed. All pierced jewelry is removed to minimize the risk of injury during surgery. The nurse confirms that the client's identification (ID) and allergy bands are securely fastened to ensure accurate client identification and prevent adverse reactions. Dentures are removed, as well as glasses/contacts and hearing aids. Additionally, the nurse instructs the client to empty their bladder before the surgery to promote comfort and prevent potential complications during the procedure.

2.4 Intraoperative Nursing Care

The **intraoperative period** is a critical phase in the client's surgical journey, encompassing the time from when the client is wheeled into the operating room until they are transferred to the Post-Anesthesia Care Unit (PACU), Same-Day Surgery Suite, or Intensive Care Unit (ICU) following the surgical procedure. See Figure 2.5[1] for an image of intraoperative care. During this phase, nurses play a pivotal role in ensuring safety, promoting well-being, and advocating for the client.



Figure 2.5 Intraoperative Care

In the intraoperative environment, nurses perform a wide range of essential tasks to provide comprehensive care to clients undergoing surgery. Nurses in the intraoperative environment must be highly skilled, detail-oriented, and

1. "Cardiac_surgery_operating_room.jpg" by Pfree2014 is licensed under CC BY-SA 4.0

capable of working efficiently in a fast-paced and high-stress setting to ensure the best possible outcomes for their clients.

One of the primary safety goals of nursing staff during the intraoperative period is to maintain a vigilant, safe, and controlled environment. They work collaboratively with the surgical team to confirm the client's identity, verify the surgical site through a "time-out" procedure, and ensure all necessary equipment and supplies are readily available.

The **surgical time-out** is a safety procedure that includes a purposeful pause before all surgeries begin. It is performed to address one of The Joint Commission's National Patient Safety Goals to reduce mistakes in surgery. During the surgical time-out, the entire operating room team reviews the client's identity, the procedure, and the location of the surgical site to prevent wrong-site, wrong-procedure, and wrong-person errors. The time-out is also a time designated for team members to voice any concerns about the client's safety or the procedure.[2,3]

Monitoring

Nurses assist with continual monitoring and documenting of the client's vital signs, anesthesia levels, and responses to the surgical intervention and assist with identifying the development of potential complications.

Ensuring adequate ventilation and oxygenation during surgery are essential for preventing respiratory complications and maintaining client safety throughout the intraoperative period. The nurse collaborates closely with the anesthesia provider to address any signs of hypoventilation

2. Freundlich, R. E., Bulka, C. M., Wanderer, J. P., Rothman, B. S., Sandberg, W. S., & Ehrenfeld, J. M. (2020). Prospective investigation of the operating room time-out process. *Anesthesia and analgesia, 130*(3), 725–729. https://doi.org/10.1213/ANE.0000000000004126

3. Johns Hopkins Medicine. (n.d.). *Surgical team*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/the-surgical-team

promptly. Nurses continuously monitor the client's vital signs, including heart rate, blood pressure, oxygen saturation, and respiratory rate, as well as the client's breathing pattern and end-tidal carbon dioxide (ETCO2) levels, to detect any deviations from normal and to promptly address any changes to prevent hypoventilation. These assessments are typically documented every five minutes to detect any deviations from the baseline.[4]

Intraoperative Nursing Interventions

Intraoperative nursing interventions play a critical role in ensuring the safety and well-being of clients undergoing surgical procedures. Throughout the intraoperative period, nurses are actively involved in a range of essential tasks aimed at optimizing client outcomes and preventing complications. By diligently following established protocols and collaborating closely with the surgical team, intraoperative nurses contribute significantly to creating a safe and conducive environment for surgical interventions. The role of the intraoperative nurse is multifaceted and includes actions described in the following subsections.[5]

Setup and Maintain Sterile Fields

Nurses in the intraoperative scrub role help set up the sterile field in the operating room, ensuring that all necessary surgical instruments, drapes, and supplies are properly arranged. They ensure the integrity of the sterile field is maintained throughout the procedure to prevent contamination and

4. Salazar, A. M. (2022). Nursing care during the perioperative period within the surgical context. *Investigacion y Educacion en Enfermeria, 40*(2), e02. https://doi.org/10.17533/udea.iee.v40n2e02

5. Salazar, A. M. (2022). Nursing care during the perioperative period within the surgical context. *Investigacion y Educacion en Enfermeria, 40*(2), e02. https://doi.org/10.17533/udea.iee.v40n2e02

minimize the risk of surgical site infections. See Figure 2.6[6] for an image of surgical instruments set up on a sterile field in the operating room.



Figure 2.6 Surgical Instruments Setup on a Sterile Field

Infection control measures are meticulously implemented to minimize the risk of surgical site infections such as scrupulous handwashing, absolute sterile technique, and personal protective equipment.

6. "US Navy 110825-N-EP471-069 Hospital Corpsman 2nd Class Amanda Fletcher assists Lt. Cmdr. Timothy Mickel as he performs finger surgery on a Haitian.jpg" by U.S. Navy photo by Mass Communication Specialist 1st Class Kim Williams is licensed in the Public Domain.

Advocate for the Client

Advocating for the client's safety and well-being is a central responsibility of intraoperative nurses. They verify the client's identity, surgical site, and presence of the signed informed consent form before the surgery begins. During the surgery, they ensure safety protocols are followed and facilitate communication among the surgical team members to ensure a safe and efficient surgical environment.

Nurses serve as the client's voice when they are under anesthesia, advocating for their best interests and ensuring their rights and preferences are respected. This involves effective communication with the client's family or designated representatives and conveying relevant information about the surgical procedure. The nursing staff also collaborates closely with the anesthesia team to effectively manage pain and discomfort, ensuring a smooth transition to the postoperative phase.

Position Client to Prevent Injury

Proper client positioning is crucial during the intraoperative period to prevent injury and optimize surgical access. Nurses play a vital role in assisting the surgical team in positioning the client safely. The nurse ensures the appropriate position is achieved and maintained throughout the surgical procedure, which may involve using stirrups or placing the client in a prone position to expose the surgical site adequately. Common surgical positions include supine, lateral, prone, Fowler's, and lithotomy positions.[7] The **lithotomy position** enhances access to the pelvic organs. The client is placed on their back with their buttocks at the edge of the table and their legs abducted 30 to 45 degrees from the midline. The patient's knees and hips are flexed to about 90 degrees and supported with stirrups or padded leg

7. Armstrong, M., & Moore, R. A. (2022). Anatomy, patient positioning. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513320

holders. See an illustration of the lithotomy position in Figure 2.7.[8] and additional information about other positions using the information in the following box.



Figure 2.7 Lithotomy Position

8. "Lithotomy_position_01.jpg" by Saltanat ebli is licensed under CC0, Public Domain.

Review common positions in the "Basic Concepts" section of the "Mobility" chapter in Open RN *Nursing Fundamentals, 2e*.

Careful attention is given to techniques to prevent postoperative complications associated with positioning, which can include nerve damage, pressure injuries, or musculoskeletal strain. Frequent assessments are also performed throughout the procedure to detect any signs of potential injury or discomfort, allowing for timely adjustments to maintain client safety and well-being.[9]

To prevent complications related to client positioning, nurses take measures to reduce pressure on vulnerable areas by using padding and gel pads to cushion bony prominences. Regular skin assessments are conducted to identify areas of potential skin breakdown or pressure injuries. By diligently applying these preventive strategies, the nurse aims to minimize the risk of pressure injuries and other complications related to client positioning.[10]

Assist the Surgeon

In collaboration with surgical technologists, nurses assist the surgeon by providing instruments and surgical supplies and anticipating the surgeon's needs to maintain a smooth workflow.

9. Salazar, A. M. (2022). Nursing care during the perioperative period within the surgical context. *Investigacion y Educacion en Enfermeria, 40*(2), e02. https://doi.org/10.17533/udea.iee.v40n2e02

10. Salazar, A. M. (2022). Nursing care during the perioperative period within the surgical context. *Investigacion y Educacion en Enfermeria, 40*(2), e02. https://doi.org/10.17533/udea.iee.v40n2e02

Administer Medications

Under the supervision of the anesthesia team, nurses may administer medications, fluids, and blood products as required during the surgery.

Document Procedures

Accurate documentation is essential for proper client care and recordkeeping. Nurses document the details of the surgery, anesthesia, medications, and any significant events that occur during the intraoperative period.

Communicate With the Surgical Team

Effective communication among all members of the surgical team is crucial for seamless coordination. Nurses actively communicate with the surgeon, anesthesiologist, and other team members to ensure everyone is well-informed with consistent knowledge about the client's status.

Nurses also collaborate with the surgical team to ensure that the surgical incision is closed securely, and drains are functioning properly. Vigilant monitoring of the wound site for signs of complications allows for early intervention and appropriate management.[11]

Handoff Care

As the surgical procedure concludes, nurses prepare the client for transfer to the postanesthesia care area, ensuring a smooth handoff of care.[12]

11. Salazar, A. M. (2022). Nursing care during the perioperative period within the surgical context. *Investigacion y Educacion en Enfermeria, 40*(2), e02. https://doi.org/10.17533/udea.iee.v40n2e02

12. Benze, C., Spruce, L., & Groah, L. (2021). *Perioperative nursing: Scope and standards of practice.* AORN. https://www.aorn.org/docs/default-source/

guidelines-resources/periop-nursing-scope-standards-of-practice.pdf?sfvrsn=c532cdee_1

2.5 Postoperative Nursing Care

The **postoperative period** is a crucial phase that begins after the surgical procedure is completed and the client is transferred to the Post-Anesthesia Care Unit (PACU), specialty care areas, or the Intensive Care Unit (ICU).

Care in the Post-Anesthesia Care Unit or Intensive Care Unit

The postoperative journey consists of three distinct phases, each with specific focuses and goals. Phase I occurs in the PACU or ICU, with close monitoring of the client's airway, vital signs, and recovery indicators taking precedence. Vigilant observation is essential as clients emerge from anesthesia, ensuring their safe transition and stabilization.

As the client progresses to Phase II, the focus shifts towards preparing them for transfer to the Medical-Surgical (MS) unit or extended-care environment. During this phase, the nurse assesses the client's level of consciousness, establishes baseline oxygen saturation, and ensures that vital signs remain stable.

In Phase III, the client transitions to an extended-care environment, either within the Medical-Surgical unit, skilled care facility, or the client's home.[1]

In the PACU, a specialized team of nurses skillfully attends to clients with diverse medical and surgical conditions. PACU nurses possess in-depth knowledge of anatomy and physiology, various anesthetic agents and medications, and pain management. They play a pivotal role in guiding clients through the process of extubation and possess advanced life support skills (ACLS) to manage any emergent situations that may arise during the recovery period. In this manner, PACU nurses help ensure successful

1. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

postoperative outcomes and facilitate clients' transition from the intraoperative environment to a smooth recovery process.[2]

The immediate postoperative recovery phase requires seamless communication and attention to critical details to ensure client safety and optimal outcomes. The PACU RN must receive clear and thorough information from the operating room/anesthesia staff and a detailed handoff report from the operating room RN to effectively manage the client's recovery and address any complications that may arise. By closely monitoring vital signs, fluid balance, and surgical site management, the PACU RN can provide timely interventions and support for clients during this crucial phase of the postoperative journey.

Transfer to Medical-Surgical Unit

After the client is considered stable in the PACU, the client is transferred to a Medical-Surgical Unit or Intensive Care Unit (ICU), based on their clinical status, and the PACU RN provides a handoff report to the receiving nurse.

Critical components of the handoff report from the PACU RN to the floor nurse include the following[3]:

- Physical Assessment data, such as pain and level of consciousness
- Type/Extent of Procedure
- Anesthesia Type/Duration
- Allergies
- Health Problems
- Vital Signs Status
- IV Fluids/Medications
- Estimated Blood Loss (EBL)

2. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

3. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

- Urine Output
- Drain Placement and Output
- Intraoperative Complications
- Primary Language/Sensory Impairments
- Special Client Requests
- Incisions/Dressings
- Prescribed Activity Restrictions or Joint/Limb Immobility
- Low Hemoglobin Management

Applying the Nursing Process to Postoperative Care

During the postoperative care period, reestablishing the client's physiologic balance, managing pain and discomfort, preventing complications, and providing health teaching are priorities of nursing care. The nurse performs focused assessments and provides immediate interventions in assisting the client to attain optimal function quickly, safely, and comfortably as possible.

Postoperative nurses assess for potential complications and implement postoperative care measures, such as pain management, post anesthesia care, and wound care. They ensure adequate fluid balance and tissue perfusion and continue to provide emotional support to the client and their family members during the recovery process. They also provide appropriate health teaching before discharge home.

Routine Postoperative Assessment

Postoperative assessments and monitoring ensure the well-being and recovery of clients upon arrival to the Medical-Surgical Unit. Upon arrival at the Medical-Surgical Unit, a complete head-to-toe assessment is performed. A second nurse may assist with performing a skin assessment.

The respiratory system receives priority as nurses closely monitor for adequate gas exchange. Nurses closely monitor vital signs and perform thorough cardiovascular and peripheral vascular assessments to monitor for

any potential complications that may have occurred as a result of positioning and compromised circulation.[4]

Pain management also receives priority postoperatively, and nurses assess pain levels regularly to administer appropriate interventions and ensure client comfort. Psychosocial assessments are also valuable in identifying emotional or psychological needs the client may have during the recovery process.[5]

Assessing wound sites for signs of infection, bleeding, dehiscence, or poor healing is crucial in ensuring successful surgical outcomes.[6] Typically, the surgical incision is covered after surgery, and the first dressing change is performed by the surgeon. Until that time, the nurse assesses the dressing covering the incision to ensure it is intact, and there are no signs of excessive bleeding.

Neurological assessments focus on cerebral functioning and level of consciousness. Nurses observe for signs of lethargy or restlessness and the client's response to verbal stimuli to gauge wakefulness and cognition. Motor and sensory assessments help identify any deficits or complications related to anesthesia and nerve function.[7]

Maintaining fluid balance and monitoring electrolyte levels are essential to prevent imbalances that may arise due to anesthesia or fluid loss during surgery. Nurses carefully track kidney and urinary system function, as

4. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

5. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

6. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

7. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

anesthesia may delay urine output. A urinary output of less than 30 mL/hour should be reported promptly.[8]

Gastrointestinal assessments include monitoring for nausea and vomiting, a common side effect of general anesthesia. Clients often experience decreased peristalsis after surgery due to the effects of anesthesia and opioid analgesics, especially in clients experiencing abdominal or pelvic surgery, so the client must be monitored for constipation. The return of flatus and a bowel movement are the best indicators of gastrointestinal recovery.[9] Nurses administer stool softeners and/or laxatives as prescribed or advocate for these medications if needed.

Laboratory evaluations, such as electrolyte levels, white blood cell count, and hemoglobin, provide additional insights into the client's overall condition. An increase in neutrophils (also referred to as a "left shift") may indicate an inflammatory response to surgery or infection.[10]

See Table 2.5a for an overview of routine focused assessments on clients upon arrival to the Medical-Surgical Unit after discharge from the PCU.

8. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

9. Eipe, N. (2022). Anesthesia for the patient with obesity. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

10. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Table 2.5a. Routine Focused Assessments Upon Arrival to the Medical-Surgical Unit[11,12]

11. Nursing Times. (2013). *Postoperative care 1: Principles of monitoring postoperative patients*. https://www.nursingtimes.net/clinical-archive/critical-care/postoperative-care-1-principles-of-monitoring-postoperative-patients-31-05-2013/

12. Ignativicious, D., Workman, M. L., & Rebar, C. R. (2018). *Medical-surgical nursing* (9th ed.). Elsevier.

System/Area	Focused Assessment
Respiratory	• Is the airway patent? • What is the quality and pattern of breathing, respiratory rate and depth, lung sounds, and pulse oximetry level compared to baseline? • Is oxygen being administered? If so, what is the ordered method of delivery and flow rate? Is it set accurately?
Cardiovascular	• Are the blood pressure, heart rate, heart rhythm, and capillary refill within the client's baseline range? • Are the peripheral pulses palpable? • Is there unilateral redness, warmth, or pain indicative of a deep vein thrombosis?
Temperature	• Is the client's temperature significantly different from baseline and/or PACU? Clients who were in surgery for a long period of time are at risk for hypothermia, especially children and older adults. Adjust ambient room temperature and provide warmed blankets, as indicated, for client comfort. Elevated temperature can be a sign of infection or malignant hyperthermia, a complication of general anesthesia.

Neurological	• Is the client awake, aware of their surroundings, and oriented x 3 within their baseline range? • What is the client's level of pain and/or other level of discomfort? In addition to asking the client to rate and describe their pain, include assessment of objective signs of pain, such as increased heart rate, blood pressure, and respiratory rate; restlessness; profuse sweating; confusion in older adults; grimacing; guarding; moaning; and crying. Note that positioning during surgery can cause pain. A supine position may cause low back pain, and lateral chest position can cause shoulder and neck pain.
Gastrointestinal	• Is the client experiencing nausea and/or vomiting, a common side effect of anesthesia? • Is abdominal distension present? • Are bowel sounds present in all four quadrants? • Is the client passing flatus or stool? • Is a nasogastric tube in place? If so, is suction applied to the correct setting, if ordered? What is the color, consistency, and amount of drainage?
Genitourinal	• Was a Foley catheter placed for surgery? If so, what is the color, clarity, and amount of urine? • If a Foley was placed and then removed postoperatively, has the client voided yet?

Surgical Site and Skin	• What dressing was applied to the surgical site? Is it intact and dry? • Is there bleeding or drainage on the dressing? • Are any pressure injuries present? Assess bony prominences and areas experiencing pressure during positioning during surgery. Note that supine position may cause pressure injuries on heels, elbows, or sacrum.
Fluid/ Electrolyte Balance	• Was an IV infusion in place on arrival to the unit from the PACU? If so, how much was infused? • Have other postoperative IV fluids been ordered? If so, what type and what is the ordered rate of infusion? Has it been set yet? • Have postoperative lab tests been ordered? If so, have they been performed and what are the results? Common tests include complete blood count, electrolytes, and kidney function tests.
Other Equipment	• Are drains present? If so, are they set properly? How much drainage is present and what are its characteristics? • Is other postoperative equipment ordered, such as sequential compression devices (SCDs) or orthopedic devices? If so, are they applied appropriately?
Psychosocial	• Have the client's and family members' psychological, social, cultural, and spiritual responses to surgery been adequately addressed? Indications of anxiety include restlessness, crying, and increased blood pressure, heart rate, and respiratory rate.

Nursing Diagnoses for Postoperative Care

Nursing diagnoses for postoperative clients are customized based on the client's assessment data and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions.[13] Common nursing diagnoses related to postoperative care include the following:

- Risk for Impaired Gas Exchange
- Acute Pain
- Nausea
- Impaired Skin Integrity
- Risk for Fluid Imbalance
- Risk for Inadequate Tissue Perfusion
- Risk for Infection
- Risk for Constipation
- Readiness for Enhanced Knowledge

> Review information about creating nursing diagnoses in the "Diagnosis" section of the "Nursing Process" chapter of Open RN *Nursing Fundamentals, 2e*.

Outcome Identification

Nursing care should always be individualized and client centered. No two people are the same, and neither should nursing care plans be the same for two people. Goals and outcomes should be tailored specifically to each client's needs, values, and cultural beliefs. Clients and family members should

13. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

be included in the goal-setting process when feasible. Involving clients and family members promotes awareness of identified needs, ensures realistic goals, and motivates their participation in the treatment plan to achieve the mutually agreed upon goals and live life to the fullest with their current condition.[14]

Outcome identification includes setting short- and long-term goals and creating specific expected outcome statements for nursing diagnoses identified for the client. Goals are broad, general statements, and outcomes are specific and measurable. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.[15]

Outcome statements are always client centered. They should be developed in collaboration with the client and individualized to meet a client's unique needs, values, and cultural beliefs. They should start with the phrase "*The client will…*" Outcome statements should be directed at resolving the defining characteristics for that nursing diagnosis. Additionally, the outcome must be something the client is willing to cooperate in achieving. Outcome statements should also contain five components easily remembered using the "SMART" mnemonic[16]:

- Specific
- Measurable
- Attainable/Action oriented
- Relevant/Realistic
- Time frame

14. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

15. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

16. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals//

Review information about establishing outcomes in the "Outcome Identification" section of the "Nursing Process" chapter in Open RN *Nursing Fundamentals, 2e*.

Sample expected outcomes for common nursing diagnoses related to postoperative are as follows:

- *The client will report pain is controlled at an acceptable level to them (i.e., typically rated as 3 or less on a pain intensity rating scale of 0 to 10).*
- *The client's surgical wound will remain well-approximated.*
- *The client will remain free from infection.*

Planning Postoperative Nursing Interventions

Nursing interventions are customized based on the type of surgery and the nursing diagnoses previously established for the client based on the postoperative assessment(s). Routine nursing interventions for postoperative clients are outlined by body system in Table 2.5b.

Table 2.5b. Routine Postoperative Nursing Interventions

System	Routine Interventions
Respiratory	Closely monitor respiratory status per agency policy. Administer oxygen therapy as prescribed. Teach how to cough and deep breathe or use the incentive spirometer hourly, if prescribed. Teach the client how to splint the surgical area as indicated. Review information about promoting oxygenation and incentive spirometry in the "Oxygenation" chapter of Open RN *Nursing Fundamentals, 2e*. Assist the client out of bed and ambulate as soon as possible, according to agency policy and provider orders, to promote ventilation, remove secretions, and prevent atelectasis and pneumonia.
Cardiovascular	Administer prophylactic interventions for prevention of clots and DVTs as prescribed. Interventions may include anticoagulant therapy, sequential compression devices (SCD), anti-embolism stockings (i.e., TED hose), and early ambulation. Continue to monitor for signs of DVT and promptly report any concerns to the health care provider. Instruct the client to request assistance when transferring out of bed due to potential orthostatic hypotension and risk for falls.
Neurological	Assess mental status every shift. Encourage use of sensory assistive devices such as hearing aids and eyeglasses. Manage pain using prescribed pain medications and nonpharmacological strategies. Review the "Pain Management" section in the "Comfort" chapter in Open RN *Nursing Fundamentals, 2e* for more information.
Gastrointestinal	Administer antiemetics as indicated for nausea and vomiting. Administer stool softeners and/or laxatives as indicated for constipation. Ensure adequate hydration and mobility to assist in the return of peristalsis postoperatively. Progress the client's diet as prescribed from NPO to clear liquids to full liquids to regular diet as indicated. Review information about antiemetics and laxatives in the "Gastrointestinal" chapter in Open RN *Nursing Pharmacology, 2e*.
Genitourinal	Monitor urine output. If an indwelling catheter was placed for surgery and removed, the client should be anticipated to void within eight hours of removal. If the client does not void within this time frame, additional interventions are required according to agency policies, such as bladder scanning or intermittent urinary catheterization. Review information about "Urinary Retention" in the "Elimination" chapter in Open RN *Nursing Fundamentals, 2e*.
Surgical Site and Skin	Until the surgeon assesses and removes the initial surgical dressing (usually 24-48 hours after surgery), assess the integrity of the dressing and reinforce it as needed. If excessive bleeding is noted, notify the surgeon. Assess the surgical site and perform dressing changes as prescribed by the surgeon after the initial dressing is removed and the incision is assessed by the surgeon. Review information about wound care and dressing changes in the "Wound Care" chapter of Open RN *Nursing Skills, 2e*. See Figure 2.8[17] for an image of a surgical wound from a tibial repair with staples in place. Administer IV antibiotics for infection prophylaxis as prescribed.Assist with repositioning and mobility to prevent skin breakdown.
Fluid/ Electrolyte Balance	Monitor input/output and electrolyte status. Administer IV fluids as prescribed. Review related information in the "Fluids and Electrolytes" chapter of Open RN *Nursing Fundamentals*, 2e
Psychosocial	Encourage verbalization, validate feelings, and promote healthy coping strategies because clients may already be grieving for the loss represented by the surgical procedure, diagnosis, or prognosis of the illness. Review therapeutic techniques in the "Communication" chapter of Open RN *Nursing Fundamentals, 2e*. Refer to chaplain or pastoral care as indicated.

17. "Post_Lateral_Tibial_Plateau_Fracture_Repair_Surgical_Incision_Site_3.jpg" by LottieLattes is licensed under CC BY-SA 4.0



Figure 2.8 Surgical Site

MONITORING FOR POTENTIAL POSTOPERATIVE COMPLICATIONS

Despite careful preoperative care and planning, complications can still occur due to the inherent risks associated with surgery. To address this risk, The Joint Commission has collaborated with various groups and agencies to develop specific measures in the surgical care environment to promote client safety and reduce the chance of surgical complications. Measures include actions such as preventing venous thromboembolism (VTE) and appropriate prophylactic antibiotic administration, among others. These measures

improve quality of care and efficiency during the perioperative experience. By reducing surgical complications, hospitals also avoid costs associated with longer postoperative hospitalizations and readmissions.

Signs and symptoms of postoperative complications must be quickly recognized by nurses and communicated to the health care provider for prescription of timely medical interventions to ensure client well-being and recovery. Table 2.5c summarizes common surgical complications and associated interventions.

Table 2.5c. Common Postoperative Complications, Related Assessments, and Interventions[18,19,20,21]

18. Salazar, A. M. (2022). Nursing care during the perioperative period within the surgical context. *Investigacion y Educacion en Enfermeria, 40*(2), e02. https://doi.org/10.17533/udea.iee.v40n2e02

19. Glick, D. B. (2022). Overview of post-anesthetic care for adult patients. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

20. Conde, M. V., & Adams, S. G. (2021). Overview of the management of postoperative pulmonary complications. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

21. Evans, H. L., & Hedrick, T. L. (2022). Overview and the evaluation and management of surgical site infection. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Complication	Definition	Assessment	Medical and Nursing Interventions
Respiratory Depression	A reduction in respiratory rate commonly associated with opioid and/or anesthesia use.	Respiratory rate less than 12 and decreased pulse oximetry readings.	Administer narcan per provider order, withhold opioids, and/or stop PCA if in use. Provide oxygen and initiate capnography.
Hemorrhage	Excessive bleeding internally or at the surgical site due to blood vessel damage or clotting abnormalities.	If bleeding is present on a dressing, circle the drainage in a permanent marker for follow-up assessments. Decreased blood pressure from baseline with **tachycardia** (heart rate over 100 beats per minute). Cold, clammy skin.	Replace blood volume as prescribed through blood product transfusions or administration of intravenous (IV) fluids. If excessive bleeding occurs at the surgical site, reinforce the dressing and notify the surgeon of how many dressings were saturated.
Paralytic Ileus	Temporary paralysis of the intestines, leading to the absence of bowel sounds and inability to pass flatus or stool.	Absent bowel sounds. No flatus or stool. Abdominal distension and pain. Nausea and vomiting.	Initiate nasogastric tube with suctioning as prescribed to decompress the stomach and intestines. Keep NPO. Administer IV fluids to maintain hydration as indicated.
Atelectasis & Pneumonia	Collapse of alveoli, which can result in pneumonia (infection in the lungs).	**Dyspnea** (shortness of breath). Decreased pulse oximetry readings. Diminished lung sounds and/or presence of crackles **Cyanosis** (bluish skin discoloration). Cough. Tachycardia. Elevated temperature over 100.4 F (38 C). Pain on the affected side.	Perform suctioning, as indicated, to clear airways of secretions. Administer oxygen, as indicated. Encourage frequent position changes to enhance postural drainage and aid in lung expansion. Administer antibiotics, as prescribed, if pneumonia is suspected or confirmed. Encourage early ambulation to promote expansion of lungs and movement of secretions. Teach incentive spirometry and/or coughing and deep breathing.
Infection of Surgical Site	Bacterial or other microbial contamination at the surgical incision site, causing delayed healing.	Redness, warmth, tenderness of surgical site. Increased drainage. Elevated white blood cell count (WBC). Elevated temperature Positive wound cultures.	Administer antibiotics, as prescribed, based on wound culture results. Promote rest and nutritional food choices to support the body's immune response and wound healing.
Dehiscence or Evisceration	Dehiscence: the separation of surgical wound edges, exposing underlying tissues. Evisceration: protrusion of internal organs through a dehisced surgical incision site.	Separation of wound edges.	Notify the surgeon or physician immediately for further evaluation and intervention as necessary. Cover the open wound with a sterile nonadherent or saline dressing to protect underlying tissues until the wound can be assessed by the surgeon. Place the client in a low Fowler's position to reduce tension on the wound. Advise the client to limit movement and avoid coughing, which can increase wound stress. Keep the client NPO (nothing by mouth) in preparation for possible surgical intervention.

Psychosis	Impaired thinking and perception that can be precipitated by anesthesia and opioid pain management.	Disorientation and disordered thinking.	Use therapeutic communication to validate the client's feelings. Reorient client as indicated. Administer medication as prescribed to manage psychosis and stabilize mood and perception.
Cardiovascular Compromise	Issues affecting the cardiovascular system, such as hypotension and shock.	Decreased blood pressure. Increased pulse. Cold, clammy skin.	Identify and treat the underlying cause of the cardiovascular compromise. Provide oxygen therapy to improve tissue oxygenation. Administer intravenous (IV) fluids to maintain blood volume and improve blood pressure. Monitor the client's cardiovascular status closely and intervene promptly to prevent worsening of symptoms or complications.
Urinary Retention	Inability to empty the bladder after surgery, leading to bladder distention.	Unable to void after surgery. Bladder distention.	Catheterize the client as needed to relieve urinary retention and maintain bladder function. Monitor urine output and assess for signs of bladder distention regularly. Encourage the client to be in sitting position while voiding for complete bladder emptying, if orders allow, and facilitate privacy. Perform bladder scanning per agency policy.
Urinary Infection	Bacterial infection in the urinary tract, often caused by urinary catheter use or urinary retention.	Foul-smelling or cloudy urine. Urinalysis demonstrating blood/WBCs/bacteria/ nitrites in urine. Elevated white blood cell count (WBC).	Notify the physician and request a urinalysis/urine culture. Administer antibiotics based on urinalysis/ urine culture results and physician's orders. Encourage increased fluid intake to flush out bacteria from the urinary tract. Ensure regular bladder emptying through voiding or catheterization as needed. If an indwelling catheter is in place, remove it as soon as indicated per agency policy.
Deep Vein Thrombosis (DVT)	Formation of a blood clot (thrombus) in a deep vein, usually in the legs.	Unilateral redness, warmth, edema, and possible calf pain.	Promptly notify the health care provider for diagnostic testing and anticoagulant therapy to prevent clot progression resulting in a potential embolism.
Embolism	A blockage in a blood vessel caused by a dislodged clot or foreign material, often moving to the lungs (pulmonary embolism).	Dyspnea. Pain. **Hemoptysis** (coughing up blood). Restlessness.	Request immediate/emergency assistance for sudden dyspnea. Administer oxygen therapy to oxygenate the blood that is able to bypass the embolism. Administer anticoagulant therapy (heparin) to prevent further clot formation and/or tissue plasminogen activator (tPA) to break down the clot, as prescribed.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

2.6 Learning Activities

Learning Activities

Preoperative Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Agnes Smith, a 42-year-old woman, underwent total hysterectomy under general anesthesia this morning. During the admission assessment, the client mentions to the nurse that her last menses was two months ago and that the bleeding was heavier than usual, which she assumes is why her surgeon is recommending the surgery. Agnes is unclear if her hysterectomy will be vaginal or abdominal. The client denies taking any prescription medicines but does mention taking aspirin or Tylenol 2 tablets "one or two times per day for pain in her knee." Agnes is tearful and states, "I have never had surgery. I am afraid of 'going under.'"

1) What information do you need to know or gather about this client before surgery occurs? Why?

2) Describe the teaching topics that should be provided. How should teaching needs be prioritized?

3) What lab tests and other diagnostic tests should be completed? Why?

1. "Preoperative Case Study" by Kellea Ewen is licensed under CC BY-NC 4.0

4) Is there any information that should be shared with the surgeon or anesthesiologist?

5) What interventions can be used to reduce the client's anxiety?

6) Based upon the information provided, what type of surgery is being described?

7) What medications might be given preoperatively to this client and why?

8) If the client was 88 years old, how should preoperative care be modified to meet the needs of an older adult?

9) What risks are more likely with an older adult?



An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=808#h5p-5

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- Test your knowledge on preoperative teaching using this NCLEX Next Generation-

style question. You may reset and resubmit your answers to this question an unlimited number of times.[2]

- Test your knowledge using this NCLEX Next Generation-style Case Study. You may reset and resubmit your answers to this question an unlimited number of times.[3]



2. "Preop Multiple Response" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

3. "Perioperative Case Study" by Travis Christman for OpenRN is licensed under CC BY-NC 4.0

II Glossary

Anesthesia: Medications used to reduce or temporarily eliminate sensory perception; commonly referred to as “negative sensation.” (Chapter 2.2)

Atelectasis: Collapse of lung tissue. (Chapter 2.3)

Cardiovascular surgery: Surgery involving the heart and blood vessels; often performed to treat heart conditions or improve blood flow. (Chapter 2.2)

Child life specialists: Members of the health care team who work with children and their families to provide education and preparation during hospitalization. (Chapter 2.3)

Conscious sedation: A state where the client remains conscious but deeply relaxed and pain-free; also known as “moderate sedation” or “twilight anesthesia.” (Chapter 2.2)

Cosmetic surgery: Surgery performed primarily to enhance or alter a person’s appearance. (Chapter 2.2)

Curative surgery: Surgery performed to remove or treat the cause of a disease, providing a cure or permanent resolution. (Chapter 2.2)

Cyanosis: Bluish skin discoloration. (Chapter 2.5)

Deep vein thrombosis (DVT): The formation of a blood clot (thrombus) in a deep vein, usually in the legs. (Chapter 2.3)

Dehiscence: The separation of surgical wound edges, exposing underlying tissues. (Chapter 2.5)

Diagnostic surgery: Surgery performed to obtain a definitive diagnosis or to assess the extent of a disease or condition. (Chapter 2.2)

Dyspnea: Shortness of breath. (Chapter 2.5)

Embolism: A blockage in a blood vessel caused by a dislodged clot or foreign material, often in the lungs (pulmonary embolism). (Chapter 2.5)

Emergency department surgical setting: Urgent or emergency surgeries that are necessary to address critical conditions or life-threatening situations. (Chapter 2.2)

Epidural blocks: A procedure involving injection of an anesthetic agent into the epidural space; often used for vaginal, perineal, hip, and lower extremity surgeries. (Chapter 2.2)

Evisceration: The protrusion of internal organs through a dehisced surgical incision site. (Chapter 2.5)

Expected outcomes: Statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. (Chapter 2.3)

Exploratory surgery: Surgery performed to visualize and inspect internal organs and structures to diagnose or assess health conditions. (Chapter 2.2)

Field blocks: A series of local anesthetic injections around the operative field. (Chapter 2.2)

General anesthesia: The use of medications to induce a state of unconsciousness and loss of sensation throughout the entire body. (Chapter 2.2)

Hemoptysis: Coughing up blood. (Chapter 2.5)

Hemorrhage: Excessive bleeding at the surgical site due to blood vessel damage or clotting abnormalities. (Chapter 2.5)

Informed consent: An active, shared decision-making process between the health care provider and the recipient of care, empowering clients to participate in decisions about their treatment and surgical procedures. (Chapter 2.2)

Inpatient setting: Surgery requiring the client to be admitted to the hospital either the day before the surgery or on the same day of the procedure. (Chapter 2.2)

Intraoperative period: The time from when the client is wheeled into the operating room until they are transferred to the Post-Anesthesia Care Unit (PACU), Same-Day Surgery Suite, or Intensive Care Unit (ICU) following the surgical procedure. (Chapter 2.4)

Length of stay: A clinical metric that measures the time elapsed between a client's admission and discharge. (Chapter 2.1)

Lithotomy position: A position used during procedures to enhance access of the pelvic organs. The client is placed on their back with their buttocks at the edge of the table and their legs abducted 30 to 45 degrees from the midline. The patient's knees and hips are flexed to about 90 degrees and supported with stirrups or padded leg holders. (Chapter 2.4)

Local anesthesia: Medications used to numb a specific area of the body, typically near the surgical site. (Chapter 2.2)

Minimally invasive surgeries: Surgeries where smaller incisions are made, resulting in reduced trauma, faster recovery, and improved client outcomes. (Chapter 2.1)

Monitored anesthesia care (MAC): The administration of IV sedation and pain management for clients undergoing certain procedures. The anesthesia provider continuously monitors the client's vital signs and level of consciousness throughout the procedure. (Chapter 2.2)

Nerve blocks: The injection of a local anesthetic into or around a single nerve or a group of nerves in the involved area. (Chapter 2.2)

Neurosurgery: Surgery for the treatment of conditions affecting the nervous system, brain, and spinal cord. (Chapter 2.2)

Obstetric/gynecological surgery: Surgical procedures related to pregnancy, childbirth, and the female reproductive organs. (Chapter 2.2)

Orthopedic surgery: Surgery related to the musculoskeletal system, dealing with bones, joints, muscles, ligaments, and tendons. (Chapter 2.2)

Outpatient/ambulatory surgery: Surgery requiring the client to go to the surgical area on the day of the surgery and return home the same day; also known as "same-day surgery." (Chapter 2.2)

Outpatient clinic surgical setting: Surgery performed in health care facilities where clients receive medical care or procedures without requiring hospitalization. (Chapter 2.2)

Palliative surgery: Surgery performed to alleviate symptoms, reduce pain, or improve the client's comfort without curing the disease. (Chapter 2.2)

Paralytic ileus: Temporary paralysis of the intestines, leading to the absence of bowel sounds and inability to pass flatus or stool. (Chapter 2.5)

Perioperative care: A client's surgical experience. (Chapter 2.1)

Pneumonia: Infection of the lungs. (Chapter 2.5)

Postoperative period: The phase of client care that occurs after a surgical procedure. (Chapter 2.5)

Preoperative period: The phase of client care that occurs before a surgical procedure. (Chapter 2.3)

Psychosis: A mental health disorder characterized by inappropriate affect

and impaired thinking and perception that can be caused by surgery and/or anesthesia. (Chapter 2.5)

Reconstructive/restorative surgery: Surgery performed to restore form and function after injury, disease, or previous surgical procedures. (Chapter 2.2)

Regional anesthesia: Medications used to numb a large area of the body, such as an entire limb or a section of the body, by blocking the nerve signals in that region. (Chapter 2.2)

Spinal blocks: Anesthetic medications injected into the cerebrospinal fluid (CSF) in the subarachnoid space, providing anesthesia for lower abdominal surgeries, pelvic procedures, hip, and knee surgeries. (Chapter 2.2)

Surgical time out: A purposeful pause before the procedure begins in which the surgical team confirms the procedure to be performed, the site, and client identity. (Chapter 2.4)

Tachycardia: A heart rate over 100 beats per minute. (Chapter 2.5)

Transplantation surgery: Surgery that involves the replacement of a failed organ or tissue with a healthy organ or tissue from a donor. (Chapter 2.2)

Urinary retention: The inability to empty the bladder after surgery, leading to bladder distention. (Chapter 2.5)

Urological surgery: Surgery related to the urinary system and male reproductive organs. (Chapter 2.2)

World Health Organization (WHO) Surgical Safety Checklist: A tool designed to improve client safety throughout the perioperative period. It serves as a standardized framework that helps health care teams ensure critical safety measures are consistently implemented before, during, and after surgery. (Chapter 2.2)

PART III

CHAPTER 3 HEMATOLOGICAL ALTERATIONS

3.1 Hematology Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with hematology disorders
- Identify nursing responsibilities during the administration of blood products
- Explain the pathophysiology of hematology disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in caring for the client with hematology disorders
- Integrate pharmacological and nonpharmacological measures for the client with hematology disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=79#h5p-37

"Hematology PreTest" by Kellea Ewen and Open RN is licensed under CC BY-NC 4.0

Hematology is the study of blood, blood components, and blood-forming organs and their impact on an individual's health and well-being. The hematological system is important for transporting and regulating different functions within the body, as well as for ensuring that cells receive the nutrients and oxygen they need to function. The hematology system also plays an important role in waste removal and immune function. Dysfunction within the hematology system can contribute to numerous health alterations, as the body relies on coordinated physiological processes to help maintain homeostasis. Homeostasis is the body's ability to maintain stable internal conditions and function despite changes in the external environment.[1] It is a self-regulating process that ensures the body's internal environment remains within a narrow range, allowing cells and organs to function optimally. When homeostasis is disrupted or unable to be maintained, health alterations may arise.

1. American Society of Hematology. (n.d.). *Blood basics*. https://www.hematology.org/education/patients/blood-basics

3.2 Review of Hematology Anatomy & Physiology

The hematological system involves many multifaceted processes that help the body maintain homeostasis and ensure appropriate functioning.

Bone Marrow

Blood formation takes place primarily in the red bone marrow, which plays a central role in producing the key blood components of red blood cells (erythrocytes), white blood cells (leukocytes), and platelets (thrombocytes). Over time, red marrow is replaced by yellow marrow in some bones. Yellow marrow consists mainly of fat cells.

Bone marrow is located in flat bones such as the sternum, skull, and pelvis. In the bone marrow, blood stem cells that are immature and undifferentiated have the remarkable capacity to become any type of cell. As these stem cells differentiate, they require specific growth factors for specialization. For example, **erythropoietin**, produced by the kidneys in response to hypoxia, is essential for red blood cell (RBC) production. RBC production also relies on adequate levels of iron, vitamin B12, folic acid, copper, and cobalt. Diets that are depleted in these micronutrients impede red blood cell production.

Thrombopoietin is the growth factor that regulates platelet production. Twenty percent of platelets are stored in the spleen, and eighty percent of platelets circulate in the bloodstream.[1]

1. Leukemia Foundation. (2024). *The bone marrow and blood formation.* https://www.leukaemia.org.au/blood-cancer/understanding-your-blood/bone-marrow-and-blood-formation/

Blood Components

Red Blood Cells

Red blood cells (RBCs), also called **erythrocytes**, transport oxygen and carbon dioxide between tissues and the lungs. RBCs, the most abundantly formed elements in the blood, are basically sacs packed with hemoglobin that carry oxygen. For this reason, a lack of RBCs results in symptoms related to decreased oxygenation of the body's tissues and organs. See Figure 3.1[2] for an illustration of RBCs containing hemoglobin that carries oxygen molecules.

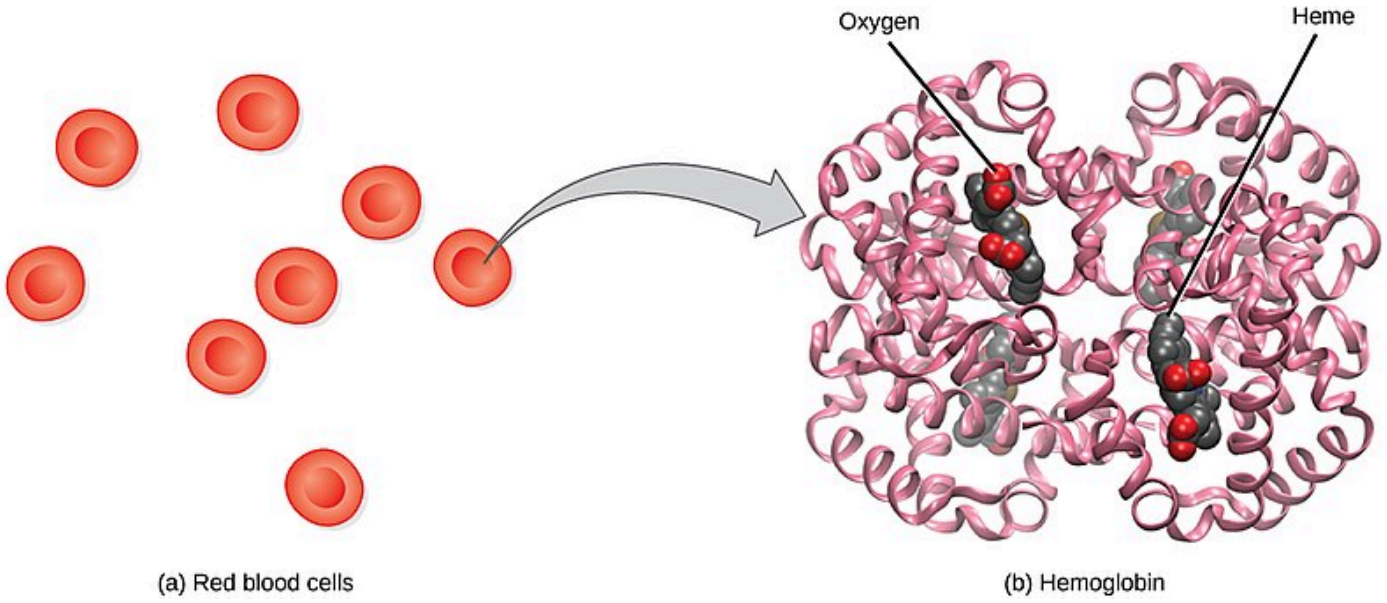


Figure 3.1 Red Blood Cells

Production of RBCs in the bone marrow occurs at the staggering rate of more than 2 million cells per second. For this production to occur, raw materials, including iron, folic acid, and B12, must be present in adequate amounts.

RBCs live only 120 days on average and must be continually replaced. Old RBCs and hemoglobin are broken down by white blood cells in a process called phagocytosis. When hemoglobin breaks down, bilirubin is formed. If the body cannot adequately metabolize bilirubin, a symptomatic yellow

2. "Figure_39_04_01.jpg" by CNX OpenStax is licensed under CC BY 4.0

discoloration called **jaundice** occurs in the skin, mucus membranes, and eyes.[3,4,5]

White Blood Cells

White blood cells (WBCs), also called **leukocytes**, provide immune function and body defenses against disease. WBCs protect the body against invading microorganisms and body cells with mutated DNA, and they also clean up debris.[6] There are five main types of WBCs called neutrophils, lymphocytes, monocytes, eosinophils, and basophils. See Figure 3.2[7] for an illustration of the different types of WBCs.

3. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

4. Kalakonda, A., Jenkins, B. A., & John, S. (2022). *Physiology, Bilirubin*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470290/

5. Philips, M. M. (2023). *Jaundice causes*. National Institutes of Health. Medline Plus. https://medlineplus.gov/ency/article/007491.htm

6. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

7. "Blausen_0909_WhiteBloodCells.png" by Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014" is licensed under CC BY 3.0

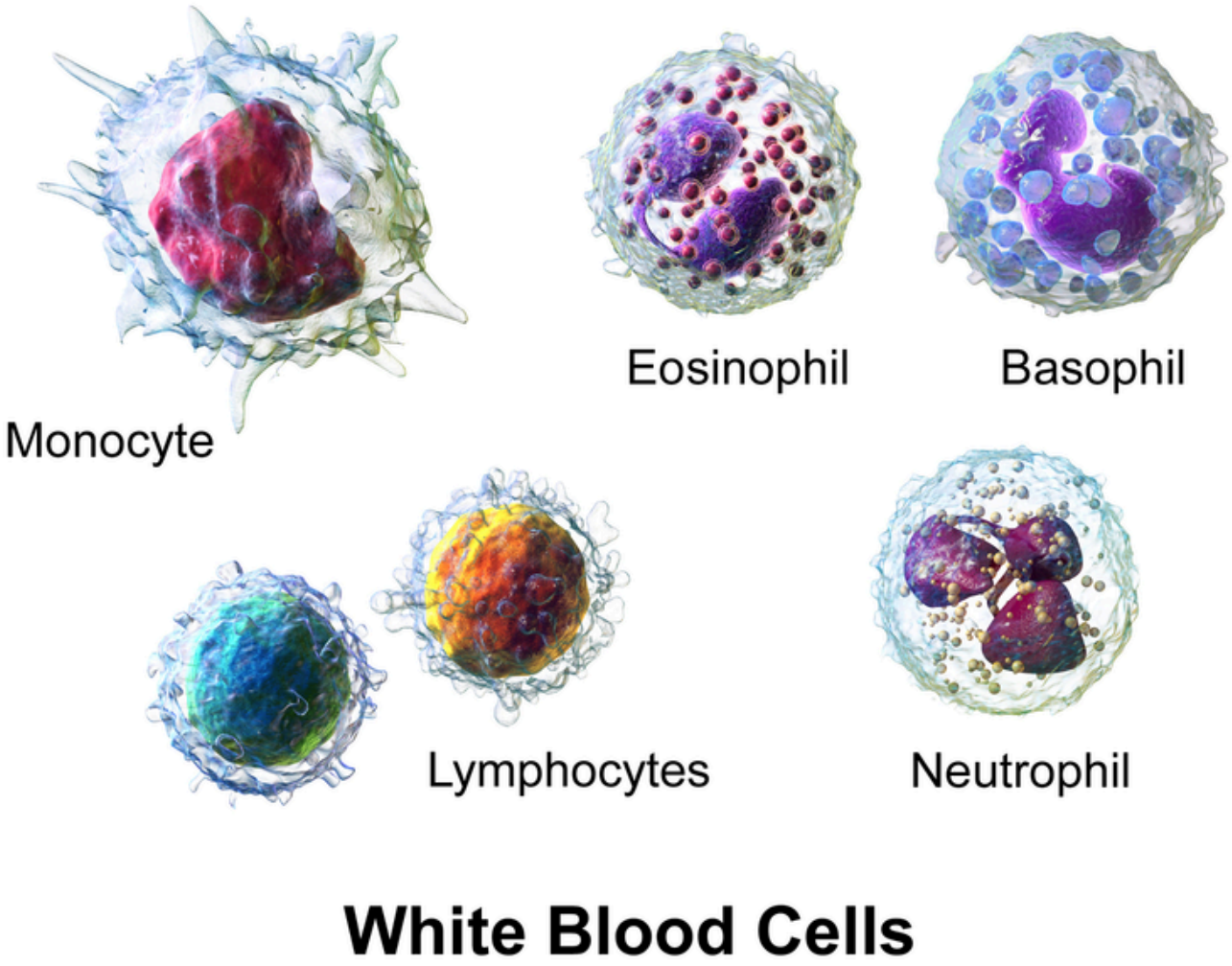


Figure 3.2 Types of White Blood Cells

Table 3.2a summarizes the main functions of the different types of WBCs.

Table 3.2a. Types of WBCs and Functions[8,9]

8. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

9. American Society of Hematology. (n.d.). *Blood basics*. https://www.hematology.org/education/patients/blood-basics

Leukocyte Type	Percentage in Total WBC Count	Main Function
Neutrophils (NEUT)	40 -70%	**Phagocytosis:** The engulfment and destruction of bacteria, an important process during acute bacterial infections and inflammation. Mature neutrophils are commonly referred to as "segs," and immature neutrophils are commonly referred to as "bands." A "shift to the left" indicates that mature segs are being consumed at the site of an infection, and the bone marrow is rapidly creating new bands.
Lymphocytes (LYM)	20-45%	**Adaptive immunity:** The production of antibodies called B cells and targeted killing of infected cells by T cells.
Monocytes (MONO)	2-10%	Transformed into macrophages in acute infections to clear debris and pathogens via phagocytosis. Monocytes are also present in the immune response to chronic infections.
Eosinophils (EO)	1-6%	Defend against parasites and modulate allergic reactions by releasing histamine and other chemicals.
Basophils (BASO)	0.5-1%	Release histamine and other inflammatory mediators during an allergic reaction.

Review information about pathogens, natural defenses against infection, inflammation, specific adaptive immunity, and infection in the "Infection" chapter of Open RN *Nursing Fundamentals, 2e*.[10]

Platelets

Platelets, also called **thrombocytes**, primarily assist in blood clotting and also release growth factors to repair and heal tissue. Platelets serve a critical function in **hemostasis**, the process by which the body seals a ruptured blood vessel and prevents further loss of blood. During hemostasis, platelets

10. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

become activated and create a platelet plug. See Figure 3.3[11] for an illustration of platelets and activated platelets. Hemostasis and blood clot formation are further discussed in the "Blood Clot Formation" subsection.

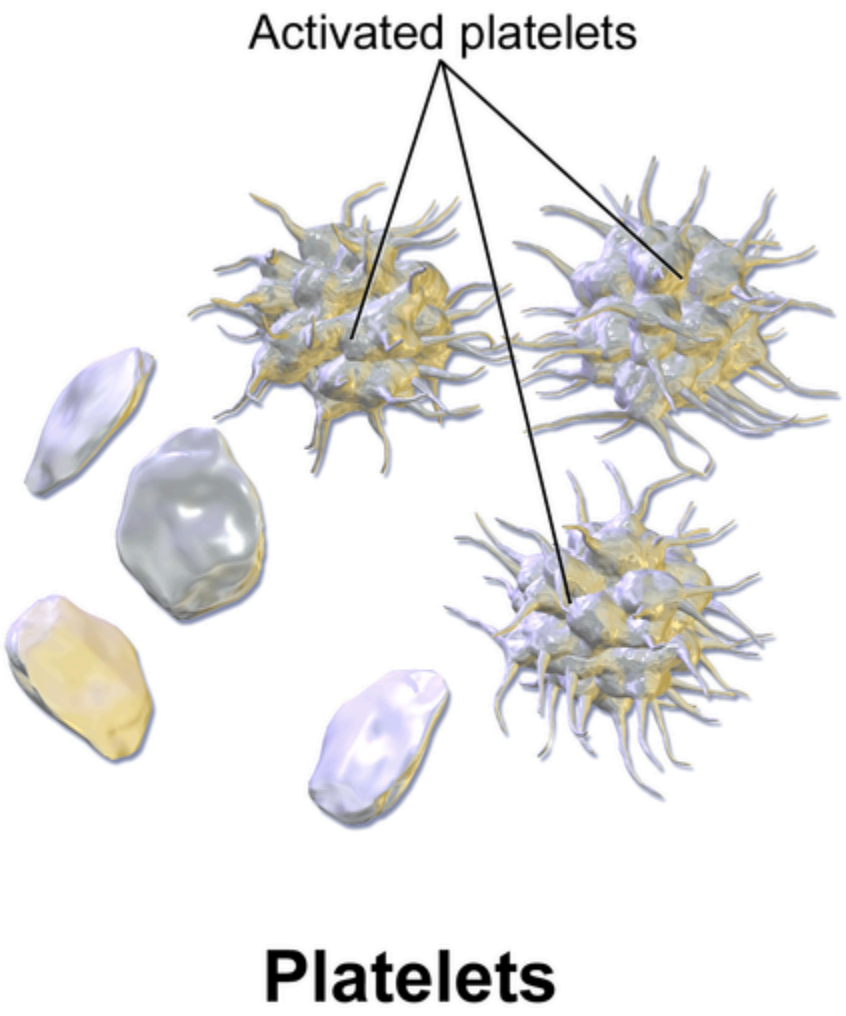


Figure 3.3 Platelets and Activated Platelets

11. "Blausen_0740_Platelets.png" by Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014" is licensed under CC BY 3.0

Accessory Organs

The spleen and liver are essential accessory organs for blood production and clotting regulation.

Spleen

The spleen produces and stores WBCs, filters and stores RBCs and platelets, and plays a role in the filtration and destruction of old RBCs. There are two types of tissue in the spleen: white pulp and red pulp. White pulp, the lymphatic tissue of the spleen, produces WBCs. Red pulp serves as a storage site for RBCs and platelets. The spleen also filters antigens and plays a role in the destruction of old RBCs and the breakdown of hemoglobin.[12]

Because the spleen serves as a reservoir for blood, injury to the spleen can result in hemorrhage. For this reason, clients who have experienced blunt abdominal trauma undergo rapid diagnostic testing to check for splenic damage and hemorrhage.

Enlargement of the spleen, called **splenomegaly**, can occur due to a variety of reasons, such as systemic infection, sickle cell disease, venous congestion, or malignancy.

Clients who undergo **splenectomy** (i.e., removal of the spleen) experience reduced immune function and an increased risk of infection.[13]

Liver

The liver serves as a storage site for whole blood and blood cells. It also produces prothrombin and other blood clotting factors. Prothrombin and its role are further described in the “Blood Clot Formation” subsection.

12. Kapila, V., Wehrle, C.J., & Tuma, F. (2023). *Physiology, Spleen*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537307/

13. Kapila, V., Wehrle, C.J., & Tuma, F. (2023). *Physiology, Spleen*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537307/

The liver also plays a significant role in the breakdown of hemoglobin. The liver receives unconjugated bilirubin from blood circulation, where it undergoes conjugation so it can be filtered and excreted by the kidneys. If the liver is impaired and cannot adequately metabolize bilirubin, characteristic jaundice occurs.[14,15]

Blood Clot Formation

Hemostasis is a process that leads to cessation of bleeding from a blood vessel and involves multiple interlinked steps. The steps begin when there is trauma to the lining of a blood vessel and culminates into the formation of a "plug" that closes the damaged site of the blood vessel and controls the bleeding.[16]

Hemostasis can be divided into four stages: 1) injury to the blood vessel, 2) vascular spasms of the injured blood vessel, 3) formation of a temporary "platelet plug," and 4) coagulation and formation of the fibrin clot (i.e., the blood clot).[17] Failure of any of these stages of hemostasis can result in hemorrhage.[18] See Figure 3.4[19] for an illustration of these steps of hemostasis.

14. American Society of Hematology. (n.d.). *Blood basics*. https://www.hematology.org/education/patients/blood-basics

15. Kalra, A., Yetiskul, E., & Wehrle, C.J. (2023). *Physiology, Liver*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK535438/

16. LaPelusa, A., & Dave, H.D. (2023). *Physiology, Hemostasis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK545263/

17. LaPelusa, A., & Dave, H.D. (2023). *Physiology, Hemostasis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK545263/

18. American Society of Hematology. (n.d.). *Blood basics*. https://www.hematology.org/education/patients/blood-basics

19. "1909_Blood_Clotting.jpg" by OpenStax College is licensed under CC BY 3.0

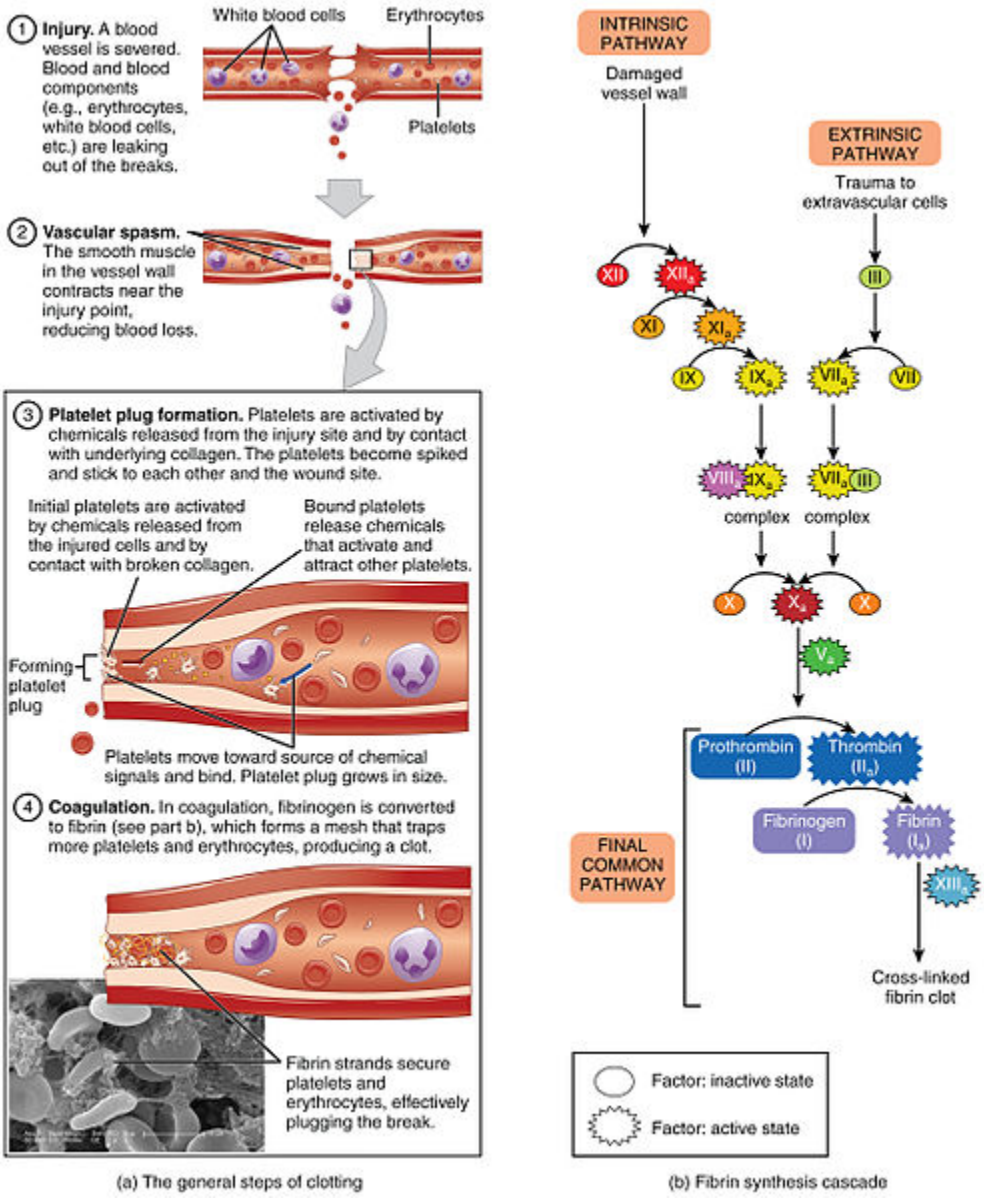


Figure 3.4 Hemostasis

Vascular Spasm

Vascular spasm occurs after a blood vessel is injured. Vasoconstriction occurs when smooth muscle in the vessel wall contracts near the point of injury to reduce the amount of blood loss.

Platelet Plug Formation

The next step of hemostasis is creation of a platelet plug. Platelets are

activated by chemicals released by the injured vessel site and by contact with the underlying collagen. The activated platelets become spiked and stick to one another at the wound site in a process called **platelet aggregation**.

The key steps of platelet aggregation are as follows:

1. **Adhesion:** Platelets have receptors on their surfaces that allow them to adhere to the exposed collagen and other proteins at the site of injury.
2. **Activation:** Upon adhesion, platelets become activated and change their shape. They release chemical signals, which attract and activate more platelets.
3. **Aggregation:** The activated platelets stick together and form a **platelet plug** at the site of injury. This plug helps to temporarily seal the wound.[20,21]

Coagulation Cascade

The final step of hemostasis is the **coagulation cascade**. The coagulation cascade is a complex series of reactions involving a variety of coagulation factors that eventually leads to the formation of a fibrin clot, a fibrous protein that strengthens the platelet plug and creates what is commonly called a "blood clot."

The key steps of the coagulation cascade include the following:

1. **Activation of clotting factors:** When tissue is injured, a series of clotting factors are activated. This involves a cascade of enzyme-mediated reactions, with each activated clotting factor activating the next one in the sequence.

20. Chaudhry, R., Usama, S.M., & Babiker, H.M. (2023). *Physiology, Coagulation Pathways*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482253/

21. Leung, L. (2023). Overview of hemostasis. *UpToDate*. https://www.uptodate.com

2. **Formation of prothrombinase complex:** One of the crucial steps of the coagulation cascade is the formation of prothrombinase, which converts the inactive prothrombin into its active form, thrombin. Thrombin plays a central role in the next step of hemostasis.
3. **Conversion of fibrinogen to fibrin:** Thrombin catalyzes the conversion of soluble fibrinogen into insoluble fibrin. Fibrin forms a mesh-like structure that traps red blood cells, platelets, and other blood components to create a stable blood clot.[22,23]

Fibrin clot formation is the final stage of the blood clotting process. Fibrin forms a network of fibers, reinforcing the initial platelet plug and stabilizing the clot.

These are the key steps of fibrin clot formation:

1. **Activation of fibrin:** Thrombin activates fibrinogen, causing it to form long fibrin strands. These strands then intertwine to create a mesh-like network.
2. **Cross-linking of fibrin:** Enzymes help to cross-link the fibrin strands, strengthening the clot's structure further.
3. **Clot retraction:** Once the fibrin clot is formed, platelets within the clot contract, pulling the fibrin strands closer together and compacting the clot. This clot retraction contributes to wound closure.

Fibrinolysis

Fibrinolysis is a natural mechanism that occurs in the body to help break

22. Chaudhry, R., Usama, S.M., & Babiker, H.M. (2023). *Physiology, Coagulation Pathways*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482253/

23. Leung, L. (2023). Overview of hemostasis. *UpToDate*. https://www.uptodate.com

down blood clots to prevent clots from becoming too large and blocking blood vessels. The process of fibrinolysis is driven by an enzyme called **plasmin**. Plasmin is responsible for breaking down fibrin, the mesh-like structure of a blood clot.[24,25]

The key steps of fibrinolysis are as follows:

1. **Activation of plasminogen:** Plasminogen is an inactive precursor of plasmin that is always present in the**plasmin**blood. Plasminogen only becomes active when a blood clot is formed and needs to be degraded. When this occurs, substances trigger the conversion of plasminogen into its active form plasmin.
2. **Formation of tissue plasminogen activator (tPA):** Tissue plasminogen activator is a substance released by endothelial cells lining blood vessels. Tissue plasminogen activator can also be administered as a medical intervention in occurrence of a stroke or if an individual experiences a cardiac blockage. Tissue plasminogen activator is the substance that binds to plasminogen, causing the conversion into active plasmin.
3. **Plasmin action:** Active plasmin then begins to break the fibrin strands within the blood clot. It breaks the fibrin into smaller and smaller products.
4. **Dissolution of the clot:** As plasmin continues to break apart the fibrin strands, the blood clot gradually dissolves. This makes the clot continue to decrease in size and restores blood flow.[26,27]

24. Chaudhry, R., Usama, S.M., & Babiker, H.M. (2023). *Physiology, Coagulation Pathways*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482253/

25. Leung, L. (2023). Overview of hemostasis. *UpToDate*. https://www.uptodate.com

26. Chaudhry, R., Usama, S.M., & Babiker, H.M. (2023). *Physiology, Coagulation Pathways*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482253/

Fibrinolysis plays an important part in hemostasis to not only ensure that blood clots form to control bleeding but also dissolve appropriately to allow blood flow through the vessel. Disorders in fibrinolysis can result in health alterations related to thrombosis (clot formation) or hemorrhage (increased risk of bleeding).[28,29] Warfarin is a commonly prescribed medication that disrupts the coagulation cascade to prevent clot formation in clients who are at risk. Read more about warfarin in the following box.

The Role of Warfarin

Warfarin disrupts the coagulation cascade by specifically targeting vitamin K, an essential nutrient required for the synthesis of several clotting factors in the liver. Vitamin K is responsible for activating clotting factors by modifying them into their active forms.

Warfarin acts as a vitamin K antagonist, meaning it interferes with the function of vitamin K and reduces the production of active clotting factors. It does this by blocking the enzyme responsible for recycling vitamin K, known as vitamin K epoxide reductase. Without enough vitamin K available, the liver is unable to produce fully functional clotting factors, which slows

27. Leung, L. (2023). Overview of hemostasis. *UpToDate*. https://www.uptodate.com

28. Chaudhry, R., Usama, S.M., & Babiker, H.M. (2023). *Physiology, Coagulation Pathways*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482253/

29. Leung, L. (2023). Overview of hemostasis. *UpToDate*. https://www.uptodate.com

down the clotting process. For this reason, clients on warfarin must eat a consistent amount of vitamin K in their diet.

This anticoagulant effect of warfarin is carefully controlled to achieve the desired therapeutic effect. The dosage of warfarin for each individual is carefully adjusted to ensure their ability to clot is neither too fast nor too slow. Too much warfarin can lead to excessive bleeding, whereas not enough warfarin can allow disruptive clot formation.

For this reason, routine monitoring of a client's **International Normalized Ratio (INR)** is essential during warfarin therapy. The INR is a blood test that measures how long it takes for the blood to clot compared to a standardized value. By monitoring the INR regularly, health care providers adjust each client's warfarin dosage as needed to maintain the appropriate anticoagulant effect.

3.3 General Hematological System Assessment

When evaluating a client for possible disorders of the hematology system, the nurse pays close attention to risk factors, cultural factors, and socioeconomic factors, in addition to the client's health history, physical examination findings, and diagnostic test results.

Risk Factors & Social Determinants of Health Related to Hematological System

Assessing for hematological risk factors allows health care professionals to identify individuals who may be at a higher risk of developing blood-related disorders. Identification of risk factors will allow for early intervention and preventative measures to be enacted, potentially impacting the severity or progression of the hematological alteration. It is important that nurses and health professionals carefully consider the following risk factors:

- **Family History/Genetic Predisposition:** Family history of certain blood disorders can increase an individual's risk of developing the same condition. For example, hemophilia, a bleeding disorder, has a genetic predisposition.
- **Age:** Many hematological disorders are more commonly seen in older individuals. For example, anemia and chronic leukemia commonly occur in older adults.
- **Environmental Exposures:** Exposure to certain environmental toxins, radiation, or chemicals can increase an individual's risk for developing a hematological condition. For example, exposure to benzene is an environmental risk for hematological conditions.
- **Nutrition:** Inadequate intake or absorption of essential nutrients, such as iron, vitamin B12, and folic acid, can lead to certain blood disorders. For example, iron-deficiency anemia can be caused by a lack of iron in the diet. Chronic health issues like inflammatory bowel disease can interfere with the absorption of nutrients.

- **Medications:** Medications can affect blood cell production and function. For example, chemotherapy and immunosuppressive medications can affect blood cell production and function.
- **Underlying Health Conditions:** Chronic health conditions can affect blood cell production and function, such as chronic kidney disease and liver disease.[1,2]

Cultural Factors

Cultural practices, beliefs, and lifestyle choices can influence an individual's health, including their risk for developing hematological conditions.

- **Diet and Nutrition:** Cultural dietary patterns can affect an individual's intake of essential nutrients like iron, vitamin B12, and folic acid that are needed for healthy blood cell production. For example, vegetarian or vegan diets are often low in iron and can increase the risk for developing anemia.
- **Herbal Medicines:** Some cultural practices involve the use of traditional medicines and herbal remedies. While some herbal remedies may have beneficial effects, others might interfere with blood clotting or blood cell function and the risk of hematological disorders. For example, ginseng and green tea can interfere with blood clotting and should be discontinued before surgery.[3]

1. American Society of Hematology. (n.d.). *Blood disorders.* https://www.hematology.org/education/patients/blood-disorders

2. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

3. Wang, C. Z., Moss, J., & Yuan, C. S. (2015). Commonly used dietary supplements on coagulation function during surgery. *Medicines, 2*(3), 157–185. https://doi.org/10.3390/medicines2030157

- **Inherited Blood Disorders**: Certain blood disorders, such as sickle cell disease or thalassemia, are more prevalent in specific ethnic groups due to inherited genetic factors. Cultural background can play a significant role in determining the prevalence of these conditions within certain populations.
- **Traditional Practices and Rituals:** Certain cultural practices may involve activities that carry a risk of bleeding or clotting disorders. For example, rituals in some cultural practices involve scarification or practices that may lead to injury and bleeding.
- **Health Care Beliefs and Access:** Cultural beliefs about health and illness can influence health care-seeking behaviors and adherence to medical advice. Lack of access to health care services or differences in health care practices between cultures may affect the detection and management of hematological disorders.
- **Religious Practices:** Some religious practices, such as fasting or dietary restrictions, may impact an individual's nutritional intake and, in turn, affect their hematological health.
- **Genetic Variations:** Certain ethnic groups may carry specific genetic variations that affect blood cell function or clotting factors, leading to an increased risk of certain hematological disorders.[4,5]

Socioeconomic Factors

Socioeconomic factors can play a significant role in impacting the hematological system. These factors may influence an individual's access to health care, nutritional status, exposure to environmental hazards, and overall well-being.

4. American Society of Hematology. (n.d.). *Blood disorders*. https://www.hematology.org/education/patients/blood-disorders

5. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors.* National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

- **Access to Health Care:** An individual's access to quality health care services, including regular check-ups and early detection, can affect their health and hematological function. Limited access to medical care may result in delayed diagnosis and treatment of blood-related conditions, potentially leading to more severe health outcomes.
- **Nutritional Status:** Socioeconomic factors can influence an individual's dietary habits and nutritional intake. Low socioeconomic status may be associated with limited access to nutritious foods, which could increase the risk of nutritional deficiencies and related hematological disorders, such as anemia.
- **Exposure to Environmental Hazards:** Socioeconomic factors can determine an individual's living conditions and exposure to environmental pollutants. People in lower socioeconomic groups may be more likely to live in areas with higher pollution levels, which can negatively impact the hematological system.
- **Occupational Hazards:** Certain occupations may involve exposure to chemicals or toxins that can affect blood cell production or lead to hematological disorders.
- **Stress and Mental Health:** Prolonged stress can affect the immune system and blood cell production, potentially influencing hematological health.
- **Health Care Adherence:** Socioeconomic factors may affect an individual's ability to adhere to prescribed medical treatments and follow-up appointments, impacting disease management and control of hematological disorders.
- **Health Literacy:** Socioeconomic status can influence health literacy. Health literacy refers to an individual's ability to access, understand, and use health-related information. Lower health literacy may lead to a lack of awareness about hematological disorders and their prevention, hindering early intervention.
- **Social Support:** Support systems and social networks play a role in managing chronic conditions, including hematological disorders. Socioeconomic factors may influence the availability of social support, impacting disease management and outcomes.[6,7]

General Assessment

A comprehensive evaluation of a client's body systems is essential because hematological conditions can affect many body systems due to decreased oxygen delivery, increased risk for bleeding or clotting, or increased risk of infection.

Health History

Specific areas to note in a client history that may reveal an underlying hematological disorder include the following assessment findings[8,9]:

- **RBC impairment and impact on oxygenation:**
  - **Fatigue:** Fatigue is a common symptom of many hematological disorders, particularly anemia. Explore the client's level of fatigue, its impact on daily activities, and any associated symptoms.
  - **Shortness of Breath, Heart Palpitations, or Chest Pain:** Obtain information about the onset, duration, and triggers of shortness of breath, heart palpitations, or chest pain. Ask if the client experiences these symptoms at rest, during physical activity, or at specific times of

6. American Society of Hematology. (n.d.). *Blood disorders*. https://www.hematology.org/education/patients/blood-disorders

7. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

8. American Society of Hematology. (n.d.). *Blood disorders*. https://www.hematology.org/education/patients/blood-disorders

9. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

the day.

- **WBC impairment and risk for infection:**
  - **Infection and Fever:** Determine if the client has experienced any recent infections, such as respiratory or urinary tract infections, and ask about any associated fever or chills.
  - **Lymph Node Swelling:** Lymph node swelling can occur with systemic infection. Inquire about the location, duration, and progression of any lymph node swelling. Ask if the client has noticed any changes in the size or tenderness of the lymph nodes.

- **Platelet impairment and risk for bleeding:**
  - **Excessive Bruising or Bleeding:** Ask about any recent injuries or trauma and inquire about the frequency, severity, and duration of excessive bruising or bleeding. Take note of any history of recurrent nosebleeds, prolonged bleeding after minor cuts, bleeding gums, or blood in the urine or stool.
  - **Excessive or Prolonged Bleeding After Dental Work or During Menstruation:** Specifically ask about any prolonged bleeding episodes after dental procedures or during menstrual periods.

Physical Assessment

Conducting a thorough examination of each body system provides the nurse with cues regarding potential hematological disorders. Early identification of abnormal findings and notification of the health care provider can lead to prompt intervention and management and improve client outcomes. Table 3.3a summarizes assessments for each body system.

Table 3.3a. General Hematological Assessments by Body System[10,11]

10. American Society of Hematology. (n.d.). *Blood disorders*. https://www.hematology.org/education/patients/blood-disorders

11. Office on Women's Health. (2021). *Bleeding disorders*. U.S. Department of Health & Human Services. https://www.womenshealth.gov/a-z-topics/bleeding-disorders

Body System	Focused Assessments
Skin	• Check for pallor or jaundice. • Assess mucous membranes and nail beds for pallor or cyanosis. • Check gums for bleeding. • Inspect for hemorrhagic lesions in the skin and excessive bruising. • Inquire about itching (that can occur from poor perfusion). • Examine for excessive bleeding around IV catheters and/or tubes in hospitalized clients. • Observe hair patterns for abnormalities. • Inspect nails for abnormalities. For example, iron-deficient anemia can cause spooning of the nails.
Head & Neck	• Check for pallor or ulcerations of the mouth mucosa. • Examine the tongue for glossitis (a sign of iron-deficiency anemia) and fissures. • Inspect and palpate lymph nodes for enlargement or tenderness.

Respiratory	• Assess the rate and depth of respirations at rest and during mild physical activity. • Evaluate whether the client is fatigued easily, experiences shortness of breath at rest or on exertion, or needs extra pillows to breathe comfortably while sleeping.
Cardiovascular	• Check pulses for strength and regularity. • Look for distended neck veins or edema. • Listen for murmurs, gallops, or irregular rhythms. • Assess for abnormal blood pressure readings.
Renal & Urinary	• Look for **hematuria** (bloody urine) or darkish brown/gold coloration, which can indicate bleeding problems. • For clients with chronic kidney disease, less erythropoietin may be produced and can result in anemia.
Musculoskeletal	• Check for rib or sternal tenderness, which can be an important sign of bone marrow overproduction.
Abdominal	• Note splenomegaly or hepatomegaly. • Check for blood in the stool from gastrointestinal bleeding.

Central Nervous	• Specific nutritional deficiencies can impact nerve function. For example, B12 anemia can cause paresthesia, altered mental status, and visual disturbances. • Bleeding problems can affect the brain, especially if the client has experienced head trauma.
Psychosocial	• Identify the client's social support, coping mechanisms, access to community resources, and financial health to provide comprehensive care.

Based on the client's health history and physical examination findings, the health care provider should be notified of signs of potential hematological disorders to determine the need for follow-up, such as blood tests, bone marrow examination, or imaging studies.

Check Your Knowledge – Clinical Scenario Part A

Sarah Jimenz presents to her primary care provider with a chief complaint of fatigue, bruising, and swollen lymph nodes in her neck for the past two months. She also reports ongoing shortness of breath with minor exertion and presence of heart palpitations.

Sarah denies any past medical issues, surgeries, or hospitalizations. She also is not currently taking any medications or herbal supplements. Her family history reveals no notable concerns. Sarah currently works as an elementary school teacher and is married with two children. She reports that she eats a balanced diet but has not been eating as much lately due to

work-related stress and family responsibilities. She denies consuming tobacco products or alcohol.

A physical examination reveals the following findings:

Skin: Skin appears pale. No signs of jaundice or cyanosis. Petechiae and ecchymoses are observed on her lower extremities.

Head & Neck: Mucous membranes and nail beds appear pale. The tongue shows signs of slight fissures. Palpation of lymph nodes reveals bilateral enlargement of the cervical lymph nodes, which are slightly tender.

Respiratory: Respiratory rate is within the normal range at rest. However, she reports feeling fatigued easily and experiences shortness of breath with minimal exertion.

Cardiovascular: Pulses are regular and of normal strength. No distended neck veins or edema are noted. Blood pressure reading shows a lower value than usual.

Renal & Urinary: No hematuria or abnormal urine coloration is observed. However, Sarah mentions experiencing frequent urinary tract infections over the past few months.

Musculoskeletal: Firm pressure on the skin over the ribs and sternum elicits tenderness. Sarah reports some discomfort in these areas.

Abdominal: Palpation reveals an enlarged spleen on the left side under the ribs. The liver is not palpable. There are no signs of blood in the stool.

Central Nervous System: Sarah appears alert and oriented. There are no signs of neurological deficits or head trauma.

Psychosocial: Sarah expresses feeling overwhelmed and stressed due to work and family responsibilities. She has a good

support system in her family and friends but admits not seeking help when needed.

1. Based upon Sarah's case presentation, what physical assessment findings and clinical manifestations are consistent with the presence of a possible hematological alteration?

Check your answers in the Chapter 3 Answer Key

Life Span Considerations

Nurses consider the following characteristics for the pediatric and older adult populations[12]:

Pediatric Considerations

- A small volume of blood loss can be significant for small children. For example, 100 mL of blood loss by an infant weighing 5 kg is 10% of their total blood volume.
- RBC and WBC levels increase from birth throughout childhood, achieving adult levels in adolescence.
- Newborns' platelet and clotting factors are low, so prophylactic vitamin K is administered at birth.

Older Adult Considerations

- Older adults have decreased blood volume with lower levels of plasma proteins.

12. Queensland Pediatric Emergency Care. (2022). *How children are different – Anatomical and physiological differences*. https://www.childrens.health.qld.gov.au/__data/assets/pdf_file/0031/179725/how-children-are-different-anatomical-and-physiological-differences.pdf

- As bone marrow ages, there is less red bone marrow, and fewer blood cells are produced.
- Hemoglobin and hematocrit levels may be decreased.
- Atrophy of the kidneys, liver, and spleen affect the hematological system. Atrophic kidneys make less erythropoietin that stimulates the production of RBCs. An atrophied liver produces less clotting factors, and decreased functioning affects the recycling/breakdown of RBCs. An atrophic spleen stores fewer platelets and is less efficient in recycling the "heme" (i.e., the iron component) needed to produce RBCs.
- Increased incidence of arthritis, vision impairment, chronic disease, and living alone put older adults at risk for poor nutrition, resulting in the lack of nutrients needed for building RBCs.
- Thin skin, fragile blood vessel walls, and increased use of anticoagulants result in increased bruising.
- Initiating IV access can be challenging due to fragile vessels. Nurses consider the size of the IV cannula when initiating IV access and may select a smaller gauge cannula like 22 gauge.
- Chronic medical conditions (such as heart failure and kidney disease) increase the risk of fluid overload following blood transfusions, dialysis, and IV fluid administration.

Diagnostic Testing

Diagnostic testing is ordered by health care providers to identify and diagnose hematological conditions. When identifying hematological conditions, one of the most definitive signs of an issue is reflected in the change of laboratory test results. Common laboratory tests that are performed to assist in hematological alteration identification include the following[13]:

- **Complete Blood Count (CBC):** A CBC provides a comprehensive

13. MedlinePlus. (2016). *Blood count tests.* National Library of Medicine. https://medlineplus.gov/bloodcounttests.html

assessment of various blood components, including RBCs, WBCs, platelets, hematocrit (HCT), and hemoglobin (Hgb). Additional parameters help evaluate the overall health of the hematological system and can indicate anemia, infection, or other blood disorders:

  - **Mean Corpuscular Volume (MCV):** Shows the size of the red blood cells, which can help to diagnose different types of anemia. An increased MCV means that red blood cells are large or macrocytic. This could be seen in vitamin B12 anemia. A decreased MCV means that red blood cells are small or microcytic. This could be seen with iron-deficiency anemia.
  - **Mean Corpuscular Hemoglobin Concentration (MCHC):** Helps to determine the coloring of the red blood cells. A decrease in MCHC means that the red blood cells are hypochromic or paler than normal. This can be seen in iron-deficiency anemia.
  - **CBC With Differential:** Measures the different types of white blood cells (i.e., neutrophils, neutrophils, lymphocytes, monocytes, eosinophils, and basophils).

- **Peripheral Blood Smear:** A peripheral blood smear is a microscopic examination of a thin layer of blood cells, allowing a provider to determine the shape, size, and appearance of different types of blood cells.
- **Prothrombin Time/International Normalized Ratio (PT/INR):** PT/INR tests evaluate the blood's ability to clot through the extrinsic pathway. PT measures how long it takes for blood to clot after specific factors are added. INR is a standardized value used to monitor clients taking warfarin.
- **Partial Thromboplastin Time (PTT):** PTT assesses the blood's ability to clot through the intrinsic pathway. PTT measures how long it takes for blood to clot after certain activators are added. It is used to evaluate coagulation disorders and monitor clients on heparin.
- **Liver Function Tests (LFTs):** Impaired liver function can affect the synthesis of clotting factors. Therefore, LFTs may be ordered if clotting abnormalities are seen.
- **Iron Studies:** Iron studies include tests like serum iron, total iron-binding

capacity (TIBC), and ferritin levels. These tests are used to diagnose iron-deficiency anemia and other disorders related to iron metabolism.

- **Serum Iron:** Measures how much iron is in the blood.
- **Total Iron-Binding Capacity (TIBC):** Measures the blood's ability to attach to iron and carry it throughout your body. More specifically, a TIBC test shows the amount of transferrin in the blood. Transferrin is a protein the liver makes that regulates the absorption of iron into the blood.
- **Transferrin Saturation:** Transferrin saturations of less than 20% indicate iron-deficiency anemia, while transferrin saturations of more than 50% suggest iron overload such as polycythemia.
- **Serum Ferritin:** Measures the amount of ferritin, a blood protein that contains iron. Low serum ferritin levels indicate iron-deficiency anemia, whereas high levels indicate a condition that causes the body to store too much iron, such as polycythemia.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Bone Marrow Aspiration & Biopsy

Bone marrow aspiration and biopsies are performed to obtain samples of bone marrow for diagnostic purposes. Results of bone marrow aspiration and biopsy guide health care professionals in providing tailored and effective care to clients.[14] The results of these procedures provide information about cell composition, overall health, and function of an individual's bone marrow.

Bone marrow aspiration involves the extraction of a small sample of liquid bone marrow from the center of a bone. Common sites for bone marrow aspiration include the pelvic bone and sternum. The procedure is typically

14. Leukaemia Foundation. (2024). *The bone marrow and blood formation*. https://www.leukaemia.org.au/blood-cancer/understanding-your-blood/bone-marrow-and-blood-formation/

performed under local anesthesia. To perform the aspiration, the provider inserts a needle into the bone marrow space and then draws out a liquid sample. The aspiration allows the provider to evaluate the cellular components of the bone marrow, including the composition of red blood cells, white blood cells, and platelets. Bone marrow aspiration is helpful for determining the presence of severe blood disorders, such as leukemia, and is also used to monitor disease progression or treatment effectiveness.[15]

Bone marrow biopsy involves obtaining a small core of bone and marrow tissue from the bone marrow space. The procedure is often performed in conjunction with bone marrow aspiration. In contrast to the bone marrow aspiration procedure, the provider uses a larger needle to remove a cylindrical section of both the bone and marrow. Bone marrow biopsy provides a comprehensive evaluation of the bone marrow, allowing for a closer assessment of the bone marrow's cellular density, structure, and the presence of any abnormal or diseased cells. It helps diagnose a wider range of conditions, including nonhematological disorders like metastatic cancers and immune diseases that may infiltrate the bone marrow.[16]

See Figure 3.5[17] for an illustration of a bone marrow biopsy. See Figure 3.6[18] for an image of a bone marrow biopsy needle.

15. Medline Plus. (2024). *Bone marrow aspiration.* National Library of Medicine. https://medlineplus.gov/ency/article/003658.htm

16. Medline Plus. (2024). *Bone marrow biopsy*. National Library of Medicine. https://medlineplus.gov/ency/article/003934.htm

17. "Blausen_0097_BoneMarrowBiopsy.png" by Blausen Medical Communications, Inc. is licensed under CC BY 3.0

18. "Multi_Purpose_Bone_Marrow_Biopsy_Needle.jpg" by Thirteen Of Clubs from Minneapolis is licensed under CC BY-SA 2.0

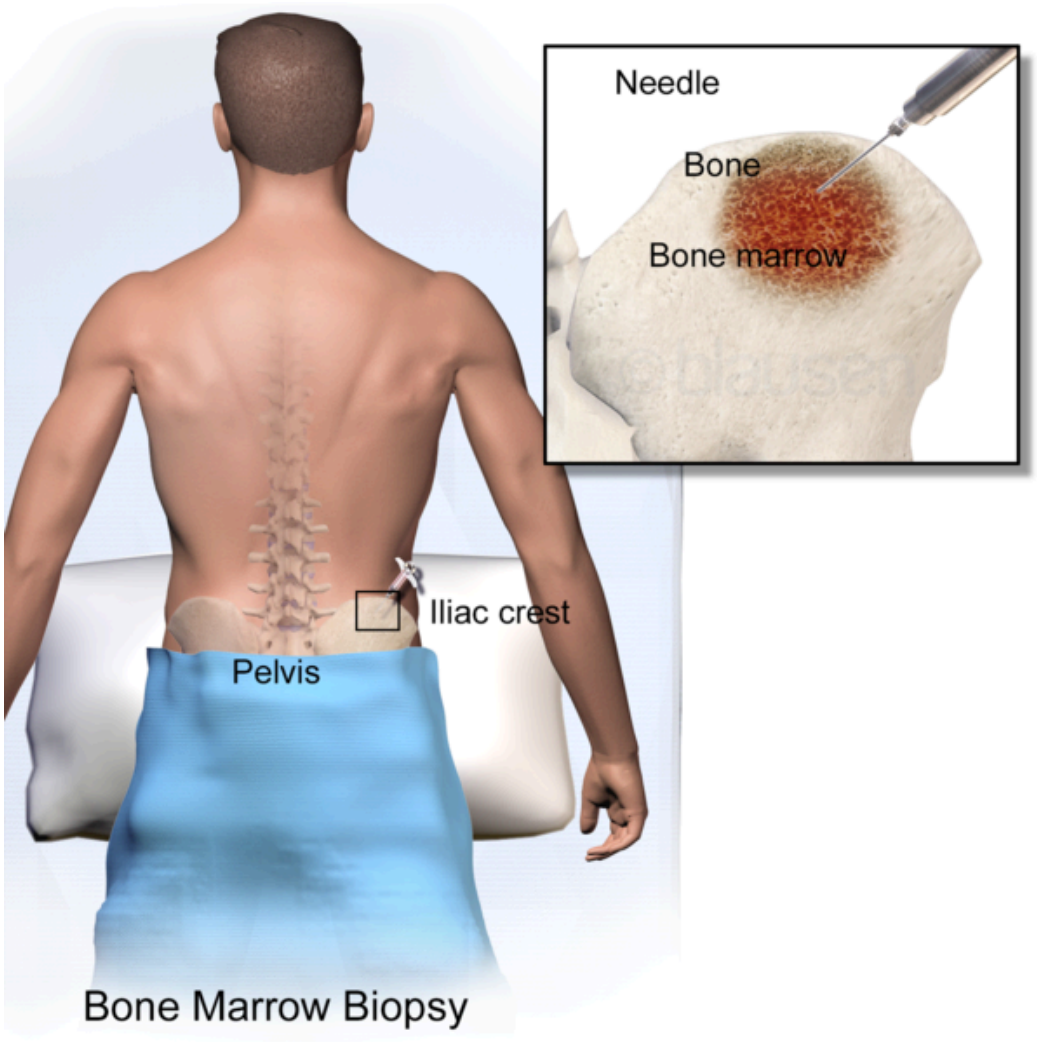


Figure 3.5 Bone Marrow Biopsy



Figure 3.6 Bone Marrow Biopsy Needle

NURSING CARE DURING BONE MARROW ASPIRATION/ BIOPSY

Nursing care for a client undergoing a bone marrow aspiration and biopsy involves not only assisting during the procedure but also providing comprehensive post-procedure care and emotional support. Nurses provide care to clients before, during, and after bone marrow aspiration and biopsy and also provide health teaching.

Pre-Procedure:

- Ensure informed consent has been obtained and the client understands the procedure, its purpose, and potential risks. Notify the surgeon of any concerns related to adequate informed consent.

- Address the client's anxiety by providing clear and honest explanations and offering emotional support.
- Prepare the client for a sterile procedure and explain the need for the precautions to prevent infection.
- Position the client in a prone or side-lying position, whichever is more comfortable and suitable for the procedure.[19,20,21]

During the Procedure:

- Administer a local topical anesthetic to numb the area where the needle will be inserted, reducing discomfort during the procedure.
- Inform the client that they may experience a burning or stinging sensation, pressure, and a crunching sound as the needle enters the bone marrow space.
- Assist the health care provider with the procedure, ensuring the client remains as comfortable and still as possible.
- Offer reassurance and encouragement throughout the process, addressing any concerns the client may have.[22,23,24]

19. Leukaemia Foundation. (n.d.). *The bone marrow and blood formation*. https://www.leukaemia.org.au/blood-cancer/understanding-your-blood/bone-marrow-and-blood-formation/

20. Medline Plus. (n.d.). *Bone marrow biopsy*. National Library of Medicine. https://medlineplus.gov/ency/article/003934.htm

21. Medline Plus. (n.d.). *Bone marrow aspiration*. National Library of Medicine. https://medlineplus.gov/ency/article/003658.htm

22. Leukaemia Foundation. (n.d.). *The bone marrow and blood formation*. https://www.leukaemia.org.au/blood-cancer/understanding-your-blood/bone-marrow-and-blood-formation/

Post-Procedure Care:

- Monitor the client closely for any signs of bleeding, infection, or adverse reactions to the procedure.
- Administer a mild analgesic, as prescribed, to manage any discomfort or pain. The analgesic should be aspirin-free to prevent bleeding.
- Apply an ice pack to the site to help reduce swelling and discomfort.
- Inspect the aspiration site every two hours for any signs of bleeding, swelling, or infection.
- Ensure cessation of bleeding at the site by applying pressure as needed until it resumes.[25,26,27]

Health Teaching:

- Educate the client about potential side effects, such as mild pain or discomfort at the aspiration site and inform them of when to seek further medical attention if needed.
- Review any post-procedure care instructions and ensure the client

23. Medline Plus. (n.d.). *Bone marrow biopsy.* National Library of Medicine. https://medlineplus.gov/ency/article/003934.htm

24. Medline Plus. (n.d.). *Bone marrow aspiration.* National Library of Medicine. https://medlineplus.gov/ency/article/003658.htm

25. Leukaemia Foundation. (n.d.). *The bone marrow and blood formation.* https://www.leukaemia.org.au/blood-cancer/understanding-your-blood/bone-marrow-and-blood-formation/

26. Medline Plus. (n.d.). *Bone marrow biopsy.* National Library of Medicine. https://medlineplus.gov/ency/article/003934.htm

27. Medline Plus. (n.d.). *Bone marrow aspiration.* National Library of Medicine. https://medlineplus.gov/ency/article/003658.htm

understands how to care for the site and when to follow up with the health care provider.

- Offer emotional support and address any concerns or questions the client may have regarding the postoperative care at home.
- Provide instructions to the client on activity restrictions, advising against contact sports or any activity that may cause trauma to the area for 24-48 hours.[28,29,30]

Check Your Knowledge – Clinical Scenario Continued Part B

Recall Sarah Jimenz, discussed earlier in this section. Sarah presented to her primary care provider with a chief complaint of fatigue, bruising, and swollen lymph nodes in her neck for the past two months. She also reported ongoing shortness of breath with minor exertion and presence of heart palpitations.

Based on Sarah Jimenz's presentation and the physical assessment findings previously discussed, the health care provider determines additional laboratory and diagnostic testing should be ordered.

28. Leukaemia Foundation. (n.d.). *The bone marrow and blood formation*. https://www.leukaemia.org.au/blood-cancer/understanding-your-blood/bone-marrow-and-blood-formation/

29. Medline Plus. (n.d.). *Bone marrow biopsy.* National Library of Medicine. https://medlineplus.gov/ency/article/003934.htm

30. Medline Plus. (n.d.). *Bone marrow aspiration.* National Library of Medicine. https://medlineplus.gov/ency/article/003658.htm

1. What laboratory and diagnostic tests would be helpful in diagnosing Sarah? Why?

Check your answers in the Chapter 3 Answer Key

3.4 Common Hematological Disorders

Hematological conditions discussed in this chapter include anemia, iron-deficiency anemia, vitamin B12 and folate deficiency anemia, sickle cell disease, polycythemia vera, thrombocytopenia, leukopenia, and aplastic anemia.

3.5 Anemia

Anemia is a condition characterized by a reduction in either the number of red blood cells, the amount of hemoglobin, or the hematocrit (percentage of red blood cells in the total blood volume). There are several types of anemia with different causes and treatments. Anemia itself is not a specific disease, but an abnormal condition that causes a decreased amount of oxygen delivered to body tissues, resulting in a variety of potential symptoms.[1]

Common symptoms of anemia include fatigue, weakness, pale skin, unexplained shortness of breath, and heart palpitations.[2] Severe symptoms can include fainting, angina (chest pain), and myocardial infarction (heart attack). See Figure 3.7[3] for an illustration of the symptoms of anemia.

1. American Society of Hematology. (n.d.). *Anemia*. https://www.hematology.org/education/patients/anemia
2. American Society of Hematology. (n.d.). *Anemia*. https://www.hematology.org/education/patients/anemia
3. "Symptoms_of_anemia.svg.png" by Mikael Häggström is licensed in the Public Domain

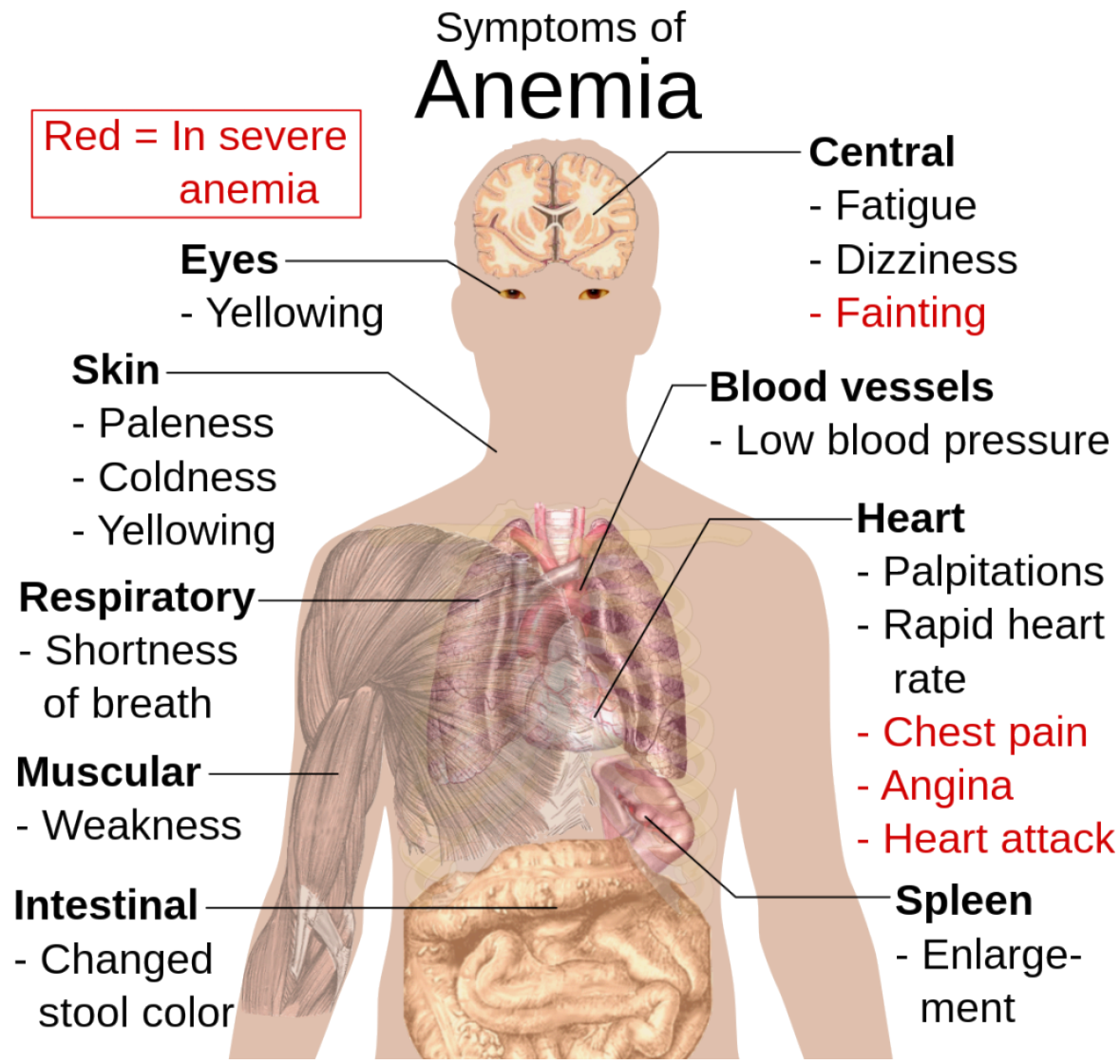


Figure 3.7 Symptoms of Anemia

There are several common reasons for anemia in adults, including gastrointestinal (GI) bleeding caused by various gastrointestinal disorders such as peptic ulcers, inflammatory bowel disease, or colorectal cancer; chronic kidney disease; and excessive menstrual bleeding in females.[4]

4. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

Blood Transfusions

In severe cases of symptomatic, severe anemia (i.e., dyspnea or chest pain) or hemoglobin levels less than 7 g/dL, transfusions of red blood cells are typically prescribed to rapidly increase hemoglobin levels.

Registered nurses administer blood products according to hospital policies and protocols and assess the client for transfusion reactions and potential complications. Nurses also evaluate the effectiveness of blood transfusions by monitoring the client's hemoglobin level. For each unit of RBCs transfused, the client's hemoglobin level can be anticipated to increase by 1g/dL.

Nurses who administer blood products must complete specific training for safe transfusion practices and demonstrate competency in the transfusion administration process. The nurse is responsible for knowing which blood components are appropriate for specific client situations and serving as the last link in the chain of safety events. Agency policy and procedures must be strictly followed to prevent client harm. The nurse must verify that the client has signed informed consent for the procedure in their medical record.

Nurses must be aware of the client's beliefs (and in the case of minors, their parents' religious beliefs). Some religions, such as Jehovah's Witnesses, oppose blood transfusions. They may be excommunicated from their church and the facility can be sued, even if the transfusion is implemented to save their life. This is another reason why it is critical to obtain written informed consent prior to initiating blood or blood product administration. It is essential to follow agency policies and procedures if a client (or the parent of a minor) refuses blood therapy.

Prior to blood product administration, the nurse confirms that a blood sample has been collected from the client and transported to the laboratory within the past 72 hours for typing and compatibility screening. This is the first step in maintaining client safety and preventing errors. Diligent client identification and blood product compatibility verification are vital for safe blood product administration. A two-person verification process is used for blood product transfusions. The first individual is the qualified transfusionist who will administer the blood or blood product to the client. The second individual conducting the identification verification process is qualified to participate in the verification process, as determined by the hospital. See

Table 3.5a for an overview of nursing responsibilities related to administration of blood transfusions based on using the nursing process.

Table 3.5a. Nursing Responsibilities Related to Blood Product Administration[5]

5. Blood and blood product transfusion. (2022). *Lippincott procedures*. http://procedures.lww.com

Assessment	Rationale
Verify written informed consent has been received for the procedure. Check the form to ensure it is properly completed and signed and assess client understanding of the procedure.	Infusion of blood is an invasive procedure with inherent risks and requires specific informed consent. Client understanding of the procedure and its rationale must be assessed by the nurse prior to its initiation.
Verify provider order for the blood product to be administered. Note any pre- or post-transfusion medications that have been prescribed.	A provider order is necessary before transfusing any blood product. Verifying the order and associated medications ensures they are appropriately administered.
Obtain client allergies, previous transfusion history, and transfusion reactions.	Gathering this data helps prevent transfusion reactions. If the client has had previous transfusion reactions, measures can be taken to help prevent another one from occurring.
Assess the recent laboratory values and results related to the blood product being transfused.	Ensure the type and screen has been completed. Assessment of other laboratory values provides a baseline comparison when evaluating the client's response to the transfusion or in the event of a complication.
Analyze recent vital signs and notify the provider of any concerns. For example, if the client has a fever, clarify the order with the provider before obtaining the blood product from the blood bank.	If the client has any vital signs that are out of range and require clarification from the provider, this clarification should be addressed before obtaining the blood product because it typically must be initiated within 20-30 minutes of retrieval and cannot be returned.
Perform a respiratory assessment, skin assessment, and pain assessment.	Establish a baseline to use to trend future assessments and recognize changes in the event a transfusion reaction occurs.
Planning	
Review the indication for the transfusion with clinical supportive data.	The RN develops a plan of care and formulates expected outcomes of the procedure based on the indication for the transfusion.
Review expected outcomes for the client receiving a blood product transfusion. Expected outcomes of the transfusion are based on the indications for the transfusion.	Examples of expected outcomes for a PRBC transfusion include improved activity tolerance and improved hemoglobin and hematocrit to target range.
Determine if pre- or post-medication is needed for this specific client.	Diphenhydramine and acetaminophen are commonly prescribed for clients with a previous history of reactions. Anticipate that a client with a history of heart failure who will be receiving multiple units of blood may require furosemide to prevent fluid overload.
Implementation	
Verify venous access with 20G to 24G short peripheral catheters based on vein size and client preference, or 18G to 20G if rapid transfusion is required. Verify the integrity and patency of IV catheters. The distal lumen of a central venous access device may also be used to administer blood.	Correct catheter use ensures appropriate size, gauge, and viable intravenous access for the blood product. A second venous access site may be required for administration of other fluids, medications, or other substances while blood is transfusing because they cannot be administered using the same line.
Use Y-infusion tubing sets specific to blood product administration and 0.9% normal saline IV fluid.	Only IV normal saline is compatible with simultaneous blood product administration. Lactated ringers, dextrose, hyperalimentation (artificial nutrients supplied intravenously), and other intravenous solutions with medications are not compatible with blood products.
Obtain blood or blood product from facility blood bank (follow agency policy).	Blood should not remain in the client care area for more than 30 minutes before the transfusion begins, so the nurse must be prepared to begin the transfusion shortly after the blood is delivered.

Perform the following checks with a second nurse or agency-defined trained health professional: compare the blood unit to the order, verify the client's identity, verify the client's blood type and Rh factor against the type of blood that will be infused, check the expiration of the blood component, and compare the client's number against the blood product number. The nurses should also visually inspect the blood for any unusual color, precipitate, clumping, and any other unusual signs.	Checks by two nurses prevent transfusion reactions through proper client identification, verification of the prescription, and blood product compatibility. **Note:** The Joint Commission classifies a blood incompatibility error as a sentinel event (i.e., an event that is an unexpected occurrence resulting in death or serious physical or psychological injury, or the risk thereof).[6]
Obtain and document pre-transfusion vital signs and a baseline physical assessment. If the client is febrile (i.e., above 37.8° C or 100.4° F), notify the provider before starting the transfusion.	Baseline data and hemodynamic status must be established immediately before the transfusion begins so that manifestations of a transfusion reaction can be quickly recognized. For example, if a client develops fluid overload, a baseline assessment, including lung sounds, can be used for comparison with new findings.
An RN initiates the blood transfusion and remains with and monitors the client for a transfusion reaction for at least 15 minutes as the transfusion begins at a slow rate of 2 mL/min (i.e., 120 mL/hour). Ask the client to report unusual sensations (i.e., chills, hives, itching, shortness of breath, and chest pain). Note: All blood products must be completely administered in less than four hours. Administration sets are changed based on agency policy, commonly at the completion of every unit or every four hours.	Most transfusion reactions occur within the first 15 minutes of starting the transfusion. Blood products should not hang for more than four hours, and administration sets should be changed at the completion of each unit or every four hours to reduce bacterial contamination.
After 15 minutes, obtain another set of vitals. The RN determines an appropriate rate of transfusion based on agency policy and client considerations.	Most transfusion reactions occur within the first 15 minutes of starting the transfusion. The rate of infusion can be adjusted after the initial 15 minutes based on client tolerance. For example, a client with an active hemorrhage requires a fast rate whereas an elderly, symptomatic anemic client with a history of heart failure requires a slower rate.
If signs of a transfusion reaction occur, stop the transfusion and perform appropriate steps based on the agency's transfusion reaction policy and protocol. Assess the client and obtain vital signs. Start normal saline with new primed tubing attached directly to the venous access device and notify the health care provider immediately. Do not infuse saline through the existing tubing because it will cause the blood in the tubing to enter the client. Do not discard the blood product or tubing; prepare it for lab analysis according to agency policy.	These steps prevent increased risks to the client. New tubing ensures that none of the blood product will further infuse into the client. Agency policy typically requires additional steps such as labs drawn, urine collection, and forms to be filled out and sent to lab.
Frequently monitor and assess the IV site and surrounding area.	Early detection of IV site complications improves client outcomes.
Evaluation	
After the procedure, evaluate and document client response and tolerance of the infusion, comparing current status to baseline data, such as physical assessment, vital signs, and lab results. Assess IV site to ensure integrity and patency after the infusion.	Evaluation determines if the goals of the transfusion therapy were achieved or if late onset transfusion complications are developing. **Note:** Some laboratory results may not reflect anticipated targets for several hours after the transfusion is completed.

Nurses must be knowledgeable of potential complications that can occur during blood transfusions. The majority of transfusion reactions occur because of clinical error.

6. World Health Organization. (2022). *Blood products*. https://www.who.int/health-topics/blood-products#tab=tab_

Delegation Tips

Each state's Nurse Practice Act specifies if the skill of blood product transfusion can be delegated to a licensed vocational/practical nurse (LVN/PN) and if unlicensed assistive personnel (UAP) may collect vital signs after the first 15 minutes of the transfusion and the client's stability has been confirmed. During the delegation process, the registered nurse (RN) should specify the frequency in which the client should be monitored and vital signs collected, as well as the parameters for vital signs and symptoms that should be immediately reported. Examples of parameters include an increased temperature, decreased pulse oximetry reading, shortness of breath, chest pain, hives, or chills. The RN retains responsibility and accountability for monitoring the client's status during the transfusion.

Transfusion Reactions

Transfusion reactions are adverse events that are directly related to the transfusion of blood products and may range from mild to severe with life-threatening effects. The onset of transfusion reactions may occur during the transfusion (known as acute transfusion reactions) or in days or weeks following the transfusion (known as delayed transfusion reactions). Reactions may be an immune-related reaction or non-immunological condition. Immune-related reactions are often due to a mismatch or incompatibility of the transfused blood product and the recipient's blood type or Rh factor. Non-immunologic reactions are typically caused by the physical effects of the blood component or the transmission of a disease.

It can be difficult to ascertain if a reaction will occur and what kind of reaction is occurring because some reactions can present with non-specific, overlapping manifestations. The most common manifestations of transfusion reactions include fever, urticaria, chills, and itching. Some mild symptoms

may resolve without treatment, but some are severe, presenting with high fevers, respiratory distress, hypotension, and hemoglobinuria.[7]

The most common types of transfusion reactions include acute hemolytic, febrile non-hemolytic, delayed hemolytic, anaphylactic, simple allergic, transfusion-associated circulatory overload (TACO), transfusion-related acute lung injury (TRALI), and septic (bacterial contamination).[8] If a client experiences a blood transfusion reaction, always follow agency policy to manage mild to severe blood reactions. See Table 3.5b for additional information about different types of transfusion reactions, their causes, onset, manifestations, prevention, and related nursing interventions.[9]



Life-threatening transfusion reactions typically occur within 15 minutes of initiating a transfusion. Remain with the client during this time and monitor their physiologic responses.

Table 3.5b. Transfusion Reactions and Related Nursing Interventions[10]

7. Lotterman, S., & Sharma, S. (2023). *Blood Transfusion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499824/
8. Lotterman, S., & Sharma, S. (2023). *Blood Transfusion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499824/
9. Lotterman, S., & Sharma, S. (2023). *Blood Transfusion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499824/
10. Lotterman, S., & Sharma, S. (2023). *Blood Transfusion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499824/

Transfusion Reaction	Cause	Onset	Manifestations	Prevention	Nursing Interventions
Mild to Moderate Allergic Reaction	Hypersensitivity to a foreign protein in the donor product.	During the transfusion and up to 24 hours post-transfusion.	Pruritus, erythema, local hives, urticaria, and bronchospasm.	If known history of a previous allergic reaction, may require administration of an antihistamine prior to infusion.	Stop transfusion and notify the provider. Administer antihistamine if prescribed and carefully monitor for new or progression of symptoms. Analyze vital signs every 15 minutes.
Anaphylactic	Recipient allergy to donor antigen (most often IgA).	Occurs within 5-15 minutes of initiation of transfusion.	Similar to mild/moderate allergic reaction, but more severe with nausea/vomiting, shortness of breath, cough, wheezing, hypotension, and loss of consciousness. May lead to cardiac arrest.	If known history of previous allergic reaction, transfuse with leukocyte – depleted RBCs.	Stop transfusion and notify the provider. Maintain IV access. Administer epinephrine, antihistamines, and corticosteroids as prescribed. Monitor vital signs frequently until stable.
Febrile Non-Hemolytic	Caused by cytokines released from blood donor's leukocytes or platelets. Most common transfusion reaction that typically occurs in immunocompromised clients.	Occurs 30 minutes after initiation of transfusion to six hours post-transfusion.	Increased fever greater than 1-degree Celsius above baseline with associated flushing, chills, muscle pain, and headache. Tachycardia, tachypnea, and hypotension may also occur.	If known history of a previous febrile non-hemolytic reaction, use a leukocyte-reduced blood product.	Stop transfusion and notify the provider. If prescribed, administer antipyretics. Monitor temperature every four hours and as needed.
Acute Hemolytic	ABO and Rh incompatibility results in destruction of RBCs.	Occurs within 15 minutes of initiation of transfusion.	Flank pain, chest pain, increased heart rate, chills, increased temperature, low back pain, headache, dyspnea, bronchospasm, anxiety, hypotension, or pain along the accessed vein.	Considered a hospital-acquired condition preventable by diligent client identification and blood product compatibility verification.	Stop transfusion, remove blood tubing, and maintain access with 0.9% normal saline. Notify the provider and monitor vitals every 15 minutes. Obtain blood and urine samples and send to the lab with unused portion of blood product.

Septic	Contamination of blood product with bacterial microorganisms.	During transfusion and possibly up to two hours post-transfusion.	High fever, skin flushing, hypotension, back pain, abdominal cramping, nausea, and vomiting and diarrhea.	Complete transfusion within four hours to avoid bacterial growth. Proper care of blood product is required from donation through administration.	Stop the transfusion, remove blood product and tubing, and maintain IV access with 0.9% normal saline. Notify the provider. Monitor vital signs. Obtain blood cultures as prescribed. Administer fluids, obtain gram stain, and provide broad-spectrum antimicrobials as prescribed.
Transfusion-Associated Circulatory Overload (TACO)	Occurs when the volume of the transfusing blood component causes volume overload (hypervolemia) from an overly rapid administration rate or amount.	Can occur anytime during the transfusion or within one to two hours post-transfusion.	Crackles in lung bases, dyspnea, cough, tachypnea, tachycardia, hypertension, jugular vein distension, and headache.	Follow prescribed rate of infusion, typically 2 – 4 mL/kg/hr. Use caution with older adults and with those who have cardiac and renal disorders.	Reduce rate or stop transfusion as prescribed by provider. Monitor and manage client manifestations. Elevate head of bed and administer diuretic as prescribed.
Transfusion – Related Acute Lung Injury (TRALI)[11]	Acute lung injury caused by antibodies in the donor blood products that react with antigens in the recipient. Recipient chemical mediators are released and lead to pulmonary edema.	Within 6 hours to 72 hours of transfusion of blood products that are rich in plasma.	Cyanosis, dyspnea, fever, hypoxemia, hypotension, and pulmonary edema that is not cardiac-related (i.e., due to fluid overload).	Assess for contributing factors that predispose the client to this condition, including infection, inflammation, or recent surgery.	Stop the transfusion immediately and notify the provider. Administer treatment to support blood pressure as prescribed. Administer supplemental oxygen as prescribed. Prepare for endotracheal intubation and mechanical ventilation. Notify the blood bank so they can screen for certain donor antibodies.

11. Lotterman, S., & Sharma, S. (2023). *Blood Transfusion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499824/

View this supplementary YouTube video[12] on blood transfusion reaction types:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=874#oembed-1

Read additional information about blood product transfusions in the "Administer Blood Products" chapter of Open RN *Nursing Advanced Skills*.

12. RegisteredNurseRN. (2018, March 20). *Blood transfusion procedure nursing | Reaction types, complications (hemolytic/ febrile) NCLEX* [Video]. YouTube. Used with permission. https://youtu.be/v4PHCwvkH24

3.6 Iron-Deficiency Anemia

A common type of anemia is **iron-deficiency anemia (IDA)**. Iron-deficiency anemia is characterized by a lack of sufficient iron in the body, leading to decreased production of hemoglobin and red blood cells.[1,2]

Iron-deficiency anemia can develop due to several reasons, including the following risk factors[3,4]:

- **Inadequate Dietary Intake:** Not consuming enough iron-rich foods in the diet can lead to a deficiency. Iron is found in foods such as meat, fish, poultry, legumes, and leafy green vegetables. Individuals who consume vegetarian diets may experience iron deficiency due to the lack of iron consumption from meat products. Infants and young children who are exclusively breastfed may also be at risk due to inadequate iron intake. Elderly individuals also may experience increased risk of iron-deficiency anemia related to poor dietary intake
- **Increased Iron Requirements:** Certain conditions, such as pregnancy and rapid growth during childhood, can increase the body's iron requirements. Dietary supplementation with iron during pregnancy is often necessary to ensure the developing fetus and placenta receive adequate nutritional support due to the increased iron demands of

1. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

2. American Society of Hematology. (n.d.). *Iron-deficiency anemia.* https://www.hematology.org/education/patients/anemia/iron-deficiency

3. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

4. American Society of Hematology. (n.d.). *Iron-deficiency anemia.* https://www.hematology.org/education/patients/anemia/iron-deficiency

pregnancy.

- **Blood Loss:** Chronic or acute blood loss from medical conditions such as gastrointestinal or genitourinary bleeding, or excessive blood loss during menstruation, can deplete the body's iron stores.
- **Poor Iron Absorption:** Some individuals may have difficulty absorbing iron from their diet due to gastrointestinal disorders (such as inflammatory bowel disease) or gastric bypass surgeries that affect the absorption process.

Assessment

Physical Examination

Clinical manifestations of iron-deficiency anemia are related to the decreased oxygenation of tissues due to decreased levels of hemoglobin. See Table 3.6a for a summary of clinical manifestations of iron-deficiency anemia across body systems.

Table 3.6a. Clinical Manifestations of Iron-Deficiency Anemia[5,6]

5. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

6. American Society of Hematology. (n.d.). *Iron-deficiency anemia.* https://www.hematology.org/education/patients/anemia/iron-deficiency

Body System	Clinical Manifestations
Skin	Pallor; cold extremities; thin, brittle, or spoon-shaped (**koilonychia**) nails.
Cardiovascular	Generalized fatigue and weakness, **tachycardia** (rapid heart rate), palpitations, and **angina** (chest pain). In severe anemia, **myocardial infarction** (heart attack) can occur due to decreased oxygenation.
Respiratory	**Dyspnea** (shortness of breath) and **tachypnea** (rapid respiratory rate), especially during physical activity.
Musculoskeletal	Generalized weakness.
Gastrointestinal	**Glossitis** (inflammation of the tongue), causing a smooth or sore tongue.
Nervous	Headaches and dizziness. In severe anemia, fainting may occur.
Behavior/Psychological	**Pica**, the craving and consumption of non-food items (e.g., ice, clay, dirt).

- View an image of koilonychia.[7]
- View an image of glossitis.[8]

7. Warner, M. J., & Kamran, M. T. (2023). Iron Deficiency Anemia. StatPearls [Internet]. [Figure, iron deficiency – spoon shaped nail. Image courtesy S Bhimji MD]https://www.ncbi.nlm.nih.gov/books/NBK448065/figure/article-23767.image.f3/

8. Bouquat, J. (n.d.). *Atrophic glossitis* [Figure]. https://www.brown.edu/Courses/Digital_Path/systemic_path/hn/atrophicglossitis.html

Diagnostic Testing

To identify the presence of iron-deficiency anemia, health care providers order various laboratory tests to examine the levels of iron and hemoglobin present in the blood. These tests may include a CBC, serum ferritin, serum iron level, and total iron-binding capacity. Other diagnostic tests may include laboratory studies to examine blood levels of transferrin, a glycoprotein that binds to iron in the bloodstream and is important for transporting iron throughout the body. Low levels of transferrin are often present in iron-deficiency anemia.[9,10,11] Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing priorities for clients with anemia involve addressing inadequate oxygenation, managing fatigue and activity intolerance, identifying nutritional deficiencies, administering prescribed medications, monitoring blood transfusions, providing education and support, and collaborating with the health care team for comprehensive care.[12]

9. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia
10. American Society of Hematology. (n.d.). *Iron-deficiency anemia.* https://www.hematology.org/education/patients/anemia/iron-deficiency
11. MedlinePlus. (2016). *Blood count tests.* National Library of Medicine. https://medlineplus.gov/bloodcounttests.html
12. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

Nursing diagnoses for clients with iron-deficiency anemia are formulated based on the client's assessment data, medical history, and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions. Recall that symptoms of anemia are related to decreased hemoglobin and decreased transportation of oxygen to the tissues and organs, which can result in fatigue and shortness of breath.

Nursing diagnoses include the following[13]:

- Fatigue
- Decreased Activity Tolerance
- Ineffective Peripheral Tissue Perfusion
- Imbalanced Nutrition: Less Than Body Requirements
- Readiness for Enhanced Knowledge

> Review information about creating nursing diagnoses in the "Diagnosis" section of the "Nursing Process" chapter of Open RN *Nursing Fundamentals, 2e*.

Outcome Identification

Nursing care should always be individualized and client-centered. Outcome identification includes setting short- and long-term goals and creating specific expected outcome statements for nursing diagnoses identified for the client.[14]

13. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2021). *Nursing diagnoses: Definitions and classification, 2021-2023*. Thieme Publishers New York.

14. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

- Review information about setting in the "Outcome Identification" section of the "Nursing Process" chapter in Open RN *Nursing Fundamentals, 2e*.

Sample expected outcomes for common nursing diagnoses related to anemia are as follows:

- *The client will verbalize three energy management strategies.*
- *The client's vital signs will remain within normal limits during activity.*
- *The client will verbalize three preferred food sources containing iron.*
- *The client will verbalize when to contact the health care provider for severe symptoms of anemia, including worsening shortness of breath on exertion and chest pain.*

Interventions

Medical Interventions

Medical interventions for anemia address the underlying cause of anemia and improve the client's hemoglobin levels and overall health. The specific treatment plan depends on the severity of the anemia, the underlying cause, and the client's individual health status. Common medical interventions and medications prescribed to address anemia include the following[15,16]:

15. American Society of Hematology. (n.d.). *Anemia*. https://www.hematology.org/education/patients/anemia
16. American Society of Hematology. (n.d.). *Iron-deficiency anemia*. https://www.hematology.org/education/patients/anemia/iron-deficiency

- **Treating Underlying Conditions:** If the iron deficiency is due to an underlying condition, such as gastrointestinal bleeding or excessive menstrual bleeding, treating the primary condition is essential to correct the anemia.
- **Iron and Other Nutritional Supplements:** The primary treatment for iron-deficiency anemia involves oral or intravenous iron supplementation. Oral iron supplements are commonly prescribed and come in various forms, such as ferrous sulfate, ferrous gluconate, and ferrous fumarate. These supplements help replenish iron stores and increase hemoglobin levels. Combining iron supplementation with dietary changes can enhance iron absorption.

In severe cases of iron-deficiency anemia, or when oral iron is not well-tolerated or not effective, intravenous iron therapy may be administered. IV iron is given directly into the bloodstream and can rapidly correct iron deficiency.

Clients are encouraged to eat iron-rich foods, such as red meat, poultry, fish, beans, lentils, spinach, and fortified cereals. Vitamin C can enhance the absorption of nonheme iron (found in plant-based foods and iron supplements).

- **Blood Transfusions:** In severe cases of symptomatic, severe anemia (i.e., dyspnea or chest pain) or hemoglobin levels less than 7 g/dL, transfusions of red blood cells are typically prescribed to rapidly increase hemoglobin levels.
- **Recombinant Human Erythropoietin:** Clients who have a low hemoglobin related to chronic kidney disease or cancer may be prescribed recombinant human erythropoietin. Recombinant human erythropoietin stimulates erythropoietin, a hormone produced by the kidneys that plays an essential role in the production and maturation of red blood cells (RBCs).[17]

17. Susantad, T., Fuangthong, M., & Tharakaraman, K. et al. (2021). Modified

Nursing Interventions

Nursing interventions for anemia focus on maintaining adequate oxygenation, promoting energy management and managing fatigue, administering iron and other nutritional supplements, and providing health teaching to promote client well-being and prevent complications.[18,19,20,21]

MAINTAIN ADEQUATE OXYGENATION

Maintaining adequate oxygenation is a nursing priority. Nurses monitor pulse oximetry (SpO2) readings and heart rate and administer oxygen therapy as needed to maintain adequate oxygenation. However, it is important to keep in mind that although SpO2 is an efficient method for monitoring a client's oxygenation status, it is an estimate and not always accurate. If the client is severely anemic with a significantly decreased hemoglobin level, they may have a normal SpO2 reading because their existing hemoglobin is saturated with oxygen, even though the available oxygen is not enough to meet the metabolic demands of their body. If the client has deteriorating respiratory

recombinant human erythropoietin with potentially reduced immunogenicity. *Scientific Reports, 11*, 1491. https://doi.org/10.1038/s41598-020-80402-1

18. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia
19. American Society of Hematology. (n.d.). *Iron-deficiency anemia.* https://www.hematology.org/education/patients/anemia/iron-deficiency
20. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications (NIC)* (8th ed.). Elsevier.
21. Makic, M. B., & Martinez-Kratz, M. R. (2023). A*ckley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

status, a more specific measurement of oxygen dissolved in the blood may be obtained from an arterial blood gas (ABG).

> Read more details about oxygen therapy, hypoxia, and ABG in the "Oxygen Therapy" chapter of Open RN *Nursing Skills, 2e*.

ADMINISTER BLOOD PRODUCT TRANSFUSION

Clients with symptomatic, severe anemia (i.e., dyspnea and/or chest pain) are prescribed blood transfusion(s) to rapidly increase their hemoglobin levels and improve oxygenation levels. Registered nurses administer blood products according to hospital policies and protocols and assess the client for transfusion reactions and potential complications. Nurses also evaluate the effectiveness of blood transfusions by monitoring the client's hemoglobin level. For each unit of RBCs transfused, the client's hemoglobin level can be anticipated to increase by 1g/dL.

> Read additional information about blood transfusions in the "Anemia" section of this chapter.

PROMOTE ENERGY MANAGEMENT

In addition to ensuring adequate oxygenation, another priority nursing intervention is helping clients manage fatigue and improve their activity tolerance. Fatigue can significantly affect a client's overall functioning and quality of life. It can impact their ability to perform their role responsibilities at home and at work and participate in self-care.

Signs of activity intolerance due to decreased oxygenation of tissues include dyspnea on exertion, headaches, dizziness, palpitations, chest pain, and

verbalization of fatigue. Nurses can ask clients to rate their perceived exertion level and use this rating to evaluate effectiveness of interventions. Perceived exertion is based on the physical sensations a person experiences during physical activity, including increased heart rate, increased respiration or breathing rate, increased sweating, and muscle fatigue.[22]

> Read more about How to Measure Physical Activity Intensity at the Centers of Disease Control and Prevention website.

Fatigue and muscle weakness can also increase the risk for falls, especially in older adults. Nurses implement appropriate fall prevention strategies according to the client's level of fatigue and weakness.

> Read more about fall prevention strategies in the "Preventing Falls" section of the "Safety" chapter of Open RN *Nursing Fundamentals, 2e*.

Nurses play a significant role in helping clients regulate their energy, prevent fatigue, and optimize their functioning. Nursing Interventions Classification (NIC) is a standardized, comprehensive classification of nurse-initiated and physician-initiated nursing treatments. NIC provides a list of evidence-based

22. Centers for Disease Control and Prevention. (2022). *Perceived exertion (Borg rating of perceived exertion scale).* U.S. Department of Health & Human Services. https://www.cdc.gov/physical-activity-basics/measuring/?CDC_AAref_Val=https://www.cdc.gov/physicalactivity/basics/measuring/exertion.htm

nursing interventions under the “Energy Management” category that applies to a variety of medical conditions, including anemia. See selected nursing interventions from this category in the following box.

Selected NIC Nursing Interventions to Promote Energy Management[23,24]

- Correct physiological causes of fatigue, as prescribed.
- Monitor nutritional intake to ensure adequate energy resources.
- Monitor cardiovascular response to activity (i.e., tachycardia, dyspnea, dysrhythmias, diaphoresis, pallor, respiratory rate, blood pressure).
- Teach activity organization and pacing techniques to prevent fatigue.
- Assist the client to establish realistic activity goals.
- Encourage rest periods alternated with activity periods.
- Encourage physical activity (i.e., performance of activities of daily living [ADLs] and ambulation consistent with the client’s energy resources).
- Teach the client to recognize signs and symptoms of fatigue that require reduction in activity.

23. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications (NIC)* (8th ed.). Elsevier.

24. Makic, M. B., & Martinez-Kratz, M. R. (2023). A*ckley and Ladewig’s Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

- Encourage verbalization of feelings about fatigue and limitations.

Nurses teach clients how to manage fatigue and improve their activity tolerance by balancing periods of activity with rest periods. Based on their level of fatigue, clients may also need to have their care clustered to use their available energy to complete desired activities and reduce fatigue. For example, the client may need to sit when performing tasks or take breaks between showering, dressing, and eating. They may require breaks before eating to maintain their energy to eat.

To improve activity intolerance and prevent potential complications resulting from immobility, nurses encourage clients to do as much activity as tolerated while using techniques to conserve limited energy and prevent fatigue.

Clients living at home may require assistance in completing their activities of daily living and in meal preparations, especially older adults. Nurses can assist in making referrals for home health care and/or meal delivery services, such as Meals on Wheels.

Nurses are aware that living with chronic fatigue and activity intolerance is both physically and emotionally difficult. Encouraging clients to verbalize their feelings regarding limitations helps facilitate their coping and resiliency.

ADMINISTER IRON AND OTHER NUTRITIONAL SUPPLEMENTS

For clients with iron-deficiency anemia, nurses administer prescribed iron supplements and provide health teaching about medications to promote absorption and manage side effects. Iron is available via oral (pill and liquid), intramuscular, and intravenous routes. Nurses play a key role in teaching clients the following topics regarding iron supplementation[25]:

25. Mayo Clinic. (2023). *Drugs and supplements: Iron supplement (oral route,*

- Oral iron is absorbed best on an empty stomach, but if difficult to tolerate may be taken with food.
- Common side effects of iron are gastrointestinal upset and constipation. Although iron is best absorbed on an empty stomach, it may be taken with food if gastrointestinal upset occurs. Fiber and fluids should be encouraged to prevent constipation.
- Iron can change the color of stools to black or a greenish/black color. Report changes in stool color to the provider.
- Liquid forms of iron can stain teeth. To prevent or reduce staining, iron preparations can be mixed with a small amount of water or fruit or tomato juice. Drinking the dose with a straw can also help prevent staining. When iron is prescribed for infants, it is generally given via medicine dropper. The dropper should be placed on the back of the tongue during administration. If teeth staining does occur, it can be removed by brushing the teeth with baking soda or hydrogen peroxide.
- Iron products should not be taken at the same time as dairy products, antacids, or calcium supplements, as these can interfere with the absorption of iron.
- If iron is prescribed as an intramuscular injection, the Z-track method is preferred due to iron's irritating and discoloring nature.

Clients are also encouraged to eat iron-rich foods such as red meat, poultry, fish, legumes, nuts, seeds, and green leafy vegetables. Clients are advised to enhance iron absorption from iron supplements and iron-rich foods by accompanying their intake with vitamin C food sources or supplements. Foods that are high in vitamin C are citrus fruits and fresh vegetables such as broccoli, yellow peppers, and Brussels sprouts.

PROVIDE HEALTH TEACHING AND HEALTH PROMOTION

Nurses provide health teaching about anemia, causes, and treatments to

parenteral route). https://www.mayoclinic.org/drugs-supplements/iron-supplement-oral-route-parenteral-route/description/drg-20070148

promote client well-being and overall health by performing the following interventions[26]:

- Assess the client's current knowledge of anemia, causative factors, and treatment regimen.
- Assess the client's resources and ability to obtain prescribed medications and prepare food sources to treat nutritional deficiencies.
- Explain potential side effects of prescribed medications and how to manage them.
- Explain the importance of diagnostic procedures.
- Educate the client and/or family members regarding food rich in iron, folic acid, and vitamin B12, based on the type of anemia diagnosed.
- Educate the client that if left untreated, anemia can contribute to increased risk of infection and illness because of its effect on the immune system.
- Educate the client on energy conservation techniques and fall precautions.
- Explain severe symptoms of anemia and when to contact the health care provider.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

26. Martin, P. (2023). *7 anemia nursing care plans.* NursesLabs. https://nurseslabs.com/anemia-nursing-care-plans/#h-nursing-diagnosis

Iron-Deficiency Anemia Scenario

A female client is diagnosed with iron-deficiency anemia and is prescribed iron supplements. She receives health teaching about incorporating iron-rich foods into her diet. On follow-up laboratory testing, the nurse notices the client's hemoglobin increases from 9.7 g/dL to 10.6 g/dL, and the client reports decreased heart palpitations during exercise. The nurse evaluates these results and determines the expected outcomes are partially met and the nursing plan of care is continued until the next follow-up appointment is scheduled.



RN Recap: Iron-Deficiency Anemia

View a brief YouTube video overview of iron-deficiency anemia[27]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=877#oembed-1

27. Open RN Project. (2024, March 24). *Health Alterations – Chapter 3 Hematological – Iron deficiency anemia* [Video]. YouTube. CC BY-NC 4.0 https://www.youtube.com/watch?v=vR5rDPn1m6E

3.7 Vitamin B12 and Folate Deficiency Anemia

Vitamin B^{12} and folate are water-soluble vitamins required for the production of red blood cells, white blood cells, and platelets. A deficiency of either of these vitamins causes megaloblastic anemia (also called macrocytic anemia) because the red blood cells in these disorders are abnormally large when compared to a healthy red blood cell.

As water-soluble vitamins, vitamin B^{12} and folate are not stored in the body and adequate amounts must be consumed in a person's daily diet. Vitamin B^{12} (also called cobalamin) is present in many animal products, such as meats, dairy products, and eggs. Most balanced diets contain sufficient amounts of B^{12} except for vegan diets. Folate (also called vitamin B^{9}) is present in many animal products and plants, especially liver and dark leafy vegetables. Most diets contain sufficient folate because many countries have supplemented cereals, flours, and grains with folic acid since the late 1990s to reduce the risk of neural tube defects during fetal development that can occur due to folate deficiency.[1,2,3,4]

There are three basic causes of vitamin B^{12} anemia, including dietary

1. Means, R. T., & Fairifeld, K. M. (2023). Causes and physiology of vitamin B12 and folate deficiencies. *UpToDate*. https://www.uptodate.com/contents/causes-and-pathophysiology-of-vitamin-b12-and-folate-deficiencies.

2. National Heart, Lung, and Blood Institute. (2022). *Anemia – vitamin B12 deficiency.* National Institutes of Health. https://www.nhlbi.nih.gov/health/anemia/vitamin-b12-deficiency-anemia

3. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

4. Khan, K. M. & Jialal, I. (2023). Folic Acid Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK535377/

deficiency, decreased absorption of vitamin B^{12}, and an autoimmune disorder called pernicious anemia. Populations at risk for these causes include the following[5,6,7]:

- **Dietary Deficiency:** Individuals who follow a strict vegetarian (vegan) diet and do not eat animal products are at risk for not consuming enough vitamin B^{12} in their daily diet and often require vitamin supplements. Additionally, people of low socioeconomic status may not be able to afford animal proteins that contain Vitamin B12.
- **Decreased Absorption of Vitamin B^{12}:** Some people may consume adequate amounts of vitamin B^{12} but have issues with absorbing this vitamin. Risk factors for decreased absorption of vitamin B^{12} are a gastric bypass, Crohn's disease or other inflammatory bowel disorder, chronic use of antacids or proton pump inhibitors (PPIs), chronic *H. Pylori* infection, gastric cancer, chronic use of metformin, and chronic excess alcohol intake.
- **Autoimmune Disorder: Pernicious anemia** is a specific type of vitamin B^{12} anemia. Pernicious anemia is an autoimmune disorder in which antibodies are formed that attack the stomach cells that produce intrinsic factor. **Intrinsic factor** is a protein produced by the parietal cells of the stomach that carry vitamin B^{12} into the small intestine. Without intrinsic factor, vitamin B^{12} cannot be absorbed by the gastrointestinal tract.

5. National Heart, Lung, and Blood Institute. (2022). *Anemia – vitamin B12 deficiency.* National Institutes of Health. https://www.nhlbi.nih.gov/health/anemia/vitamin-b12-deficiency-anemia

6. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

7. Means, R. T., & Fairifeld, K. M. (2023). Causes and physiology of vitamin B12 and folate deficiencies. *UpToDate*. https://www.uptodate.com/contents/causes-and-pathophysiology-of-vitamin-b12-and-folate-deficiencies.

Folate deficiency has become less common because food has been routinely supplemented with folic acid, but risk factors are similar to vitamin B^{12} deficiency. People who do not consume a varied, nutrient-rich diet are at risk for folate deficiency. For example, people with restrictive diets, anorexia nervosa, or those with excessive chronic alcohol use and a limited diet are at risk. Gastric bypass and inflammatory bowel disorders, as well as chronic medications such as methotrexate, antiseizure medications, and certain antibiotics, can also impact the absorption of folate. Furthermore, there is an increased need for folate for DNA synthesis in people who are pregnant or lactating, have chronic hemolytic anemia or severe eczema, or are undergoing dialysis.[8]

Pathophysiology

In healthy clients, when food sources containing vitamin B^{12} are ingested, vitamin B^{12} binds to an intrinsic factor, which is released from the parietal cells in the stomach. The vitamin B^{12}-intrinsic factor complex is then able to bind to receptors on the ileum of the small intestine, and vitamin B^{12} can be absorbed. If vitamin B^{12} is not absorbed, neurological and hematological impairments will be seen as this vitamin plays a role in many chemical reactions throughout the body.[9]

Vitamin B^{12} and folate play critical roles in DNA and RNA synthesis. Therefore, when these vitamins are not available, not only are typical signs of anemia seen due to impaired red blood cell formation, but also other rapidly dividing cells are also affected. This also leads to elevated homocysteine (an

8. Means, R. T., & Fairifeld, K. M. (2023). Causes and physiology of vitamin B12 and folate deficiencies. *UpToDate*. https://www.uptodate.com/contents/causes-and-pathophysiology-of-vitamin-b12-and-folate-deficiencies.

9. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

amino acid that is broken down in the process of DNA synthesis), which can be useful for diagnostic purposes.[10,11]

Vitamin B^{12} is also needed as a cofactor for enzymes in the Kreb's cycle (a complex cycle that regulates cellular energy production). When B^{12} is not present for this cycle, methylmalonic acid (MMA) accumulates, which can damage the myelin sheath that surrounds and insulates nerves. This can lead to the neurological symptoms that are seen with vitamin B^{12} deficiency. MMA levels are also useful as a diagnostic tool.[12]

Assessment

Physical Examination

Clinical manifestations of anemia caused by vitamin B^{12} and folate deficiencies are related to the body's inability to form red blood cells and other rapidly dividing cells. Vitamin B12 deficiency is also more likely to affect the nervous system, although folate deficiency may also cause neurocognitive symptoms. See Table 3.7a for a summary of the clinical manifestations of vitamin B^{12} and folic acid anemia across body systems.

10. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

11. Means, R. T., & Fairifeld, K. M. (2023). Causes and physiology of vitamin B12 and folate deficiencies. *UpToDate*. https://www.uptodate.com/contents/causes-and-pathophysiology-of-vitamin-b12-and-folate-deficiencies.

12. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

Table 3.7a. Clinical Manifestations of Vitamin B^{12} and Folate Anemia[13,14,15,16]

Body System	Clinical Manifestation
General	Fatigue, progressive weakness
Nervous	Vitamin B^{12} deficiency: Symmetrical paresthesia/peripheral neuropathy, especially in the legs causing gait problems; dizziness; headaches; and vision changes
Gastrointestinal	Loss of appetite, weight loss, diarrhea Vitamin B^{12} deficiency: **Glossitis** (pain, swelling, and tenderness of the tongue) Folate deficiency: Oral ulcers and beefy, red tongue
Integumentary	Pallor
Cardiovascular	Tachycardia and lightheadedness
Respiratory	Shortness of breath and tachypnea
Behavioral/Psychological	Subtle cognitive or psychiatric changes, especially in older adults

Diagnostic Testing

A variety of lab tests may be ordered by a provider to diagnose vitamin B^{12} or folate deficiency. See Table 3.7b for a summary of common diagnostic tests. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

13. National Heart, Lung, and Blood Institute. (2022). *Anemia – vitamin B12 deficiency.* National Institutes of Health. https://www.nhlbi.nih.gov/health/anemia/vitamin-b12-deficiency-anemia

14. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

15. Vaqar, S., Shackelford, K., & Rudolph, S. (2023). Pernicious Anemia (Nursing). StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568700

16. Means, R. T., & Fairifeld, K. M. (2023). Causes and physiology of vitamin B12 and folate deficiencies. *UpToDate.* https://www.uptodate.com/contents/causes-and-pathophysiology-of-vitamin-b12-and-folate-deficiencies.

Table 3.7b. Common Diagnostic Tests for Vitamin B^{12} and Folate Deficiency Anemia[17,18]

Lab Test	Expected Findings
Complete Blood Count	Decreased RBCs, decreased hemoglobin and hematocrit, and increased MCV (measures size of red blood cells).
Serum B12 Level	Above 300 pg/mL is normal. Between 200-300 pg/mL is borderline deficient.* Below 200 pg/mL is considered deficient.* *Additional testing is performed to determine the cause, which impacts the route of supplementation.
Folate Level	Above 4 ng/mL is normal. Between 2- 4 ng/mL is borderline deficient. Below 2 ng/mL is considered deficient.
Homocysteine Level	Elevated in vitamin B^{12} and folate deficiencies.
MMA Levels	Elevated in vitamin B^{12} deficiency. A normal MMA with elevated homocysteine levels indicates folate deficiency.
Anti-intrinsic Factor Antibodies	Positive in pernicious anemia.
Various Tests to Ascertain Etiology	If surgical or dietary history is not a causative factor, other tests may be ordered to determine the etiology of the vitamin B^{12} deficiency. For example, GI tests may be ordered to detect malabsorption issues.

Nursing Diagnoses

Nursing priorities for clients with vitamin B^{12} anemia include promoting adequate tissue perfusion and oxygenation, providing adequate pain relief, preventing long-term neurological damage, preventing injury, enhancing nutrition (if applicable), improving fatigue and activity tolerance, and providing health teaching to help the client self-manage their disease.

Nursing diagnoses for clients with vitamin B^{12} anemia are created based on the specific needs of the client, their signs and symptoms, and their etiology of the disorder. These nursing diagnoses guide the creation of client specific

17. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

18. Means, R. T., & Fairifeld, K. M. (2023). Causes and physiology of vitamin B12 and folate deficiencies. *UpToDate*. https://www.uptodate.com/contents/causes-and-pathophysiology-of-vitamin-b12-and-folate-deficiencies.

care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Common nursing diagnoses for clients with vitamin B^{12} anemia include the following[19,20,21]:

- Inadequate Tissue Perfusion
- Acute Pain
- Chronic Pain
- Risk for Falls
- Disturbed Sensory Perception
- Imbalanced Nutrition: Less Than Body Requirements
- Fatigue
- Decreased Activity Intolerance
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

19. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

20. Vaqar, S., Shackelford, K., & Rudolph, S. (2023). Pernicious Anemia (Nursing). StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568700

21. NursesLabs. (2023). *7 anemia nursing care plans.* https://nurseslabs.com/anemia-nursing-care-plans/#h-nursing-diagnosis

Sample expected outcomes related to the previous nursing diagnoses are as follows[22]:

- *The client will demonstrate adequate perfusion as demonstrated by appropriate urine output, skin color appropriate for race, palpable peripheral pulses, and vital signs within normal limits for age.*
- *The client will engage in fall prevention activities as specified by the care plan.*
- *The client will accurately verbalize the presence of sharp and dull sensations on hands and feet.*
- *The client will include food sources high in vitamin B^{12} with every meal.*
- *The client will describe two methods of energy conservation to manage fatigue.*

Interventions

Medical Interventions

Medical Interventions for vitamin B^{12} deficiency depend on the cause, as well

22. NursesLabs. (2023). *7 anemia nursing care plans.* https://nurseslabs.com/anemia-nursing-care-plans/#h-nursing-diagnosis

as the severity of the disorder. Common medical treatments include the following[23,24,25,26]:

- **Vitamin B^{12} Supplements (Cyanocobalamin):** Supplements are administered orally or parenterally, with the prescribed route determined by the severity and the cause of the deficiency. For example, individuals with pernicious anemia must receive lifelong vitamin B^{12} parenteral (IM) supplements because they cannot absorb oral vitamin B^{12} due to the lack of intrinsic factor. Clients with severe vitamin B^{12} deficiency may also be initially treated with parenteral B^{12}. Vitamin B^{12} is also available in oral, sublingual, subcutaneous, and intranasal forms. Clients should also be urged to increase their dietary intake of vitamin B^{12} with food sources such as meat and dairy. For those who follow a vegan diet, fortified cereals and fortified vegan milk substitutes are good sources of vitamin B^{12}.
- **Routine Monitoring of Vitamin B^{12} Levels:** Monitoring is especially important in those who are at risk due to malabsorption such as those with Crohn's disease.
- **Blood Transfusions:** Blood transfusions may be necessary in severe cases of vitamin B^{12} anemia. When clients have extreme symptoms or their hemoglobin levels fall below 7 g/dL, a transfusion may be prescribed.

23. National Heart, Lung, and Blood Institute. (2022). *Anemia – vitamin B12 deficiency.* National Institutes of Health. https://www.nhlbi.nih.gov/health/anemia/vitamin-b12-deficiency-anemia

24. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

25. Vaqar, S., Shackelford, K., & Rudolph, S. (2023). Pernicious Anemia (Nursing). StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568700

26. Vasavada, A. & Sanghavi, D. K. (2023). Cyanocobalamin. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555964

Folate deficiency is treated with oral or parenteral administration of folic acid. Parental administration may be prescribed for severe, symptomatic anemia and then switched to oral therapy after symptoms resolve.[27]

Nursing Interventions

Common nursing interventions for clients with vitamin B^{12} deficiency anemia include the following[28,29,30,31]:

- Monitor vitals because anemia can cause tachycardia and tachypnea.
- Perform comprehensive neurological assessments due to the neurological effects of vitamin B^{12} deficiency. If the client has been deficient in vitamin B^{12} for a prolonged amount of time, neurological symptoms may not be completely reversed even with adequate treatment.
- Administer vitamin B^{12} via enteral or parenteral routes per provider order and provide related health teaching. The RN should also monitor for potential side effects and allergic reactions. Hypokalemia is a common

27. Means, R. T., & Fairifeld, K. M. (2024). Treatment of vitamin B12 and folate deficiencies. *UpToDate*. Treatment of vitamin B12 and folate deficiencies

28. National Heart, Lung, and Blood Institute. (2022). *Anemia – vitamin B12 deficiency.* National Institutes of Health. https://www.nhlbi.nih.gov/health/anemia/vitamin-b12-deficiency-anemia

29. Ankar, A., & Kumar, A. (2022). Vitamin B12 Deficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441923

30. Vaqar, S., Shackelford, K., & Rudolph, S. (2023). Pernicious Anemia (Nursing). StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568700

31. Vasavada, A. & Sanghavi, D. K. (2023). Cyanocobalamin. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555964

side effect of cyanocobalamin and would manifest as muscle cramping/weakness and/or irregular heartbeat. Cyanocobalamin contains cobalt and may need to be avoided in those with a cobalt sensitivity/allergy.

- Encourage a diet rich in vitamin B^{12}. The recommended daily intake for vitamin B^{12} for adults is 2.4 mcg and more for those who are pregnant or breastfeeding.
- Initiate fall precautions such as a bed/chair alarm and a low height bed. Those with vitamin B^{12} anemia frequently exhibit dizziness, lightheadedness, paresthesia, vision changes, or confusion. Any of these symptoms put the client at increased risk for falls.
- Monitor input and output. Due to the potential for glossitis and impaired taste, the client may have a decreased appetite. Decreased appetite could also worsen the dietary intake of vitamin B^{12}. Diarrhea can also put the client at risk for dehydration. Decreased urine output can also indicate ineffective peripheral tissue perfusion due to decreased red blood cell production.
- Assess pain because paresthesia and peripheral neuropathy may be painful.
- Teach energy management techniques such as setting priorities, assigning tasks to others, and balancing rest with activity.

Nurses provide preventative interventions by providing health teaching about the importance of folic acid supplements to prevent neural tube defects to female clients who are pregnant or trying to get pregnant. The recommended daily allowance of folic acid for adults is 400 mcg per day. For pregnant and lactating women, the dietary guideline is 600 mcg per day. Treatment of folate deficiency is typically 1-5 mg daily.[32]

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing

32. Means, R. T., & Fairifeld, K. M. (2024). Treatment of vitamin B12 and folate deficiencies. *UpToDate*. Treatment of vitamin B12 and folate deficiencies

interventions for a specific client. Lab results showing improvement of anemia resulting from vitamin B12 or folate deficiency should improve within one to two weeks and normalize within one to two months.[33] The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Vitamin B12 Deficiency Anemia

View a brief YouTube video overview of vitamin B deficiency anemia[34]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=893#oembed-1

33. Means, R. T., & Fairifeld, K. M. (2024). Treatment of vitamin B12 and folate deficiencies. *UpToDate*. Treatment of vitamin B12 and folate deficiencies

34. Open RN Project. (2024, June 23). *Health Alterations – Chapter 3 Hematological – Vitamin B12 deficiency anemia* [Video]. YouTube. CC BY-NC 4.0https://youtu.be/sf7LS9eULyE?feature=shared

3.8 Sickle Cell Disease

Sickle cell disease (SCD) is the most common disorder affecting hemoglobin in the United States, affecting about 100,000 Americans.[1] It is a genetic hemoglobin disorder, resulting in chronic anemia, chronic pain, organ damage, and early death. Clients with SCD form sickle-shaped red blood cells instead of the usual biconcave disc-shaped cells. When triggered by a causative event, the RBCs become rigid and clump together. As a result, blood vessels become occluded, and there is decreased perfusion to tissues and organs.[2,3] See Figure 3.8[4] for an illustration of the sickled cells that results in decreased perfusion during SCD.

1. Ashorobi, D., Naha, K., & Bhatt, R. (2023). *Hematopoietic Stem Cell Transplantation in Sickle Cell Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538515/

2. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

3. Centers for Disease Control and Prevention. (2023). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

4. "Sickle_Cell_Disease_%2827249799083%29.jpg" by National Human Genome Research Institute (NHGRI) from Bethesda, MD, USA is licensed under CC BY 2.0

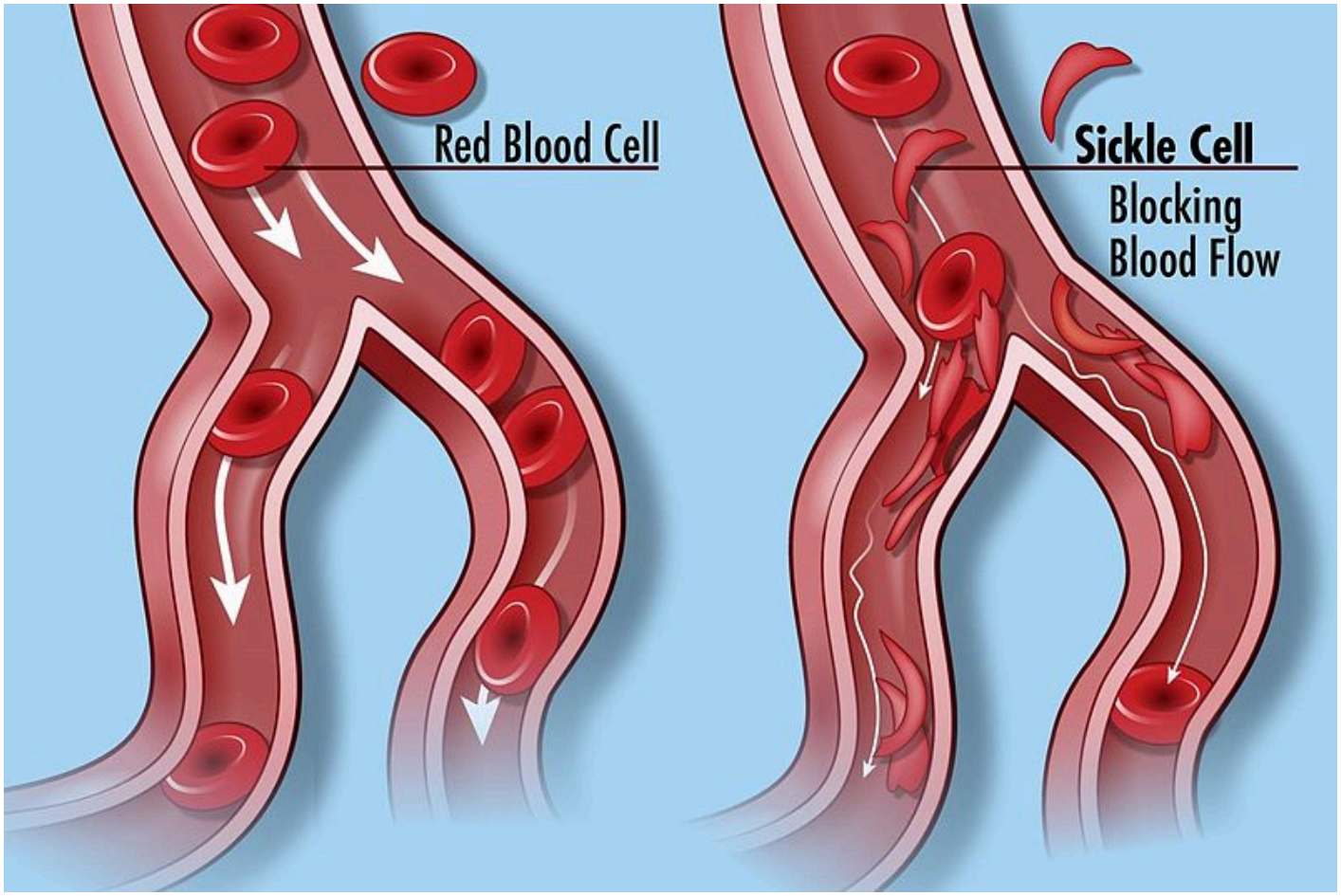


Figure 3.8 Sickle Cell Disease

The pathophysiology of SCD occurs due to a genetic mutation of the hemoglobin gene, resulting in an abnormal hemoglobin called hemoglobin S (HbS). Sickle cell disease is an autosomal recessive genetic disorder where under certain conditions, the hemoglobin molecules form a long, rigid chain. The chains cause the red blood cells to change shape from a normal biconcave disc to a rigid sickle shape.[5,6]

5. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

6. Centers for Disease Control and Prevention. (2023, July 6). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/

Individuals of African descent are at increased risk for SCD, with about 1 in 13 African Americans carrying the gene for HbS. If someone has the sickle cell trait, they are a carrier of the hemoglobin S gene, which means they can pass it on when they have a child. If two parents who are both carriers of the sickle cell trait have offspring, each child has a 25% chance of developing sickle cell disease.[7]

Advancement in new gene therapy has shown promise in clinical trials for developing a cure for SCD. This new technology entails removing the client's stem cells from their bone marrow and adding a therapeutic gene to those cells, which leads to the production of anti-sickling cells.[8]

Pathophysiology

Many conditions can trigger the sickling of red blood cells in an individual with SCD, including dehydration, low oxygen levels, infection or inflammation,

sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

7. National Heart, Lung, and Blood Institute. (2024). *What is sickle cell disease?* National Institutes of Health. https://www.nhlbi.nih.gov/health/sickle-cell-disease

8. Ashorobi, D., Naha, K., & Bhatt, R. (2023). *Hematopoietic Stem Cell Transplantation in Sickle Cell Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538515/

pregnancy, acidosis, temperature changes, stress, and high altitudes.[9,10] Nurses help teach clients how to avoid these triggers.

During a vaso-occlusive crisis, the red blood cells become rigid and sickled and block small blood vessels, causing reduced perfusion of tissues. Because of the reduced blood flow causing decreased oxygenation of tissues and organs, vaso-occlusive events cause severe pain and can result in organ damage.

When individuals experience multiple vaso-occlusive events, significant and progressive damage occurs to organs and tissues, such as the kidneys, liver, spleen, heart, and lungs. Damage to the brain can occur without outward symptoms, called a silent stroke. Reduced perfusion in the legs can cause ulcers to form that may not heal and last for long periods of time. Joints can become damaged due to lack of perfusion, resulting in decreased mobility.[11]

Damage to the spleen reduces its ability to filter and remove damaged cells

9. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

10. Centers for Disease Control and Prevention. (2023, July 6). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

11. National Heart, Lung, and Blood Institute. (2024). *What is sickle cell disease?* National Institutes of Health. https://www.nhlbi.nih.gov/health/sickle-cell-disease

and bacteria from the bloodstream, causing clients to have an increased susceptibility to infections.[12,13,14]

Sickled red blood cells have a shorter life span than that of healthy red blood cells. As a result, there is a premature breakdown of red blood cells in the spleen, which can cause hemolytic anemia. Additionally, the breakdown of red blood cells causes the release of bilirubin. If the liver has experienced damage, jaundice may occur if it is not able to adequately metabolize the bilirubin. Bilirubin can also form gallstones that get stuck in the gallbladder.[15]

SCD is a painful, life-limiting disorder. Self-management education, psychosocial care, and genetic counseling are vital to help clients manage the disease and achieve the highest level of wellness possible.

Assessment

Physical Examination

Table 3.8 provides a summary of common clinical manifestations of SCD by body system.

12. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

13. Centers for Disease Control and Prevention. (2023). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

14. National Heart, Lung, and Blood Institute. (2024). *What is sickle cell disease?* National Institutes of Health. https://www.nhlbi.nih.gov/health/sickle-cell-disease

15. National Heart, Lung, and Blood Institute. (2024). *What is sickle cell disease?* National Institutes of Health. https://www.nhlbi.nih.gov/health/sickle-cell-disease

Table 3.8. Common Clinical Manifestations of SCD by Body System[16,17]

Body System	Common Clinical Manifestations/Physical Assessment Findings
Central Nervous	Severe pain is a hallmark feature of sickle cell disease (SCD) because of lack of perfusio tissues and organs. Pain can be acute or chronic in nature. Pain is often severe and de requiring prompt and effective pain management. Decreased perfusion of the brain f vaso-occlusive episodes can cause seizures or a stroke.
Cardiovascular	Cardiovascular symptoms include tachycardia, general fatigue, and weakness. Potenti include heart failure and arrhythmias.
Respiratory	Respiratory symptoms include shortness of breath. Pulmonary complications include hypertension and acute chest syndrome, a common cause of hospital admission and with a respiratory infection.
Skin	Skin may appear pale or cyanotic due to decreased perfusion and/or decreased gas ex resulting from the lack of hemoglobin. Skin may appear jaundiced due to RBC destru in increased bilirubin levels. Clients may develop ulcers on the lower legs due to decre Wounds may have poor wound healing.
Abdominal	Diffuse and steady abdominal pain can occur during vaso-occlusive crises. **Hepatome** liver) and splenomegaly (enlarged spleen) may be present. Gallstones may occur.
Renal & Urinary	Kidney damage from poor perfusion and impaired gas exchange can lead to chronic k resulting in decreased or no urine output.
Musculoskeletal	Joints may be damaged during vaso-occlusive crises, causing pain and decreased mo as **osteonecrosis** (bone death).
Psychosocial	Anxiety, depression, and stress may occur related to chronic illness and pain.

Diagnostic Testing

Laboratory tests commonly performed to identify sickle cell disease (SCD)

16. American Society of Hematology. (n.d.). *Sickle cell disease.* https://www.hematology.org/education/patients/anemia/sickle-cell-disease

17. Centers for Disease Control and Prevention. (2023). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

include hemoglobin electrophoresis, complete blood cell count, reticulocyte count, peripheral blood smear, and bilirubin levels. These tests are ordered to help identify the presence of hemoglobin S and sickled red blood cells, immature blood cells, and lysing red blood cells.

Hemoglobin electrophoresis is a blood test that allows for the detection of abnormal types of hemoglobin. In this test, an electric current is applied to a sample of blood. This application of an electric current allows for the separation of normal and abnormal hemoglobin types. Normal types of hemoglobin are Hemoglobin A (the most common type in adults) and Hemoglobin F (the type of hemoglobin found in infants). Hemoglobin S, an abnormal hemoglobin, is the predominant type of hemoglobin present in those with sickle cell disease. High levels of Hemoglobin S are diagnostic for sickle cell disease.[18]

A complete blood count (CBC) can also be helpful in diagnosing SCD. In SCD, the red blood cells have a shorter life span of only about 10-20 days, versus a typical life span of 120 days. Therefore, a CBC for clients with SCD will show decreased numbers of red blood cells (RBC), hemoglobin, and hematocrit. Due to the anemia that results from SCD, there is also a high reticulocyte count due to compensation for the increased rate of RBC destruction. Reticulocytes are immature RBCs. Additionally, due to the rapid destruction and breakdown of RBCs, clients with SCD can also have elevated bilirubin levels. Bilirubin is released during the breakdown of RBCs. If the liver cannot keep up with the rate of RBC destruction, bilirubin levels build up and

18. Medline Plus. (2023). *Hemoglobin electrophoresis*. https://medlineplus.gov/lab-tests/hemoglobin-electrophoresis/

cause jaundice.[19,20] Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

A **peripheral blood smear** can also be used to diagnose SCD. As mentioned in the "Diagnostic Testing" subsection in the "General Hematological System Assessment" section of this chapter, a thin layer of cells is examined under a microscope during a peripheral blood smear. In someone with SCD, the RBC will appear sickle-like in shape, especially when oxygen-deprived. Although this is a simple and inexpensive test, its accuracy is based on the expertise of the pathologist viewing the cells.[21]

Other diagnostic tests may be ordered to identify complications related to decreased perfusion that occurs during vaso-occlusive crises. For example,

19. Cleveland Clinic. (2022). *Reticulocyte count.* https://my.clevelandclinic.org/health/diagnostics/22787-reticulocyte-count

20. Johns Hopkins Medicine. (n.d.). *Sickle cell disease.* https://www.hopkinsmedicine.org/health/conditions-and-diseases/sickle-cell-disease

21. Arishi, W. A., Alhadrami, H. A., & Zourob, M. (2021). Techniques for the detection of sickle cell disease: A review. *Micromachines, 12*(5), 519. https://doi.org/10.3390/mi12050519

pulmonary function tests and electrocardiograms may be evaluated to identify respiratory and cardiac complications.[22,23,24]

Nursing Diagnoses

Nursing priorities for clients with sickle cell anemia include promoting adequate oxygenation and pain relief, decreasing incidences of vaso-occlusive crises, preventing complications, and helping the client self-manage the disease and effectively cope with it.

Nursing diagnoses for clients with sickle cell disease (SCD) are formulated based on the client's assessment data, medical history, and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions to address the unique challenges and complications of SCD.

Nursing diagnoses related to SCD include the following[25]:

- Acute Pain
- Chronic Pain
- Ineffective Peripheral Tissue Perfusion

22. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

23. Centers for Disease Control and Prevention. (2023). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

24. MedlinePlus. (2016). *Blood count tests*. National Library of Medicine. https://medlineplus.gov/bloodcounttests.html

25. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

- Risk for Infection
- Risk for Impaired Skin Integrity
- Decreased Activity Intolerance
- Readiness for Enhanced Knowledge
- Risk for Impaired Resilience

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating specific expected outcome statements for nursing diagnoses identified for the client. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to SCD are as follows:

- *The client will report pain is controlled at an acceptable level to them (i.e., typically rated as 3 or less on a pain intensity rating scale of 0 to 10).*
- *The client will demonstrate adequate tissue perfusion as evidenced by vital signs within normal limits, palpable peripheral pulses, adequate urine output, capillary refill less than three seconds, and nail beds and lips of natural/pink color.*
- *The client will remain free from infection.*
- *The client will verbalize early symptoms of vaso-occlusive crisis and when to notify the health care provider.*

Interventions

Interventions implemented for clients with SCD include medical interventions and nursing interventions.

Medical Interventions

Medical interventions for sickle cell disease aim to manage symptoms, prevent complications, and improve the overall quality of life for individuals

living with the condition. Common medical interventions for sickle cell disease and sickle cell crisis include the following:

- **Pain Management:** Prompt and effective pain management is essential during vaso-occlusive crises. Pain relievers, such as acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs), may be effective for mild pain; severe pain during vaso-occlusive crises requires opioids. Morphine and dilaudid are typically administered on a routine schedule or using patient-controlled analgesia (PCA) pumps.

> Read more about pain relievers and managing pain in the "Analgesics and Musculoskeletal System" chapter in Open RN *Nursing Pharmacology, 2e*.

- **Hydration:** Oral and intravenous (IV) fluids are prescribed during vaso-occlusive crises to rehydrate and improve perfusion, especially to the kidneys.
- **Hydroxyurea Therapy:** Hydroxyurea is a medication commonly prescribed for clients with SCD that stimulates the production of fetal hemoglobin (HbF) and reduces sickling of hemoglobin (HbS). However, hydroxyurea causes bone marrow suppression, so clients are at risk for abnormally low RBC, WBC, and platelets that can result in anemia, infection, or bleeding.[26] Hydroxyurea is also teratogenic, so it cannot be taken during pregnancy, and women taking it must be counseled to use effective contraceptives to prevent pregnancy.
- **Blood Transfusions:** Red blood cell transfusions may be prescribed to

26. National Institute of Diabetes and Digestive and Kidney Diseases. (2021). *Hydroxyurea.* National Library of Medicine. https://www.ncbi.nlm.nih.gov/books/NBK548724/

help increase the number of normal red blood cells and enhance their oxygen-carrying capacity, while also reducing the percentage of sickled cells. However, this is only a temporary fix and repeated transfusions put clients at risk for iron overload.

- **Bone Marrow Transplant (Hematopoietic Stem Cell Transplantation):** Bone marrow transplant is a potentially curative treatment for sickle cell disease. It involves administering chemotherapy to destroy and remove the client's bone marrow cells and then replacing them with healthy stem cells from a compatible donor free of sickling. This transplantation can result in the client's production of healthy red blood cells.[27]
- **Antibiotics and Vaccinations:** Prophylactic antibiotics and vaccinations are prescribed to prevent infections that can trigger sickling crises.
- **Supportive Care:** Supportive care involves addressing other aspects of sickle cell disease, such as preventing complications like leg ulcers and providing psychosocial support to address emotional and mental health needs.[28,29]

27. Ashorobi, D., Naha, K., & Bhatt, R. (2023). *Hematopoietic Stem Cell Transplantation in Sickle Cell Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538515/

28. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

29. Centers for Disease Control and Prevention. (2023). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

Nursing Interventions

Nurses commonly perform these priority nursing interventions when caring for clients with SCD[30,31,32,33]:

- Ensuring adequate oxygenation and providing supplemental oxygen therapy as indicated.
- Addressing acute and chronic pain through the administration of appropriate analgesics and nonpharmacological pain relief strategies.
- Preventing dehydration to help prevent vaso-occlusive crises and other complications.
- Implementing infection control measures to minimize the risk of infections, which can trigger sickle cell crises.
- Providing health teaching on self-management, pain management strategies, recognition of signs of complications, and signs or symptoms for health care provider notification.
- Providing psychosocial support and assisting the client to cope with chronic disease.

30. American Society of Hematology. (n.d.). *Sickle cell disease*. https://www.hematology.org/education/patients/anemia/sickle-cell-disease

31. Centers for Disease Control and Prevention. (2023, July 6). *What is sickle cell trait?* U.S. Department of Health & Human Services. https://www.cdc.gov/sickle-cell/sickle-cell-trait/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/sicklecell/traits.html

32. Martin, P. (2023). *7 anemia nursing care plans*. NursesLabs. https://nurseslabs.com/anemia-nursing-care-plans/#h-nursing-diagnosis.

33. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

Each of these priorities is further discussed in the following subsections.

ENSURING ADEQUATE OXYGENATION

Decreased oxygenation and perfusion of tissues can occur in clients with SCD due to the decreased oxygen-carrying capacity of the sickled red blood cells (RBCs) and vessel occlusion that can occur during sickling of RBCs. Clients with sickle cell anemia are also more susceptible to bacterial pneumonia, which can further compromise gas exchange. Recall that lack of oxygenation also triggers additional sickling, so enhancing oxygenation and perfusion are vital.

Nurses monitor clients' respiratory status and enhance gas exchange and tissue perfusion by performing the following interventions[34,35]:

- Monitor respiratory status, including respiratory rate, use of accessory muscles, and lung sounds. Monitor pulse oximetry levels, but keep in mind the readings may be inaccurate due to the effects of decreased levels of hemoglobin. ABGs may be required to accurately monitor dissolved oxygen levels in the blood.
- Monitor peripheral perfusion, including peripheral pulses, skin color, capillary refill, pain in the extremities, and development of leg ulcers due to lack of perfusion.
- Monitor perfusion of major organs, including assessing level of consciousness, chest pain/angina, palpitations, dysrhythmias, and decreased urine output.
- Monitor for activity intolerance as demonstrated by fatigue and/or tachycardia, orthostatic hypotension, dyspnea, and/or chest pain on

34. Martin, P. (2023). *7 anemia nursing care plans.* NursesLabs. https://nurseslabs.com/anemia-nursing-care-plans/#h-nursing-diagnosis.

35. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

exertion.
- Administer oxygen therapy as indicated.
- Administer blood transfusions, as prescribed, to improve the number of oxygen-carrying red blood cells and improve oxygenation of tissues and organs.
- Implement energy management interventions (as described in the "Anemia" section)
- Maintain room temperature and body warmth without overheating to enhance tissue perfusion. Avoid extreme temperatures and overheating because this can lead to dehydration that can trigger vaso-occlusive crises.
- Encourage physical activity within the client's limitations to prevent thrombosis.
- Administer hydroxyurea as prescribed and monitor for side effects.
- Avoid air travel in unpressurized aircraft and low oxygen levels at high altitudes because hypoxia can trigger vaso-occlusive crises.

MANAGING PAIN

Clients with SCD often experience acute pain due to the vaso-occlusive nature of sickling, where sickled red blood cells block small blood vessels, causing tissue ischemia and inflammation. Chronic pain may also occur as a result of tissue damage from repetitive vaso-occlusive crises. Pain can occur in any part of the body, including bones, joints, chest, and abdomen. Nurses perform the following interventions to manage acute and chronic pain[36,37]:

- Promptly assess pain using a pain rating scale and effectively provide

36. Martin, P. (2023). *7 anemia nursing care plans.* NursesLabs. https://nurseslabs.com/anemia-nursing-care-plans/#h-nursing-diagnosis.

37. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

pain management based on the client's preferences.

- Administer analgesics, as prescribed, and monitor their effectiveness. NSAIDs may provide appropriate relief for chronic pain, but opioids are typically required during vaso-occlusive crises.
- Plan activities during peak analgesic effect to maximize movement of joints and enhance mobility.
- Apply warm, moist compresses to affected joints and avoid use of ice or cold compresses. Warmth causes vasodilation and increases circulation to hypoxic areas, but cold causes vasoconstriction.
- Provide additional nonpharmacological comfort measures such as keeping the room warm and repositioning with support devices for painful areas. Other cognitive-behavioral techniques for pain management include incorporating meditation, guided imagery, distraction, breathing, yoga, biofeedback, and progressive relaxation techniques.
- Encourage range-of-motion exercises within client's limitations.

PROMOTING HYDRATION

Dehydration can trigger vaso-occlusive crises. Nurses encourage adequate daily oral fluid intake to prevent dehydration and administer IV fluids as prescribed during vaso-occlusive crises to help maintain adequate perfusion of tissues and organs.

PREVENTING INFECTION

Clients with SCD are at increased risk for infection and infection puts clients at risk for vaso-occlusive crises. Nurses educate clients and their family members about infection prevention measures, including routine vaccinations, hand hygiene, and avoiding exposure to sick individuals. Clients are also encouraged to follow a well-balanced diet rich in nutrients to support the production of red and white blood cells, as well as overall health.

PROVIDING HEALTH TEACHING AND HEALTH PROMOTION

Nurses provide comprehensive health teaching to clients and their family members about sickle cell disease, common triggers of vaso-occlusive crises, signs of complications, home self-management techniques, and the need for seeking medical attention. Clients are encouraged to have regular medical check-ups, receive routine vaccinations, and take prescribed medications to prevent vaso-occlusive crises and future complications.

PROVIDING PSYCHOSOCIAL SUPPORT

Nurses address the emotional and psychosocial needs of clients with SCD and their family members. Nurses encourage positive coping strategies and make referrals to support groups in the community to help individuals cope with the challenges of living with a chronic condition.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Sickle Cell Disease

View a brief YouTube video overview of sickle cell disease[38]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=898#oembed-1

38. Open RN Project. (2024, March 24). *Health Alterations – Chapter 3 Hematological – Sickle cell disease* [Video]. YouTube. CC BY 4.0 https://www.youtube.com/watch?v=vR5rDPn1m6E

3.9 Polycythemia

Although anemia and sickle cell disease cause a decrease in red blood cells, **polycythemia** is a medical condition with an excessive number of red blood cells. In addition to excessive numbers of these cells, they are also abnormal, resulting in decreased oxygen-carrying capacity, poor gas exchange, increased risk of infection, and bleeding problems. Additionally, the client's blood also becomes hyperviscous (thicker than normal), which causes the blood to move more slowly in blood vessels and increases the risk for clotting in arteries and veins. This clotting can cause deep vein thrombosis (DVTs), or the clots can move to the heart or brain, causing a heart attack or stroke.[1]

There are two major types of polycythemia, primary and secondary:

- Primary polycythemia, also known as **polycythemia vera (PV)**, is caused by a type of bone marrow cancer that causes it to produce too many red blood cells, as well as white blood cells and platelets. There appears to be a genetic component to PV, but it can also be caused by exposure to radiation or chemicals like benzene.[2,3,4]
- Secondary polycythemia refers to too many red blood cells that are

1. National Center for Advancing Translational Sciences. (n.d.). *Polycythemia vera*. National Institutes of Health. https://rarediseases.info.nih.gov/diseases/7422/polycythemia-vera
2. MedlinePlus. (2016). *Blood disorders*. National Library of Medicine. https://medlineplus.gov/blooddisorders.html
3. National Heart, Lung, and Blood Institute. (2022). *Polycythemia vera*. National Institutes of Health. https://www.nhlbi.nih.gov/health/polycythemia-vera
4. National Center for Advancing Translational Sciences. (n.d.). *Polycythemia vera*. National Institutes of Health. https://rarediseases.info.nih.gov/diseases/7422/polycythemia-vera

produced as a result of conditions that cause low oxygen levels in the body, such as chronic obstructive pulmonary disease.

Assessment

Physical Examination

Clients with polycythemia vera may experience a variety of symptoms. See Table 3.9 for common symptoms of polycythemia vera by body system.

Table 3.9. Symptoms of Polycythemia Vera Across Body Systems[5,6,7]

5. MedlinePlus. (2016). *Blood disorders.* National Library of Medicine. https://medlineplus.gov/blooddisorders.html

6. National Heart, Lung, and Blood Institute. (2022). *Polycythemia vera.* National Institutes of Health. https://www.nhlbi.nih.gov/health/polycythemia-vera

7. National Center for Advancing Translational Sciences. (n.d.). *Polycythemia vera.* National Institutes of Health. https://rarediseases.info.nih.gov/diseases/7422/polycythemia-vera

Body System	Common Clinical Manifestations/Physical Assessment Findings
General	Headache, **pulsatile tinnitus** (loud or soft "whoosh" sounds in time with the heartbeat), vertigo, fat night sweats, or excessive sweating. Increased risk of bleeding due to fewer circulating platelets.
Central Nervous	Confusion and difficulty concentrating, visual disturbances (blurred vision or seeing spots), transie ischemic attacks (i.e., mini-strokes), **peripheral neuropathy** (numbness or tingling in extremities), erythromelalgia (burning pain or redness in hands or feet).
Cardiovascular	Hypertension, chest pain on exertion due to ischemia, arterial and venous thrombosis, increased h and bounding pulses, cyanosis in the nail beds, orthostatic hypotension, or distended neck veins.
Respiratory	**Dyspnea** (shortness of breath) and increased risk for pulmonary embolism.
Skin	Abnormal bruising, **pruritus** (itching), **erythromelalgia** (flushed or reddened skin due to engorged vessels, especially in the face or hands). See Figure 3.9[8] for an image of erythromelalgia.
Abdominal	Abdominal pain, splenomegaly, hepatomegaly, or weight loss.
Renal	**Hematuria** (blood in urine) or decreased kidney function.
Musculoskeletal	Joint pain, decreased bone density, or fractures.
Psychosocial	Stress, anxiety, and depression associated with living with a chronic disease that can be life-threat

8. "Erythromelalgia.jpg" by Herbert L. Fred, MD and Hendrik A. van Dijk is licensed under CC BY 2.0



Figure 3.9 Erythromelalgia

Diagnostic Testing

Diagnosing polycythemia vera begins with the CBC. In polycythemia vera, the

CBC reflects elevated red blood cells, white blood cells, and platelets, as well as elevated hematocrit and hemoglobin levels. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

To confirm a polycythemia vera diagnosis, additional testing is needed to determine the presence of the JAK2V617F mutation, which is present in about 95% of PV cases. The JAK2V617F mutation is a mutation that occurs on Chromosome 9 where the JAK2 gene helps to regulate and produce blood cells. Additionally, a bone marrow aspiration and biopsy may be performed.[9,10,11]

Nursing Diagnosis

Nursing diagnoses for clients with polycythemia vera are developed based on the client's assessment data, medical history, and specific needs.

Common nursing diagnoses for polycythemia vera include the following:

- Risk for Thrombosis
- Impaired Gas Exchange
- Activity Intolerance
- Readiness for Enhanced Knowledge
- Impaired Coping

Outcome Identification

Outcome identification includes setting short- and long-term goals and

9. MedlinePlus. (2016). *Blood disorders*. National Library of Medicine. https://medlineplus.gov/blooddisorders.html
10. National Heart, Lung, and Blood Institute. (2022). *Polycythemia vera.* National Institutes of Health. https://www.nhlbi.nih.gov/health/polycythemia-vera
11. MedlinePlus. (2016). *Blood count tests.* National Library of Medicine. https://medlineplus.gov/bloodcounttests.html

creating specific expected outcome statements for nursing diagnoses identified for the client. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes related to common nursing diagnoses for clients diagnosed with polycythemia vera are as follows:

- *The client will remain free from blood clots*.
- *The client will remain free from excessive bleeding*.
- *The client will remain free from infection*.

Interventions

Medical Interventions

Medical interventions for polycythemia vera are targeted at reducing the excessive production of red blood cells and preventing complications associated with increased risk of blood clotting.

Common medical interventions and treatments used to manage polycythemia vera include the following:

- **Therapeutic Phlebotomy with Plasmapheresis:** The primary treatment for polycythemia vera is routinely scheduled phlebotomy with apheresis. **Plasmapheresis** is the withdrawal of whole blood and the removal of red blood cells and then reinfusion of the plasma back into the client. This therapy reduces the red blood cell count, as well as blood viscosity, and lengthens the client's life span.
- **Low-Dose Aspirin:** Low-dose aspirin may be prescribed to reduce the risk of blood clots by inhibiting platelet aggregation.
- **Cytoreductive Therapy:** In symptomatic clients, medications such as hydroxyurea may be used to suppress the bone marrow's overproduction of blood cells.
- **JAK2 Inhibitors:** Therapies targeting the JAK2 pathway (i.e., ruxolitinib) may be used to control the abnormal cell growth associated with the JAK2V617F mutation.

- **Anticoagulation:** In certain cases, anticoagulant medications (i.e., warfarin or heparin) may be prescribed to prevent blood clots in clients with a history of thrombosis.[12,13]

Nursing Interventions

Nursing interventions for clients with polycythemia vera focus on preventing thromboses, ensuring adequate oxygenation, assisting with energy management, promoting hydration, managing medications, and providing health teaching to support the client's well-being.

- **Preventing Thrombosis:** Nurses help prevent thrombosis formation by promoting adequate hydration, encouraging mobility, and administering anticoagulation therapy as prescribed.
- **Ensuring Adequate Oxygenation**: Nurses monitor the client's oxygen saturation levels and respiratory status and administer supplemental oxygen as needed to maintain adequate oxygenation.
- **Assisting With Energy Management:** Nurses implement interventions related to energy management, as discussed in the "Anemia" section. Clients are encouraged to balance activity and rest periods to prevent excessive fatigue.
- **Promoting Hydration:** Nurses encourage adequate fluid intake to prevent dehydration, reduce blood viscosity, and maintain perfusion of tissues and organs.
- **Managing Medication:** Nurses safely administer prescribed medications, such as cytoreductive agents or antiplatelet drugs.
- **Participating in Health Teaching and Health Promotion:** Nurses educate

12. MedlinePlus. (2016). *Blood disorders.* National Library of Medicine. https://medlineplus.gov/blooddisorders.html

13. National Heart, Lung, and Blood Institute. (2022). *Polycythemia vera.* National Institutes of Health. https://www.nhlbi.nih.gov/health/polycythemia-vera

clients about the disease process and potential complications, such as bleeding and thrombosis. The importance of prescribed, routine phlebotomy is emphasized to reduce blood viscosity and prevent potential complications related to thrombosis.[14,15]

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Polycythemia

View a brief YouTube video overview of polycythemia[16]:

14. MedlinePlus. (2016). *Blood disorders.* National Library of Medicine. https://medlineplus.gov/blooddisorders.html

15. National Heart, Lung, and Blood Institute. (2022). *Polycythemia vera.* National Institutes of Health. https://www.nhlbi.nih.gov/health/polycythemia-vera

16. Open RN Project. (2024, June 23). *Health Alterations – Chapter 3*

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=917#oembed-1

Hematological – Polycythemia [Video]. YouTube. CC BY-NC 4.0 https://youtu.be/n-1241VmL00?feature=shared

3.10 Thrombocytopenia

Thrombocytopenia is characterized by a decreased number of platelets in the blood. Thrombocytopenia may occur due to many factors affecting platelet production, platelet destruction, or platelet utilization.

Thrombocytopenia is often an acquired condition, such as an immune-mediated response, response to another condition, or a side effect of medication. For example, idiopathic thrombocytopenic purpura (ITP) is an acquired thrombocytopenia caused by the client's immune system mistakenly destroying its own platelets. Thrombocytopenia may be caused by other hematological disorders, such as aplastic anemia or leukemia. Additionally, medications such as aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), penicillin, phenothiazines, prednisone, and chemotherapy can cause thrombocytopenia.[1]

Thrombocytopenia can also be inherited due to genetic mutations, resulting in abnormal platelet production and function. Inherited forms of thrombocytopenia are more rare than acquired forms of the disease.[2,3]

Thrombocytopenia can cause many symptoms related to excessive bleeding, such as easy bruising, petechiae, purpura, ecchymoses, prolonged bleeding from minor cuts or injuries, and excessive bleeding from the nose or gums. **Purpura** are red or purple spots on the skin that do not blanch when pressure is applied and measure between 4 and 10 millimeters (mm) in diameter. When purpura spots are less than 4 mm in diameter, they are

1. Medline Plus. (n.d.). *Acquired platelet function defect.* National Institutes of Health. https://medlineplus.gov/ency/article/000546.htm

2. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors.* National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

3. MedlinePlus. (2020). *Platelet disorders.* National Library of Medicine. https://medlineplus.gov/plateletdisorders.html

called **petechiae**.[4] See Figure 3.10[5] for an image of a severe case of petechiae and purpura. In severe cases of thrombocytopenia, internal bleeding can occur, posing life-threatening risks.[6,7]

4. Medline Plus. (n.d.). *Purpura*. National Institutes of Health. https://medlineplus.gov/ency/article/003232.htm

5. "Purpura.jpg" by User:Hektor is licensed under CC BY-SA 3.0

6. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors.* National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

7. MedlinePlus. (2020). *Platelet disorders.* National Library of Medicine. https://medlineplus.gov/plateletdisorders.html



Figure 3.10 Petechiae and Purpura

Assessment

Physical Examination

Common signs and symptoms of thrombocytopenia are summarized in Table 3.10.

Table 3.10. Clinical Manifestations of Thrombocytopenia[8,9]

Body System	Clinical Manifestations
Integumentary	Easy bruising or purpura (purple or red spots on skin), petechiae (small red or purple dots on the skin), prolonged bleeding from cuts or injuries, or excessive bleeding from the gums or nose.
Musculoskeletal	Joint pain and swelling caused by **hemarthrosis** (bleeding into joints).
Gastrointestinal	Blood in the stool or black, tarry stools.
Genitourinary	Blood in the urine or heavy menstrual bleeding.
Respiratory	**Hemoptysis** (coughing up blood).
Neurological	Intracranial hemorrhage (rare).
Cardiovascular	Tachycardia, hypotension, and weak pulses resulting from blood loss.

Diagnostic Testing

Thrombocytopenia is diagnosed by decreased platelet counts on a CBC. Bleeding times may be further evaluated by PT, PTT, and INR. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

The structure of the platelets may also be examined through a test called a peripheral blood smear. If the cause of thrombocytopenia remains uncertain,

8. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

9. MedlinePlus. (2020). *Platelet disorders.* National Library of Medicine. https://medlineplus.gov/plateletdisorders.html

a bone marrow aspiration and biopsy may be performed to assess the amount of **megakaryocytes** (platelet-producing cells).[10,11,12]

Nursing Diagnoses

Nursing diagnoses for clients with thrombocytopenia are based on their risk for bleeding and the need for health teaching to prevent bleeding.

Nursing diagnoses for clients with thrombocytopenia may include these diagnoses:

- Risk for Bleeding
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating specific expected outcome statements for nursing diagnoses identified for the client. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

An example of an expected outcome for a client with thrombocytopenia is the following:

- *The client will remain free from excessive bleeding.*

10. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors.* National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes
11. MedlinePlus. (2020). *Platelet disorders.* National Library of Medicine. https://medlineplus.gov/plateletdisorders.html
12. MedlinePlus. (2016). *Blood count tests.* National Library of Medicine. https://medlineplus.gov/bloodcounttests.html

Interventions

Medical Interventions

Medical interventions for thrombocytopenia address the low platelet counts and prevent bleeding complications. The choice of interventions depends on the underlying cause, the severity of thrombocytopenia, and the client's individual health status.

Common medical interventions and treatments used to manage thrombocytopenia are as follows:

- **Medications:** If a prescribed medication is the cause of the thrombocytopenia, it is stopped when possible. Medications like thrombopoietin receptor agonists (e.g., romiplostim) may be prescribed to stimulate the bone marrow to produce more platelets. Corticosteroids are useful to slow the rate of platelet destruction.
- **Platelet Transfusions:** In severe cases of thrombocytopenia with critically low platelet counts or when the client's risk of bleeding is high, platelet transfusion may be prescribed. This therapy provides an immediate increase in platelets and can help to stop bleeding.
- **Immunosuppressive Therapy:** Immunosuppressive medications may be prescribed for immune-mediated thrombocytopenia to suppress the immune system's attack on platelets.
- **Intravenous Immunoglobulin (IVIG):** IVIG may be prescribed for immune-mediated thrombocytopenia. It provides antibodies that can temporarily suppress the immune system's destruction of platelets.
- **Splenectomy:** In cases of refractory immune thrombocytopenia, where other treatments have been ineffective, surgical removal of the spleen (splenectomy) may be considered. The spleen stores platelets, so its removal helps to increase the number of circulating platelets in the bloodstream.
- **Lifestyle Modifications:** Health care providers may recommend lifestyle modifications, such as avoiding activities that increase the risk of bleeding.[13,14]

Nursing Interventions

Nursing interventions for clients with thrombocytopenia focus on preventing bleeding and providing health teaching to support the client's well-being.

IMPLEMENT BLEEDING PRECAUTIONS

Nurses play a significant role in preventing bleeding in clients at risk for bleeding, including those diagnosed with thrombocytopenia. Nursing Interventions Classification (NIC) provides a list of evidence-based nursing interventions categorized as "Bleeding Precautions" that can be implemented for a variety of medical conditions, including thrombocytopenia.[15] See selected nursing interventions related to this category in the following box.

13. National Heart, Lung, and Blood Institute. (2023). *Bleeding disorders: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/bleeding-disorders/causes

14. MedlinePlus. (2020). *Platelet disorders*. National Library of Medicine. https://medlineplus.gov/plateletdisorders.html

15. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications* (NIC) (8th ed.). Elsevier.

NIC Selected Nursing Interventions for Bleeding Precautions[16,17]

- Identify clients at risk for bleeding by reviewing for specific risk factors related to poor clotting function (i.e., a hematological condition or side effects from a medication).
- Assess skin for petechiae, purpura, ecchymosis, or bleeding from wounds or surgical sites.
- Monitor heart rate, blood pressure, and respiratory rate. Tachycardia, hypotension, and tachypnea are initial compensatory mechanisms associated with bleeding.
- For clients at severe risk of bleeding, monitor for signs and symptoms of internal and external hemorrhage (i.e., distension or swelling of an affected body part, change in the type or amount of drainage from a surgical wound or drain, bloody saturation of dressings, pooling of blood beneath client, hypotension, weak and rapid pulse, cool and clammy skin, rapid breathing, restlessness, reduced urine output).
- Monitor coagulation studies, such as platelets, PT, aPTT, INR, fibrinogen, and fibrin degradation products.
- Administer medications, such as thrombopoietin receptor

16. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications* (NIC) (8th ed.). Elsevier.

17. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier

agonists or immunosuppressive therapy, as prescribed.

- Administer platelets transfusions, as prescribed.
- Protect the client from injury that can cause bleeding (i.e., avoid intramuscular injections, use a soft toothbrush, use an electric razor, and avoid rectal suppositories and straining with constipation).
- Implement fall precautions because there is a high risk of internal bleeding from injuries resulting from falls.
- Avoid medications and supplements that potentially increase bleeding such as aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs), warfarin, heparin, clopidogrel, ginger, etc., as appropriate.
- Avoid invasive procedures; if they are necessary, monitor closely for bleeding.
- If excessive bleeding occurs, apply pressure or a pressure dressing over the site and immediately notify the health care provider.
- Teach the client and family on signs of bleeding (i.e., easy bruising, nosebleeds, bleeding gums, blood in the urine or stool, or extremely heavy menstrual bleeding) and to notify their health care provider if bleeding occurs.

PROVIDE HEALTH TEACHING AND HEALTH PROMOTION

Nurses teach clients and their family members about thrombocytopenia, its causes, and management. They teach about signs of bleeding and when to call the health care provider.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not

met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Thrombocytopenia

View a brief YouTube video overview of thrombocytopenia[18]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=931#oembed-1

18. Open RN Project. (2024, March 24). *Health Alterations – Chapter 3 Hematological – Thrombocytopenia* [Video]. YouTube. CC BY 4.0 https://www.youtube.com/watch?v=Pt0Y6C2Of3o

3.11 Leukopenia

Leukopenia refers to an abnormally low number of circulating white blood cells (WBC). **Neutropenia** refers to an abnormally low level of neutrophils. Neutrophils are the immune system's first line of defense. Without enough white blood cells, including enough neutrophils, the client is vulnerable to developing infections and can rapidly become septic.

Leukopenia and neutropenia are caused by other conditions such as autoimmune disease, malignancy, chemotherapy, or immunosuppressive medications.[1,2]

> Read more details about infection and sepsis in the "Infection" chapter of Open RN *Nursing Fundamentals, 2e*.

Assessment

Physical Examination

Leukopenia does not have specific symptoms. Clinical manifestations are

1. Ing, V. W. (1984). The etiology and management of leukopenia. *Canadian Family Physician 30,* 1835–1839. https://pubmed.ncbi.nlm.nih.gov/21279100/
2. Cleveland Clinic. (2022). *Low white blood cell count (Leukopenia).* https://my.clevelandclinic.org/health/symptoms/17706-low-white-blood-cell-count

related to infections that develop as a result of leukopenia, such as the following[3]:

- Fever and chills
- Malaise
- Sore throat
- Productive cough of purulent sputum
- Painful urination and/or malodorous urine
- Wounds with purulent drainage
- Tachycardia and tachypnea
- New onset confusion in older adults

Diagnostic Testing

Leukopenia is diagnosed by evaluating a CBC. In general, a WBC count less than 4,000 mm^3 is considered leukopenia, although the range can vary slightly by gender and age. Health care providers may order additional tests to evaluate suspected infection, such as a urinalysis/urine culture for a urinary tract infection, or a chest X-ray for suspected pneumonia.

A common reference range for neutrophils is called the absolute neutrophil count (ANC), which is calculated based on the percentage of neutrophils in the white blood cell count. The risk of opportunistic infection increases as the ANC falls below 1500/μL, and the risk of serious infection increases as the ANC falls to the severely neutropenic range (< 500/μL).

It is important to treat suspected infection very quickly in clients who have leukopenia and/or neutropenia because infections can quickly become severe and life-threatening due to their decreased immune response.

3. Ing, V. W. (1984). The etiology and management of leukopenia. *Canadian Family Physician 30,* 1835–1839. https://pubmed.ncbi.nlm.nih.gov/21279100/

Nursing Diagnoses

Nursing diagnoses for clients with leukopenia and/or neutropenia are as follows:

- Risk for Infection
- Fatigue Related to Disease Process
- Readiness for Enhanced Knowledge

Outcome Identification

Here are examples of expected outcomes for a client with an abnormally low white blood cell count:

- *The client will remain free from infection.*
- *The client will verbalize three energy conservation strategies by the end of the teaching session.*

Interventions

Medical Interventions

When deciding on treatment, health care providers consider the cause and severity of the leukopenia. Mild cases may not require treatment other than prevention techniques like strict handwashing and avoiding others who are ill.

Medical treatments for leukopenia may include the following[4]:

- **Antibiotics for Fever:** Fever in a client with leukopenia is assumed to be caused by an infection and is treated with antibiotics, even if the source of infection cannot be determined.

4. Metcalf, E. (2023). *Neutropenia.* WebMD. https://www.webmd.com/a-to-z-guides/neutropenia-causes-symptoms-treatment

- **Granulocyte Colony-Stimulating Factor (G-CSF):** This medication stimulates the bone marrow to produce more white blood cells and is typically prescribed for clients with low WBCs resulting from chemotherapy.
- **Stopping or Changing Medications:** Medications that cause reduced WBCs are stopped or changed, if possible, in cases of drug-induced leukopenia. Medications that can impact WBCs include the following classes:
    - Chemotherapy Drugs: Many chemotherapy drugs used in cancer treatment can suppress the bone marrow's ability to produce white blood cells, leading to leukopenia.
    - Antibiotics: Certain antibiotics, such as trimethoprim-sulfamethoxazole, linezolid, and some cephalosporins, can cause leukopenia as a side effect.
    - Anticonvulsants: Medications like phenytoin and carbamazepine, which are used to treat epilepsy and seizures, can sometimes lead to a decrease in WBCs.
    - Antipsychotic Medications: Clozapine is an antipsychotic medication known for its potential to cause **agranulocytosis**, a severe reduction in WBCs.
    - Antithyroid Medications: Methimazole and propylthiouracil, used to treat hyperthyroidism, can cause leukopenia and other blood disorders.
    - Immunosuppressants: Drugs like mycophenolate and azathioprine, used to suppress the immune system in organ transplant recipients and for autoimmune conditions, can reduce WBC counts.
    - Nonsteroidal Anti-Inflammatory Drugs (NSAIDs): Some NSAIDs, including ibuprofen and naproxen, have been associated with leukopenia in rare cases.
    - HIV Medications: Certain antiretroviral drugs used to treat HIV, like zidovudine, can lead to decreased WBC counts.
- **Stem Cell Transplants:** Stem cell transplants may be used to treat severe leukopenia caused by bone marrow problems, such as leukemia.

Nursing Interventions

Nurses play a significant role in helping clients prevent infection, as well as identifying infection early in a person at risk. They also provide health teaching to clients and their family members on how to prevent infection. Nursing Interventions Classification (NIC) provides a list of evidence-based nursing interventions categories as "Infection Protection."[5] See selected nursing interventions related to this category in the following box.

NIC Selected Nursing Interventions for Infection Protection[6,7]

- Review client history for preexisting conditions that increase their risk for infection (i.e., immunosuppressive medications, chemotherapy, bone marrow conditions).
- Monitor CBC (WBC and differential).
- Monitor and report signs of localized and systemic infection (i.e., localized redness, warmth, tenderness, drainage, fever, chills, malaise, or change in mental status in older adults).
- Monitor and report early signs of sepsis (i.e., temperature

5. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications (NIC)* (8th ed.). Elsevier

6. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications (NIC)* (8th ed.). Elsevier

7. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

over 38 or under 36 degrees Celsius, heart rate greater than 90 beats/minute, respiratory rate greater than 20 breaths/minute).

- Request cultures, as appropriate, for suspected infection of specific systems.
- Perform strict hand hygiene and maintain strict asepsis during dressing changes, wound care, intravenous therapy, and catheter handling.
- Limit the number of visitors and implement “reverse” transmission-based precautions, as indicated.
- Promote sufficient rest and nutritional intake of protein-rich foods to facilitate the production of WBCs and an effective immune response.
- Encourage fluid intake, unless contraindicated, to prevent urinary tract infections and as a replacement for fluids lost due to fever.
- Encourage coughing and deep breathing, as well as position changes, to reduce the risk of respiratory infections.
- Eliminate fresh fruits and vegetables from the diet. No flowers or plants should be in client care areas.
- Provide a private room as indicated.
- Promote immunizations as preventive infection measures, as appropriate.
- Teach the client to take their temperature every day at the same time. Teach the client and family members the signs of infection and the signs and symptoms that should be communicated to the health care provider.
- Teach the client and family members effective hand hygiene and to avoid contact with others who are ill.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Leukopenia

View a brief YouTube video overview of leukopenia[8]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=944#oembed-1

8. Open RN Project. (2024, June 23). *Health Alterations – Chapter 3 Hematological – Leukopenia* [Video]. YouTube. CC BY-NC 4.0 https://youtu.be/acyBI9GnsLg?si=GRE_8MwY_MBT7bXr

3.12 Aplastic Anemia

Aplastic anemia is a relatively rare but serious medical condition characterized by a significant reduction or absence of all three major blood cell types: red blood cells (RBCs), white blood cells (WBCs), and platelets. A reduction in all three major blood cell types is known as **pancytopenia**. Pancytopenia occurs when the bone marrow fails to produce an adequate number of blood cells, leading to a decrease in circulating levels in the bloodstream. In aplastic anemia, the bone marrow fails to produce enough cells. It can also stop producing cells completely. This deficiency of blood cells can lead to severe and life-threatening complications.[1,2]

There are two main types of aplastic anemia: acquired or inherited. Acquired aplastic anemia is the most common form of the disease. It often occurs without an identifiable cause and is believed to be the result of an autoimmune reaction in which the body's own immune system attacks the bone marrow. Exposure to toxins, viral infections, and radiation therapy can also lead to acquired aplastic anemia.

Inherited aplastic anemia is a rare form of the disease. In inherited aplastic anemia, the body has genetic mutations that impact bone marrow production and function. This is also referred to as Fanconi anemia.

Aplastic anemia can occur in any population, but is more common in young

1. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

2. MedlinePlus. (2022). *Aplastic anemia.* National Library of Medicine. https://medlineplus.gov/aplasticanemia.html

adults and adolescents. The onset of the disease can be either sudden or slowly progress and is often identified as symptoms emerge.[3,4]

Assessment

Physical Examination

Early symptoms of aplastic anemia are related to fatigue, infections that last a long time, and easy bruising or bleeding. A summary of common clinical manifestations of aplastic anemia is provided in Table 3.12. Note that the clinical manifestations are primarily related to the decreased oxygen-carrying capacity due to abnormally low levels of red blood cells, increased risk of infection due to abnormally low levels of white blood cells, and increased risk of bleeding due to low levels of platelets.

Table 3.12. Clinical Manifestations of Aplastic Anemia[5,6]

3. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia
4. MedlinePlus. (2022). *Aplastic anemia.* National Library of Medicine. https://medlineplus.gov/aplasticanemia.html
5. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia
6. MedlinePlus. (2022). *Aplastic anemia.* National Library of Medicine. https://medlineplus.gov/aplasticanemia.html

Body System	Clinical Manifestations
Hematological	Fatigue and weakness, pallor, easy bruising and **petechiae** (tiny red spots on skin), excessive bleeding from minor cuts or injuries, frequent nosebleeds, bleeding gums, blood in the urine or stools, prolonged or heavy menstrual bleeding, or increased susceptibility to infections.
Cardiovascular	Rapid or irregular heartbeat, shortness of breath, dizziness, chest pain, cold hands and feet, or decreased blood pressure.
Musculoskeletal	Bone pain, muscle weakness, joint pain and stiffness, or fractures resulting from minimal trauma.
Respiratory	Shortness of breath, cough with or without blood, frequent respiratory infections, or wheezing or crackles in the lungs.
Neurological	Headaches and dizziness, difficulty concentrating, numbness or tingling in hands or feet, problems with balance and coordination, vision changes, or seizures (in severe cases).

Diagnostic Testing

Aplastic anemia is characterized by a reduction in red blood cells, white blood cells, and platelets on a CBC. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges." The structure and appearance of the cells may also be examined with a peripheral blood smear. If abnormalities are noted, a provider will likely order a bone marrow aspiration and biopsy. These tests are important for confirming the diagnosis by examining the amount, structure of cells, and the health of the bone marrow.[7,8,9]

Nursing Diagnoses

Nursing diagnoses for clients with aplastic anemia are formulated based on the client's assessment data, medical history, and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions.

7. American Society of Hematology. (n.d.). *Anemia*. https://www.hematology.org/education/patients/anemia

8. MedlinePlus. (2022). *Aplastic anemia*. National Library of Medicine. https://medlineplus.gov/aplasticanemia.html

9. MedlinePlus. (2016). *Blood count tests*. National Library of Medicine. https://medlineplus.gov/bloodcounttests.html

Nursing diagnoses for clients with aplastic anemia may include the following:

- Fatigue
- Risk for Infection
- Risk for Bleeding
- Impaired Gas Exchange
- Activity Intolerance
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating specific expected outcome statements for nursing diagnoses identified for each client. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to aplastic anemia are as follows:

- *The client will remain free from excessive bleeding.*
- *The client will remain free from infection.*
- *The client will identify three measures to conserve energy and prevent fatigue.*

Interventions

Medical Interventions

Medical interventions for aplastic anemia address the reduced production of blood cells and improve the client's blood counts and overall health. The specific treatment plan depends on the severity of aplastic anemia, the underlying cause, and the client's individual health status. Common medical interventions and medications used to manage aplastic anemia include the following:

- **Blood Transfusions:** In severe cases of aplastic anemia with critically low blood cell counts, blood transfusions may be administered. Transfusions of whole blood provide an immediate increase in red blood cells, white blood cells, and platelets, alleviating symptoms and preventing complications.
- **Immunosuppressive Therapy:** Immunosuppressive medications are used to suppress the immune system's attack on the bone marrow.
- **Hematopoietic Stem Cell Transplantation:** For younger clients and those with severe aplastic anemia, a hematopoietic stem cell transplant (bone marrow transplant) may be considered. This procedure involves replacing the damaged bone marrow with healthy stem cells from a compatible donor.
- **Growth Factors:** Medications like erythropoietin and granulocyte-colony stimulating factor (G-CSF) can stimulate the production of specific blood cell types, such as red blood cells and white blood cells
- **Avoidance of Certain Medications:** Some medications like those used in chemotherapy can exacerbate aplastic anemia and should be discontinued or changed, if possible.[10,11]

Nursing Interventions

Nursing interventions for aplastic anemia address the reduced production of blood cells, manage symptoms, and prevent complications. Interventions focus on promoting client well-being, providing education, and supporting the client's physical and emotional needs.

Common nursing interventions for aplastic anemia include energy

10. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

11. MedlinePlus. (2022). *Aplastic anemia.* National Library of Medicine. https://medlineplus.gov/aplasticanemia.html

management, bleeding precautions, infection protection, medication management, health teaching, and supportive care[12,13]:

- **Energy Management:** Review interventions under "Energy Management" in the "Iron-Deficiency Anemia" section.
- **Bleeding Precautions:** Review interventions for "Bleeding Precautions" in the "Thrombocytopenia" section.
- **Infection Protection:** Review interventions for "Infection Protection" in the "Leukopenia" section.
- **Medication Management:** Ensure the client receives prescribed medications, including immunosuppressive therapy or growth factors.
- **Health Teaching and Counseling:** Provide education to the client and their family members about aplastic anemia, its pathophysiology, and potential causes. Explain the importance of adhering to treatment plans and regular follow-ups with health care providers.
- **Supportive Care:** Offer emotional support and create a compassionate environment to help the client cope with the challenges associated with aplastic anemia.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client,

12. American Society of Hematology. (n.d.). *Anemia.* https://www.hematology.org/education/patients/anemia

13. MedlinePlus. (2022). *Aplastic anemia.* National Library of Medicine. https://medlineplus.gov/aplasticanemia.html

reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Aplastic Anemia

View a brief YouTube video overview of aplastic anemia[14]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=952#oembed-1

14. Open RN Project. (2024, June 23). *Health Alterations – Chapter 3 Hematological – Aplastic anemia* [Video]. YouTube. CC BY-NC 4.0 https://youtu.be/_IcbxIGcyis?si=8–WFn2gM_nfpKtI

3.13 Learning Activities

Learning Activities

Hematological Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Mia, a 16-year-old high school student, had always been an active and vibrant teenager. Lately, though, she found herself struggling with a variety of symptoms that seemed to be taking a toll on her daily life. As she navigated through her busy schedule of classes, extracurricular activities, and social engagements, she couldn't shake off the persistent fatigue that had settled upon her like a heavy fog.

In her English class, Mia's friends noticed that her once rosy complexion had given way to a subtle pallor. They remarked on how her usually energetic demeanor had been replaced by a general sense of weariness. However, Mia attributed it to the stress of exams and her packed schedule, not giving it much thought. During physical education class, Mia's usual enthusiasm for sports had waned. As she attempted to participate in a simple jog around the track, she found herself becoming short of breath much sooner than usual. Her classmates, unaware of the subtle changes, joked about how she must have been slacking off during the weekend.

1. "Hematological Case Study" by Open RN is licensed by CC BY-NC 4.0

One afternoon, Mia sat in the cafeteria with her friends, absentmindedly picking at her lunch. As she bit into an apple, she winced, realizing that her gums felt a bit sore. Unbeknownst to her, her friends noticed her reluctance to eat the iron-rich foods on her plate. They exchanged concerned glances, wondering why Mia seemed disinterested in the hearty meals she used to enjoy.

As the weeks passed, Mia's symptoms persisted. She began experiencing frequent headaches and dizziness, often needing to sit down to regain her composure. In class, she found it challenging to concentrate, and her grades started slipping, causing her additional stress.

One day, Mia's friend, Emma, gently approached her about the changes she noticed and asked if everything was okay. Mia, trying to dismiss the worries, insisted it was just a phase and that she would bounce back soon. Emma encouraged Mia to make an appointment with her health care provider for a check-up.

Questions:

1. Which symptoms is Mia exhibiting that make you concerned about her hematological system?
2. Which assessments and diagnostic tests do you anticipate the health care provider would initially do for Mia?
3. What modifications to Mia's routine and lifestyle could assist her in symptom management?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=962#h5p-11

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An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=962#h5p-13

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https://wtcs.pressbooks.pub/healthalts/?p=962#h5p-14

“Hematology Question Set 2” by Open RN is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=962#h5p-52

“Case Study: Thrombocytopenia” by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=962#h5p-53

"Case Study: Sickle Cell Disease" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

- Test your knowledge on hematology using this NCLEX Next Generation-style highlight question. You may reset and resubmit your answers to this question an unlimited number of times.[2]

- Test your knowledge on hematology using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[3]

2. "Hematology Highlight" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

3. "Pediatric Hematology Bowtie" by Kellea Ewen, Jennifer Hinz, and OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on iron deficiency anemia using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[4]



- Test your knowledge on sickle cell disease using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[5]



- Test your knowledge on splenic laceration using a sample NCLEX Next Generation case study provided by the NCSBN in their Sample Pack. Note that correct answers are not provided by the NCSBN but have been indicated in this case study by nursing faculty with associated



4. "Iron Deficiency Anemia" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

5. "Sickle Cell Disease" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

rationale. This sample is provided as an example to help students prepare for the NCLEX.[6]

6. National Council of State Boards of Nursing. (2025). *NCLEX Sample Questions & Exam Preview*. NCSBN. https://www.nclex.com/prepare.page

Glossary

Adaptive immunity: The production of antibodies by B cells and targeted killing of infected cells by T cells. (Chapter 3.2)

Agranulocytosis: A severe reduction in WBCs. (Chapter 3.11)

Anemia: A clinical sign characterized by a reduction in either the number of red blood cells, the amount of hemoglobin, or the hematocrit (percentage of red blood cells in the total blood volume). (Chapter 3.5)

Angina: Chest pain. (Chapter 3.6)

Aplastic anemia: A relatively rare but serious medical condition characterized by a significant reduction or absence of all three major blood cell types: red blood cells (RBCs), white blood cells (WBCs), and platelets. (Chapter 3.12)

Bone marrow aspiration: The extraction of a small sample of liquid bone marrow from the center of a bone. (Chapter 3.3)

Bone marrow biopsy: A procedure that involves obtaining a small core of bone and marrow tissue from the bone marrow space. (Chapter 3.3)

Coagulation cascade: A complex series of reactions involving a variety of coagulation factors that eventually leads to the formation of a fibrin clot. (Chapter 3.2)

Dyspnea: Shortness of breath. (Chapter 3.6, Chapter 3.9)

Erythrocytes: Red blood cells (RBCs). (Chapter 3.2)

Erythromelalgia: Flushed or reddened skin, especially in the face or hands, due to engorged blood vessels. (Chapter 3.9)

Erythropoietin: An enzyme produced by the kidneys in response to hypoxia and essential for RBC production. (Chapter 3.2)

Fibrin clot formation: The final step in the clotting process. (Chapter 3.2)

Fibrinolysis: The process in which a clot is degraded in a healing vessel. (Chapter 3.2)

Glossitis: Inflammation of the tongue. (Chapter 3.6)

Hemarthrosis: Bleeding into joints. (Chapter 3.10)

Hematuria: Blood in the urine. (Chapter 3.3, Chapter 3.9)

Hemoglobin electrophoresis: A blood test that allows for the detection of

abnormal types of hemoglobin and often used when diagnosing sickle cell disease. (Chapter 3.8)

Hemoptysis: Coughing up blood. (Chapter 3.10)

Hemostasis: The process by which the body seals a ruptured blood vessel and prevents further loss of blood. (Chapter 3.2)

Hepatomegaly: Enlarged liver. (Chapter 3.8)

International Normalized Ratio (INR): A blood test that measures how long it takes for the blood to clot compared to a standardized value. (Chapter 3.2)

Intrinsic factor: A protein produced by the parietal cells of the stomach that allows vitamin B12 to be absorbed by the intestines. (Chapter 3.7)

Iron-deficiency anemia (IDA): A type of anemia characterized by a lack of sufficient iron in the body, leading to a decrease in the production of hemoglobin and red blood cells. (Chapter 3.6)

Jaundice: A yellow discoloration in the skin, mucus membranes, and eyes due to the body's inability to adequately metabolize bilirubin. (Chapter 3.2)

Koilonychia: Thin, brittle, or spoon-shaped nails often resulting from iron-deficiency anemia. (Chapter 3.6)

Leukocytes: White blood cells (WBCs). (Chapter 3.2)

Leukopenia: An abnormally low number of circulating white blood cells (WBC). (Chapter 3.11)

Megakaryocytes: Platelet-producing cells. (Chapter 3.10)

Myocardial infarction: Heart attack (Chapter 3.6)

Neutropenia: An abnormally low level of neutrophils, which are important for fighting infections. (Chapter 3.11)

Osteonecrosis: Bone death. (Chapter 3.8)

Pancytopenia: A reduction in all three major blood cell types and occurs when the bone marrow fails to produce an adequate number of blood cells, leading to a decrease in circulating levels in the bloodstream. (Chapter 3.12)

Peripheral blood smear: A test that can be used to diagnose SCD where a thin layer of cells is examined under a microscope to determine the shape of red blood cells. (Chapter 3.8)

Peripheral neuropathy: Numbness or tingling in extremities. (Chapter 3.9)

Pernicious anemia: A type of vitamin B12 anemia and an autoimmune

disorder in which antibodies are formed that attack intrinsic factors or the cells that produce intrinsic factors. (Chapter 3.7)

Petechiae: Tiny red spots on skin. (Chapter 3.10, Chapter 3.12)

Phagocytosis: Engulfment and destruction of bacteria. (Chapter 3.2)

Pica: Craving and consumption of non-food items (e.g., ice, clay, dirt). (Chapter 3.6)

Plasmapheresis: A treatment for polycythemia vera where there is withdrawal of whole blood and the removal of red blood cells and then a reinfusion of the plasma back into the client. (Chapter 3.9)

Plasmin: An enzyme that is responsible for breaking down fibrin, the mesh-like structure of a blood clot. (Chapter 3.2)

Platelet aggregation: Platelets stick together. (Chapter 3.2)

Platelet plug: Occurs when activated platelets stick together at the site of an injury, which helps to temporarily seal the wound. (Chapter 3.2)

Platelets: Assist in blood clotting and release growth factors to repair and heal tissue; also called thrombocytes. (Chapter 3.2)

Polycythemia: A medical condition with an excessive number of abnormal red blood cells. (Chapter 3.9)

Polycythemia vera: A medical condition that results from an abnormal increase in red blood cells, white blood cells, and platelets in the blood. (Chapter 3.9)

Pruritus: Itchiness. (Chapter 3.9)

Pulsatile tinnitus: Rhythmic pulsing sound in the ear. (Chapter 3.9)

Purpura: Purple or red spots on skin. (Chapter 3.10)

Red blood cells (RBCs): Transport oxygen and carbon dioxide between tissues and the lungs; also called erythrocytes. (Chapter 3.2)

Sickle cell disease: A genetic disorder characterized by abnormal hemoglobin molecules in red blood cells, leading to the formation of sickle-shaped cells instead of the usual biconcave disc-shaped cells. (Chapter 3.8)

Splenectomy: Surgical removal of the spleen. (Chapter 3.2)

Splenomegaly: Enlargement of the spleen. (Chapter 3.2)

Tachycardia: Rapid heart rate. (Chapter 3.6)

Tachypnea: Rapid respiratory rate. (Chapter 3.6)

Thrombocytes: Platelets. (Chapter 3.2)

Thrombocytopenia: A medical condition characterized by a decreased number of platelets in the blood. (Chapter 3.10)

Thrombopoietin: The growth factor that regulates platelet production. (Chapter 3.2)

Transfusion reactions: Adverse events that are directly related to the transfusion of blood products and may range from mild to severe with life-threatening effects. The onset of transfusion reactions may occur during the transfusion (known as acute transfusion reactions) or in days or weeks following the transfusion (known as delayed transfusion reactions). (Chapter 3.5)

White blood cells: Provide immune function and body defenses against disease; also called leukocytes. (Chapter 3.2)

PART IV

CHAPTER 4 MALIGNANCY AND AUTOIMMUNE ALTERATIONS

4.1 Autoimmune and Malignancy Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with autoimmune and malignancy disorders
- Explain the pathophysiology of autoimmune and malignancy disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in caring for the client with autoimmune and malignancy disorders
- Integrate pharmacological and nonpharmacological measures for the client with autoimmune and malignancy disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=81#h5p-38

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Malignancy and autoimmune disorders can impact any individual, regardless of their age, gender, socioeconomic background, or health status. The unpredictability of these health alterations often leaves clients and families anxious, uncertain, and vulnerable as they fear the impact on overall health and well-being. Many medical resources are dedicated to detecting and treating malignancy and autoimmune diseases. Preventive screening and early diagnosis have become foundational strategies to help ensure that individuals have the best opportunity to maintain health and achieve positive outcomes.

Malignant cells, or cancer, refer to abnormal cells that have the ability to invade and harm tissues.[1] These cells also have the potential to metastasize, or spread, to different parts of the body. Malignant cells differ from benign cells in that malignant cells exhibit uncontrolled growth and rapidly divide, subsequently invading and causing damage to normal functioning cells.

In contrast to malignancy, **autoimmune reactions** refer to actions within the body where one's own immune system accidentally initiates a response against the body's own healthy cells, tissues, or organs.[2] When the body's immune system is functioning correctly, the body can recognize bacteria, viruses, or any abnormal invader. In autoimmune reactions, the body cannot always distinguish its own healthy cells and begins to target immune actions inappropriately against itself.

Although both malignant and autoimmune reactions can significantly impact health, early detection and treatment are critical for achieving optimal

1. Patel, A. (2020). Benign vs malignant tumors. *JAMA Oncology, 6*(9), 1488. https://jamanetwork.com/journals/jamaoncology/fullarticle/2768634
2. Patel, A. (2020). Benign vs malignant tumors. *JAMA Oncology, 6*(9), 1488. https://jamanetwork.com/journals/jamaoncology/fullarticle/2768634

outcomes. This chapter will begin by reviewing the immune response and then introduce concepts related to cancer and hypersensitivity/autoimmune reactions.

4.2 Review of Anatomy and Physiology of the Immune System

Anatomy of the Lymphatic and Immune Systems

The **lymphatic system** is the system of vessels, cells, and organs that transports fluid called lymph to the bloodstream and also filters pathogens from the blood. The **immune system** is the complex collection of cells and organs that destroys or neutralizes pathogens that would otherwise cause infection, disease, or death. The lymphatic system, for most people, is associated with the immune system to such a degree that the two systems are virtually indistinguishable.

Lymph Vessels

Lymph capillaries are interlaced in **interstitial space**, the space between individual cells in the tissues. Interstitial fluid enters the lymphatic capillaries and becomes lymph. **Lymph** is a clear-to-white fluid that transports immune system cells, as well as dietary lipids and fat-soluble vitamins absorbed in the small intestine called **chyle**. See Figure 4.1[1] for an image of lymph capillaries.

1. "2202_Lymphatic_Capillaries.jpg" by OpenStax College is licensed under CC BY 3.0

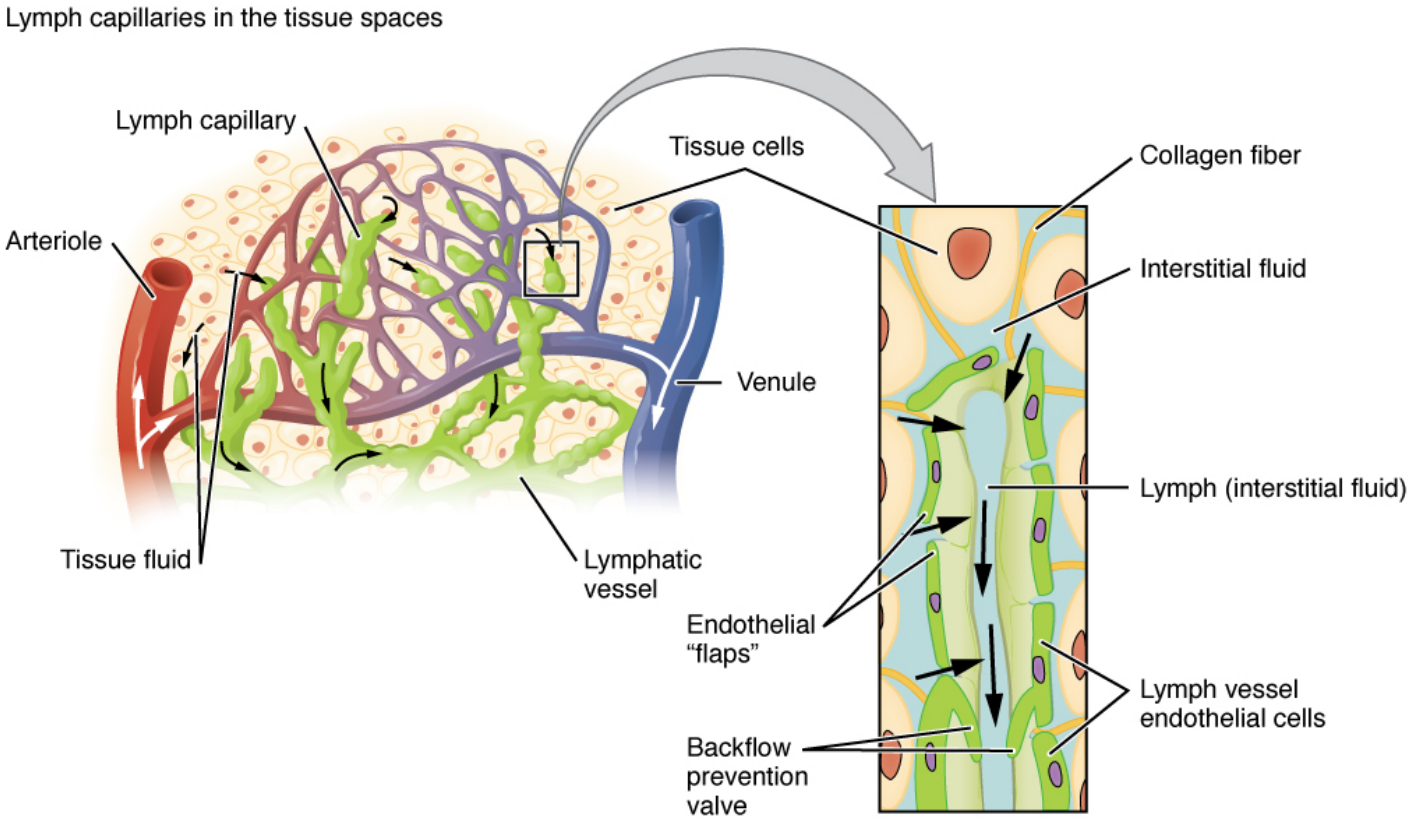


Figure 4.1 Lymph Capillaries

Lymph capillaries empty into larger lymphatic vessels that become larger and larger until they ultimately empty into the left and right subclavian veins in the neck. This is where lymph enters the bloodstream.

Lymph Nodes

Immune system cells use lymphatic vessels to not only make their way from the interstitial space into the circulation, but also use lymph nodes as major staging areas for the development of critical immune responses. A **lymph node** is one of the small, bean-shaped organs located throughout the lymphatic system. Lymph nodes store immune system cells that help the body fight infection and also filter the lymph fluid to remove foreign material such as bacteria and cancer cells.

Lymph travels through the lymph nodes near the groin, armpits, neck,

chest, and abdomen. Humans have about 500–600 lymph nodes throughout the body. See Figure 4.2[2] for an illustration of lymph vessels and nodes.

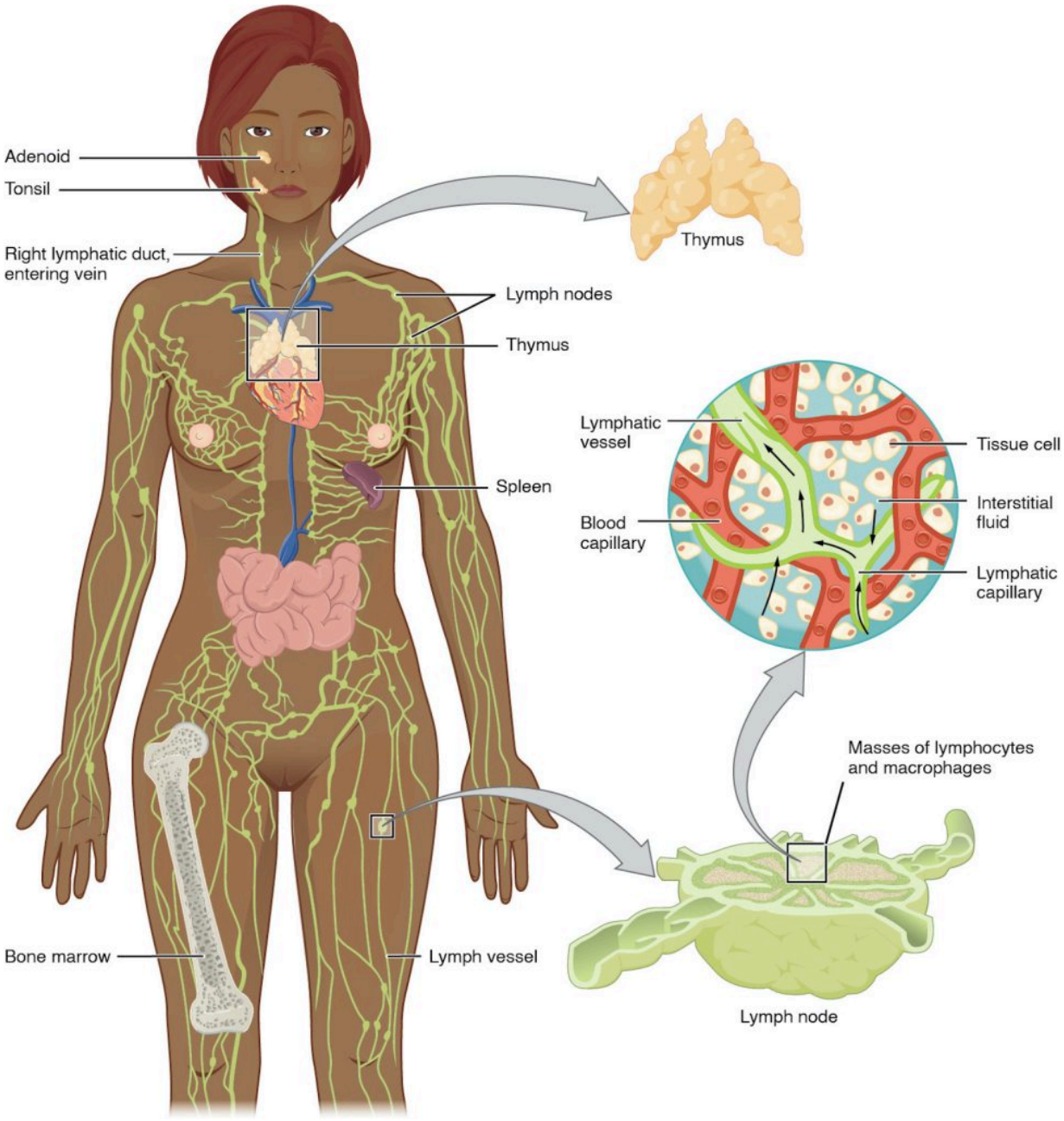


Figure 4.2 Anatomy of the Lymphatic System

2. "lymphaticimage-972×1024.jpg" by J. Gordon Betts, et al. is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction.

A major distinction between the lymphatic and cardiovascular systems is that lymph is not actively pumped by the heart but is forced through the vessels by the contraction of skeletal muscles during body movements and breathing. One-way valves in lymphatic vessels keep the lymph moving toward the heart. When the lymphatic system is damaged in some way, such as by being blocked by cancer cells or destroyed by injury, lymph "backs up" from the lymph vessels into interstitial spaces. This inappropriate accumulation of fluid is referred to as **lymphedema**. Lymphedema can also occur after lymph nodes are removed as part of cancer treatment. See Figure 4.3[3] for an image of lymphedema.

3. "Lymphedema_limbs.JPG" by Medical doctors is licensed under CC BY-SA 4.0



Figure 4.3 Lymphedema

Primary Lymphoid Organs: Bone Marrow and Thymus

The primary lymphoid organs are the bone marrow and thymus gland. The lymphoid organs are where lymphocytes mature, proliferate, and are selected to attack pathogens.

A **lymphocyte** is a type of white blood cell that fights infection. There are two main types of lymphocytes: B cells and T cells. **B cells** produce antibodies that are used to attack invading bacteria, viruses, and toxins. **T cells** destroy the body's own cells that have been taken over by viruses or become

cancerous.[4] Recall that all blood cells, including lymphocytes, are formed in the bone marrow. The B cell undergoes nearly all of its development in the bone marrow, whereas the immature T cell, called a thymocyte, leaves the bone marrow and matures in the thymus gland. The **thymus gland** is an organ found in the space between the sternum and the aorta of the heart.

Secondary Lymphoid Organs

Lymphocytes develop and mature in the primary lymphoid organs, but they mount immune responses from the secondary lymphoid organs. Secondary lymphoid organs include the lymph nodes, spleen, and tonsils.

SPLEEN

The **spleen** is sometimes called the "filter of the blood." The spleen stores and filters red blood cells and also functions as the location of immune responses to blood-borne pathogens. Therefore, clients who have had a splenectomy are at increased risk for infection.

TONSILS

The **tonsils** are lymphoid nodules located along the inner surface of the pharynx and are important in developing immunity to oral pathogens. The tonsil located at the back of the throat, the pharyngeal tonsil, is sometimes referred to as the adenoid when swollen. See Figure 4.4[5] for an illustration of

4. National Human Genome Research Institute. (2025). *Lymphocyte*. https://www.genome.gov/genetics-glossary/Lymphocyte

5. This work is a derivative of "2209 Location and Histology of Tonsils.jpg" by OpenStax and is licensed under CC BY 3.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/21-1-anatomy-of-the-lymphatic-and-immune-systems

the tonsils. Such swelling is an indication of an active immune response to infection.

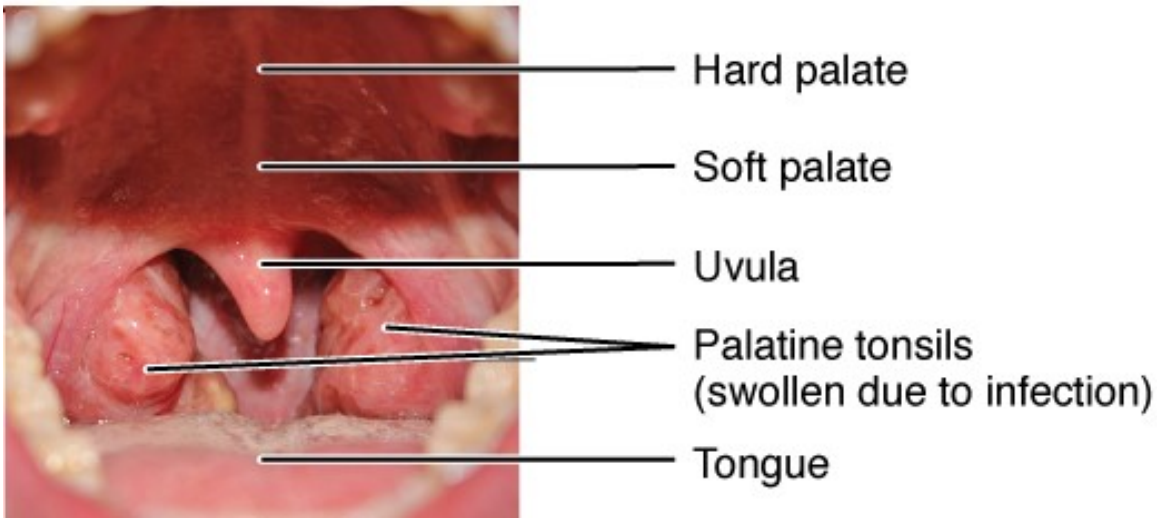


Figure 4.4 Tonsils

View a supplementary YouTube video[6] from Crash Course on the lymphatic system: Lymphatic System: Crash Course Anatomy & Physiology #44.

The Immune Response

There are two basic processes the body uses to defend against **pathogens** (i.e., microorganisms that cause infection). These processes are referred to as the innate immune response and the adaptive immune response.

6. CrashCourse. (2015, November 30). *Lymphatic system: Crash Course Anatomy & Physiology #44* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=I7orwMgTQ5I

Innate Immune Response

The **innate immune response** defends the body against pathogens in a nonspecific manner. It is called "innate" because it is present from the moment we are born. The innate immune response includes physical barriers and internal defenses.

PHYSICAL BARRIERS

Physical barriers are the body's basic defenses against infection. They include skin and mucous membranes, as well as mucus and enzymes that physically destroy and/or remove pathogens and debris from areas of the body where they might cause harm or infection.

INTERNAL DEFENSES

Internal defenses include phagocytosis, the inflammatory response, and fever.[7]

Phagocytosis

Phagocytosis refers to the process of specific white blood cells engulfing and destroying pathogens (i.e., "eating" them). Phagocytes include neutrophils and macrophages. **Neutrophils** are the most abundant type of white blood cells. They are the first to arrive during the innate immune response. After destroying a pathogen, neutrophils self-destruct and become pus. **Macrophages** are created from monocytes, a type of white blood cell. Each

7. InformedHealth.org (2023). *The innate and adaptive immune systems*. https://www.ncbi.nlm.nih.gov/books/NBK279396/

macrophage can destroy multiple pathogens, and they also clean up the destroyed neutrophils.[8] See Figure 4.5[9] for an image of phagocytosis.

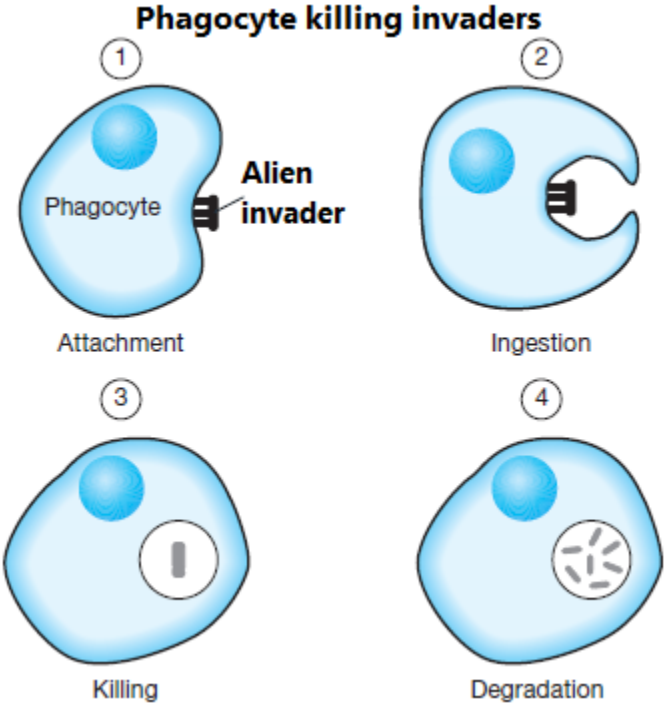


Figure 4.5 Phagocytosis

Inflammatory Response

Inflammation is characterized by heat, redness, pain, and swelling. Although inflammation is often perceived as a negative consequence of injury or disease, it is an important process that recruits immune defenses to eliminate pathogens, remove damaged and dead cells, and initiate repair mechanisms.

During the inflammatory response, the damaged cells release chemicals including histamine, bradykinin, and prostaglandins. These chemicals cause redness, heat, and increased permeability of blood vessels, so fluid leaks into

8. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Immune response*. https://medlineplus.gov/ency/article/000821.htm

9. "33815869430_4cfda6ff3d_o.png" by zzzi zeth is in the Public Domain.

tissues, causing swelling. These chemicals also attract phagocytes and lymphocytes. See Figure 4.6[10] for an image of inflammation.



Figure 4.6 Inflammation

Fever

Fever is part of the inflammatory response that extends beyond the site of infection and affects the entire body, resulting in an overall increase in body temperature. Fever enhances the innate immune response by stimulating white blood cells to kill pathogens. The rise in body temperature also inhibits the growth of many pathogens.

View a supplementary YouTube video[11] from Crash Course on

10. "Tickbite_Inflammation_2482a.jpg" by Túrelio is licensed under CC BY-SA 3.0 de.

11. CrashCourse. (2015, December 8). *Immune system, Part 1: Crash Course Anatomy & Physiology #45* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=GIJK3dwCWCw

nonspecific innate immunity: Immune System, Part 1: Crash Course Anatomy & Physiology #45.

Adaptive Immune Response

The **adaptive immune response** is activated when the nonspecific, innate immune response is insufficient to control an infection. The adaptive immune response requires exposure to a pathogen for the body to recognize it as a threat and respond. Exposure to the pathogen can be through direct contact or via immunization. After the adaptive immune system has been exposed to a pathogen, it develops memory cells to recognize this pathogen in the future and quickly mounts a defense.[12]

Lymphocytes, a specific type of white blood cell, play a key role in the adaptive immune response. There are two main groups of lymphocytes called B cells and T cells, both of which are formed in bone marrow. B cells mature in the bone marrow, and T cells mature in the thymus, the rationale for being called "B" cells and "T" cells. B cells are involved in humoral immunity, and T cells are involved in cell-mediated defenses.

HUMORAL IMMUNITY: B CELLS

Humoral immunity refers to the function of B cells and their production of antibodies. B cells originate and develop in the bone marrow and then migrate in body fluids through the lymph nodes, spleen, and blood to seek out and destroy pathogens in the interstitial spaces. B cells make Y-shaped proteins called **antibodies** that destroy pathogens based on their antigens. **Antigens** are markers that tell the immune system whether something in the body is harmful or not. Antigens are found on viruses, bacteria, cancer cells, and even normal cells of the body. Each antigen has a unique shape that the

12. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Immune response*. https://medlineplus.gov/ency/article/000821.htm

immune system reads like a name tag to know whether or not it belongs in that person's body. Antibodies are very specific to the antigens they recognize and destroy. They fit onto the antigen like a key to a lock.[13]

When a B cell finds an abnormal cell with an antigen that it has antibodies for, it binds to it and responds by cloning itself into many B cells and also releases thousands of antibodies per second to attack the pathogen. Some B cells become memory B cells that are involved in immunological memory to ensure a stronger and faster antibody response if the body is exposed to the same antigen in the future.

Passive Immunity

Passive immunity refers to transfer of immunity due to antibodies that are produced in a body other than one's own. For example, infants have passive immunity because they are born with antibodies that are transferred through the placenta from their mother. However, these antibodies can't create memory cells, so it won't remember an antigen if it gets infected again. These antibodies disappear between ages 6 and 12 months of age. Breast milk also contains antibodies, so babies who are breastfed have passive immunity for a longer period of time.[14]

Passive immunization can also be transferred from an injection of antibodies formed by another person or animal. See Figure 4.7[15] for an illustration of the immune response.

13. Cleveland Clinic. (2022). *Antigen*. https://my.clevelandclinic.org/health/diseases/24067-antigen

14. A.D.A.M. Medical Encyclopedia [Internet]. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Immune response*. https://medlineplus.gov/ency/article/000821.htm

15. "Immune Response" by Open RN is licensed by CC BY-NC 4.0

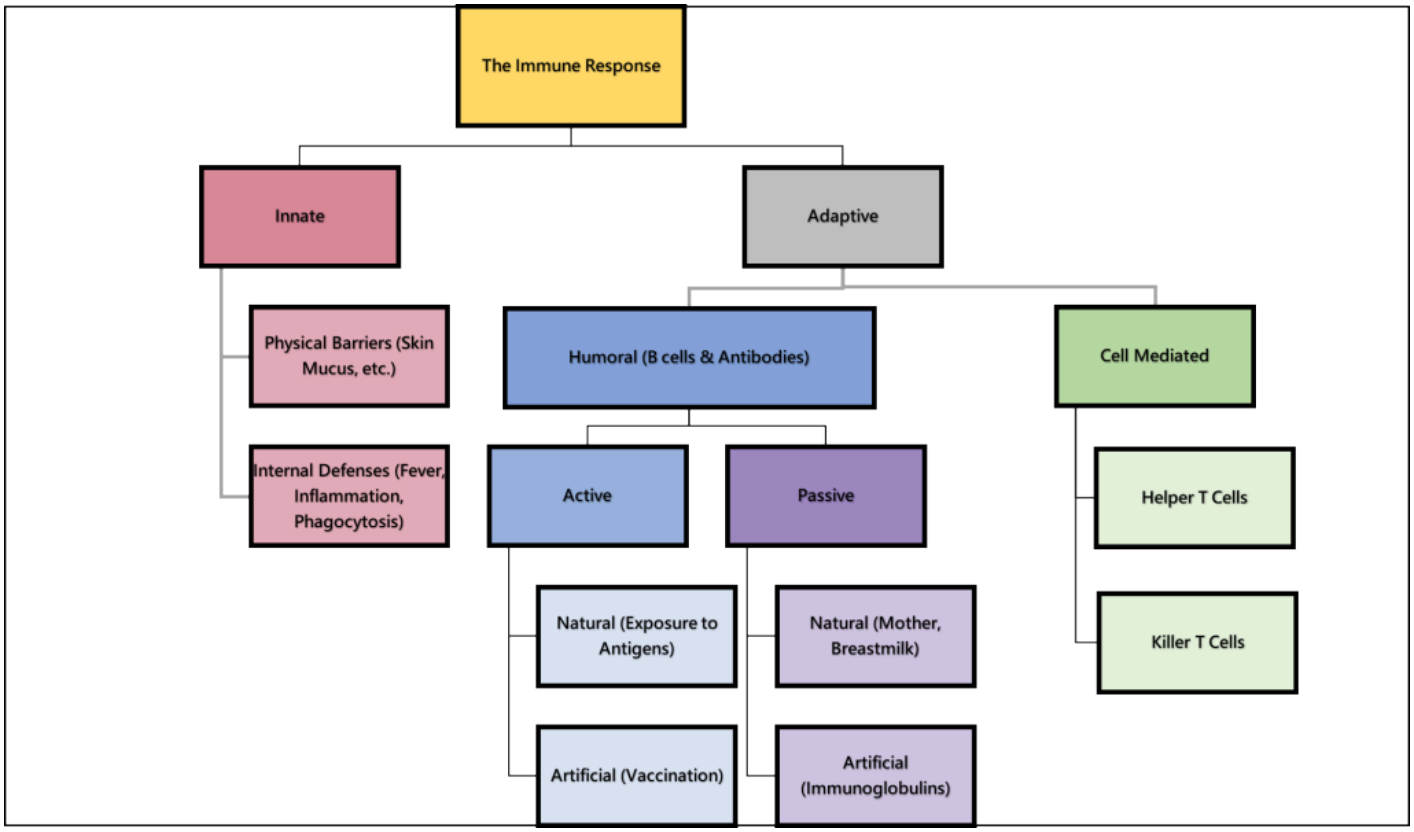


Figure 4.7 Immune Response

Immunoglobulins are a specific type of antibody. There are five classes of immunoglobulins: IgG, IgM, IgA, IgD, and IgE. Immunoglobulins provide immediate protection against an antigen, but do not provide long-lasting protection. For example, immunoglobulin is administered to individuals who have been exposed to hepatitis B as passive immunization to help fight the infection.[16]

CELL-MEDIATED RESPONSE: T CELLS

When innate immunity and humoral immunity are not effective in defending against pathogens or abnormal cells, the cell-mediated response uses

16. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Immune response*. https://medlineplus.gov/ency/article/000821.htm

lymphocyte T cells to destroy the abnormal cells. There are two major types of T cells called helper T cells and killer T cells[17]:

- **Helper T cells** use chemical messengers to activate the adaptive immune response. They stimulate B cells to make antibodies and help develop the killer T cells.
- **Killer T cells**, also called cytotoxic cells, directly kill cells that have been invaded by a virus or are otherwise abnormal. They also clone themselves into many effector T cells and create memory T cells for immunological memory of the antigen.

See Figure 4.8[18] for a comparison of the function of B cells and cytotoxic T cells. The purple cell is an invading virus. The B cells release antibodies to fight the virus and protect the body's cells from being invaded by the virus. The cytotoxic T cells recognize body cells that have been infected by the virus and destroy them.

17. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Immune response*. https://medlineplus.gov/ency/article/000821.htm

18. "General_Effector_Mechanisms_of_B_and_T_Cells.png" by סתו כסלו is licensed under CC BY-SA 4.0

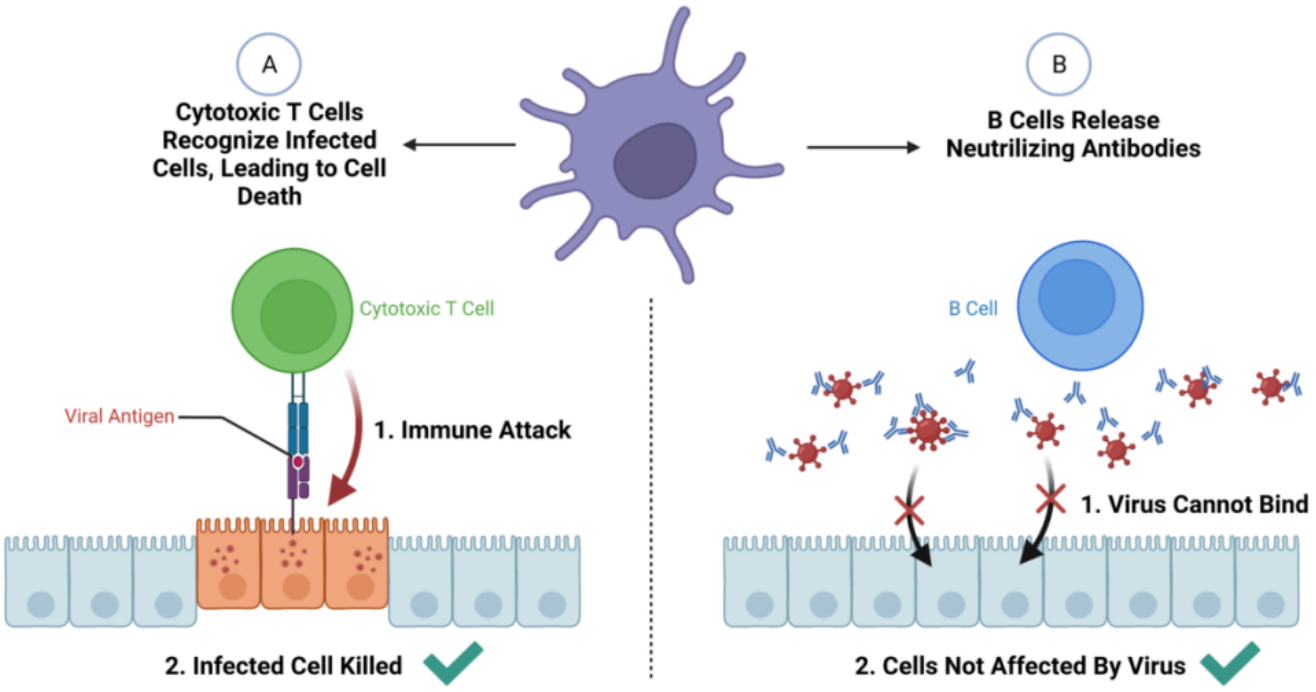


Figure 4.8 Functions of Cytotoxic T Cells and B cells

Chemical responses during the immune response including acute-phase proteins, complement proteins, and cytokines[19]:

- **Acute-phase protein:** An example of an acute-phase protein is **C-reactive protein**. High levels of C-reactive protein in blood samples indicate a serious infection or other medical condition is causing inflammation.
- **Complement proteins:** Complement proteins are always present in the blood and tissue fluids, allowing them to be activated quickly. They aid in the destruction of pathogens by piercing their outer membranes (cell lysis) or by making them more attractive to phagocytic cells.
- **Cytokines: Cytokines** are proteins secreted by cells that act as chemical messengers in immune responses. When a pathogen enters the body, the first immune cell to notice the pathogen is like the conductor of an orchestra. That cell directs all the other immune cells by creating and

19. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

sending out messages (cytokines) to the rest of the organs or cells in the body to respond to and initiate inflammation.

- However, too many cytokines can have a negative effect and result in a cytokine storm. A cytokine storm is a severe immune reaction in which the body releases too many cytokines into the blood too quickly. A **cytokine storm** can occur as a result of an infection, autoimmune condition, or other disease. Signs and symptoms include high fever, inflammation, severe fatigue, and nausea. A cytokine storm can be severe or life-threatening and lead to multiple organ failure. For example, many COVID-19 deaths were caused by cytokine storm.

See Figure 4.9[20] for an illustration of innate immunity and specific adaptive immunity using an example of a pathogen entering the body through the nose.

20. "2211_Cooperation_Between_Innate_and_Immune_Responses.jpg" by OpenStax is licensed under CC BY 3.0

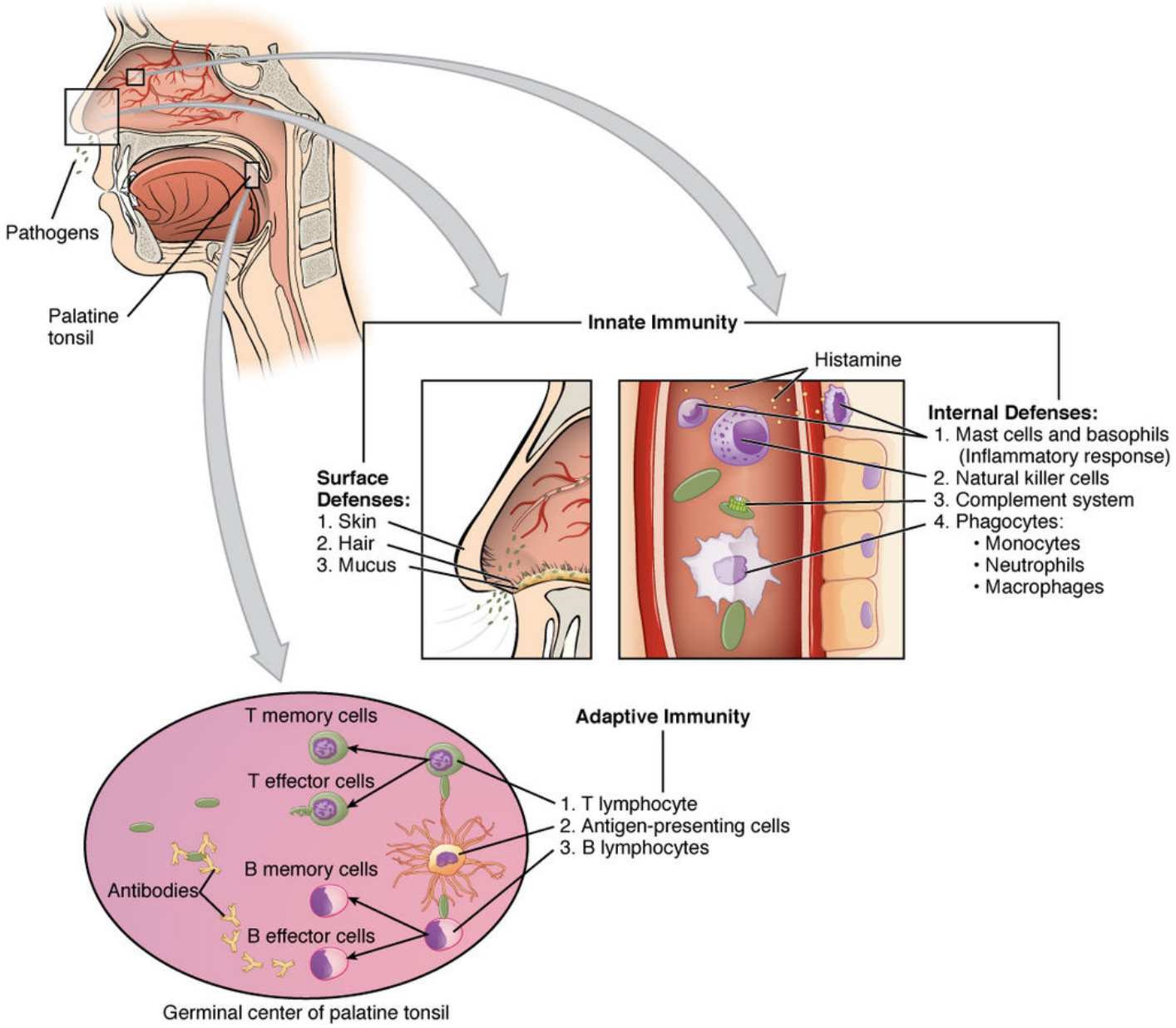


Figure 4.9 Innate Immunity and Specific Adaptive Immunity

View a diagram summary of immunity.

View a supplementary YouTube video[21] from Crash Course on cell-mediated immune response: Immune System, Part 3: Crash Course Anatomy & Physiology #47.

IMMUNOLOGICAL MEMORY

Immunological memory refers to the ability of the adaptive immune response to mount a stronger and faster immune response upon reexposure to a pathogen. Memory B and T cells for each specific pathogen are created that provide long-term protection from reinfection with that pathogen. On reexposure, these memory cells facilitate an efficient and quick immune response. For example, when an individual recovers from chicken pox, the body develops a memory of the varicella-zoster virus that will specifically protect it from reinfection if exposed to the virus again.[22]

Acquired immunity refers to immunity that develops with exposure to various antigens as an individual's immune system builds a defense. However, pathogens can mutate and change the shape of their antigens so the immune system can no longer recognize or defend against it.[23] For example, influenza viruses mutate frequently, requiring annual influenza vaccination.

21. CrashCourse. (2015, December 21). *Immune system, Part 3: Crash Course Anatomy & Physiology #47* [Video]. YouTube. https://www.youtube.com/watch?v=rd2cf5hVaIM

22. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

23. Cleveland Clinic. (2022). *Antigen*. https://my.clevelandclinic.org/health/diseases/24067-antigen

Immunization

Immunization is a method to trigger an individual's acquired immune response and prevent future disease. A **vaccine** is an agent administered by injection, orally, or by nasal spray that provides active acquired immunity to a particular infectious disease. Small doses of a viral antigen are given to activate immunological memory. Memory cells allow the body to react quickly if exposed to the recognized antigen and efficiently defend against the virus.[24]

Allergies and Immune Disorders

An **allergy** is an inflammatory response due to a hypersensitivity to a substance that most people's bodies perceive as harmless. **Histamine**, released during the immune response, is a primary cause of allergies and anaphylactic shock. **Autoimmune disease** is caused by the body's inability to distinguish its own healthy cells from abnormal cells or pathogens, producing antibodies that attack its own tissues. Allergies and autoimmune diseases will be further discussed in the "Autoimmune and Hypersensitivity Reactions" section of this chapter.

Immune Response and Cancer

There are three stages of the immune response to many cancers[25]:

- **Elimination** occurs when the immune response first develops antibodies toward tumor-specific antigens and actively kills most cancer cells.

24. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Immune response*. https://medlineplus.gov/ency/article/000821.htm

25. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). Anatomy and Physiology 2e. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

- **Equilibrium** is the period that follows elimination when remaining cancer cells are held in check.
- **Escape** from the immune response occurs when cancer mutates and no longer expresses specific antigens to which the immune system responds.

Immunodeficiency

Immunodeficiency results from a failure or absence of lymphocytes, phagocytes, and the complement system. Immunodeficiencies can be either primary or secondary. An example of a primary immunodeficiency caused by a genetic defect is severe combined immunodeficiency disorders (SCID). SCID is incompatible with life, and affected children typically die of infection within the first two years. Secondary immunodeficiency has multiple causes, such as medications (i.e., corticosteroids, immunosuppressive medications, and chemotherapy), nutritional deficiencies, and the human immunodeficiency virus (HIV) that causes acquired immunodeficiency syndrome (AIDS). HIV specifically impacts the helper T cells.[26]

Life Span Considerations

The following characteristics should be considered in pediatric and older adult clients.[27,28]

26. Justiz, Vaillant, A. A., & Qurie, A. (2023). *Immunodeficiency*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK500027/

27. Lond, M. L., Ladewig, P. W., Davidson, M. R., Ball, J. W., Bindler, R. M., & Cowen, K. J. (2017). *Maternal & child nursing care* (5th ed.). Pearson Education, Inc.

28. Stromberg, H. K. (2023). *Medical-surgical nursing: Concepts & practice* (5th ed.). Elsevier.

Pediatric Considerations

- Children have lower levels of immunoglobulins, and humoral and cell-mediated immunity are not fully developed until age 6 or 7, increasing their susceptibility to infections.
- Newborns acquire natural immunity from their mother via breast milk.

Older Adult Considerations

- Lymphocytes can become less reactive to antigens and can lose immune function, increasing the potential for infections.
- Antibody levels are decreased.
- Immune and inflammatory responses decline due to chronic disease processes.
- With aging, thinning skin naturally occurs, making it prone to injury, susceptible to intrusion of microorganisms, and the development of infection.
- Cilia in the respiratory and gastrointestinal tracts are less active, allowing entry of pathogens.
- There is a higher incidence of cancer, infection, and autoimmune diseases in older adults.
- Many older adults live in close proximity to one another in long-term care or assisted living facilities, increasing the risk of transmission of communicable diseases.

4.3 Cancer

Altered Cell Growth

Cells within the human body are exposed to many factors that can significantly impact their growth and function. Two categories of altered cellular growth are benign and malignant tumors, each possessing distinct characteristics and implications. See Figure 4.10[1] for an illustration comparing benign and malignant tumors.

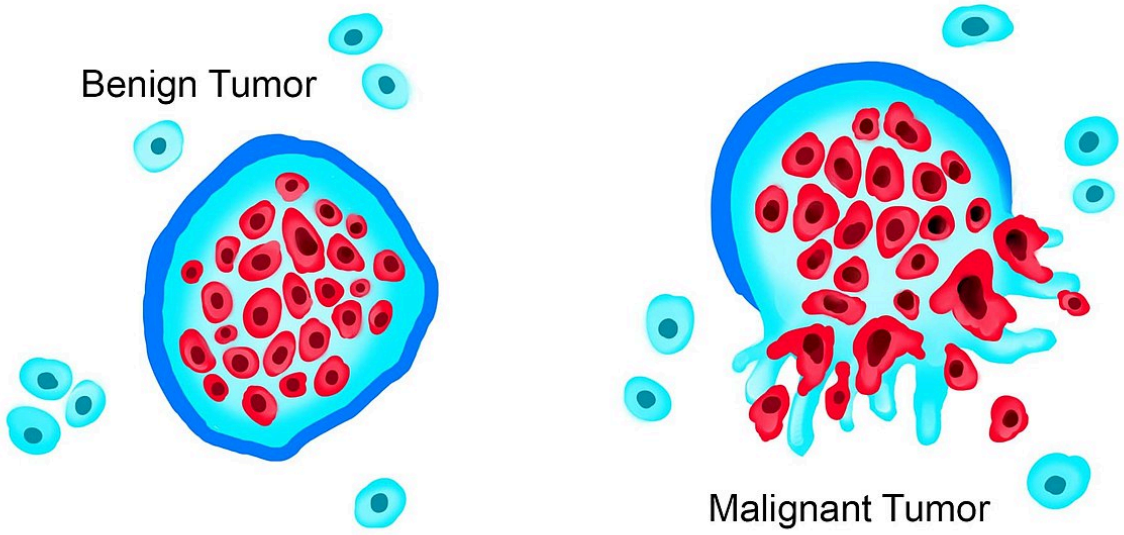


Figure 4.10 Benign and Malignant Tumors

When cellular growth and function deviate from their normal patterns, cells are categorized as abnormal. The term **benign** refers to abnormal growths that grow and divide in a controlled manner and do not spread outside their location because they are encapsulated, as demonstrated in Figure 4.10.[2]

1. "Tumor_Types_MTK.jpg" by WolfpackBME is licensed under CC BY-SA 4.0
2. National Cancer Institute. (n.d.). *Cancer terms.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/terms.html

Examples of benign tumors include moles, uterine fibroid tumors, skin tags, endometriosis, and nasal polyps. Benign growths usually involve normal cells growing in locations or at times that are irregular but cause little harm to surrounding tissues.

Malignant cells refer to cancerous developments within the body.[3] Malignancies can be solid tumors or abnormal growth patterns in the blood or lymphatic fluids. These cancer cells not only exhibit abnormal growth patterns but can also invade and impact other body tissues, called metastasis. This type of abnormal cellular growth is considered serious and can lead to death if left untreated.[4]

Malignant cells are the most dangerous due to their ability to metastasize and impact other organs and tissues. When cells **metastasize**, they typically spread through the blood or lymphatic system. They can also spread during medical procedures due to cross-contamination of surgical instruments or techniques, referred to as iatrogenic metastasis. The spread of the cancer cells and the potential rapid replication and invasion in other areas of the body complicate medical treatment, making it more difficult to rid the body of these abnormal invasive cells.

The distinction between benign and malignant growths is reflected in the medical interventions and prognosis. Benign growth is typically managed through close monitoring and/or minimal surgical interventions. For example, a benign tumor may be surgically removed with no further medical treatment required. However, malignant growths require prompt medical interventions like chemotherapy and radiation to prevent tumor progression and metastasis to other areas of the body.

3. National Cancer Institute. (n.d.). *Cancer terms.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/terms.html

4. Patel, A. (2020). Benign vs malignant tumors. *JAMA Oncology, 6*(9), 1488. https://jamanetwork.com/journals/jamaoncology/fullarticle/2768634

Metastasis

Metastasis of cancer cells can occur in different parts of the body; however, there are certain organs and tissues that are commonly impacted by each type of cancer. See Figure 4.11[5] for an illustration of metastasis of a primary tumor to the brain, lungs, or liver. Most cancer deaths are caused by metastasis to these major organs.

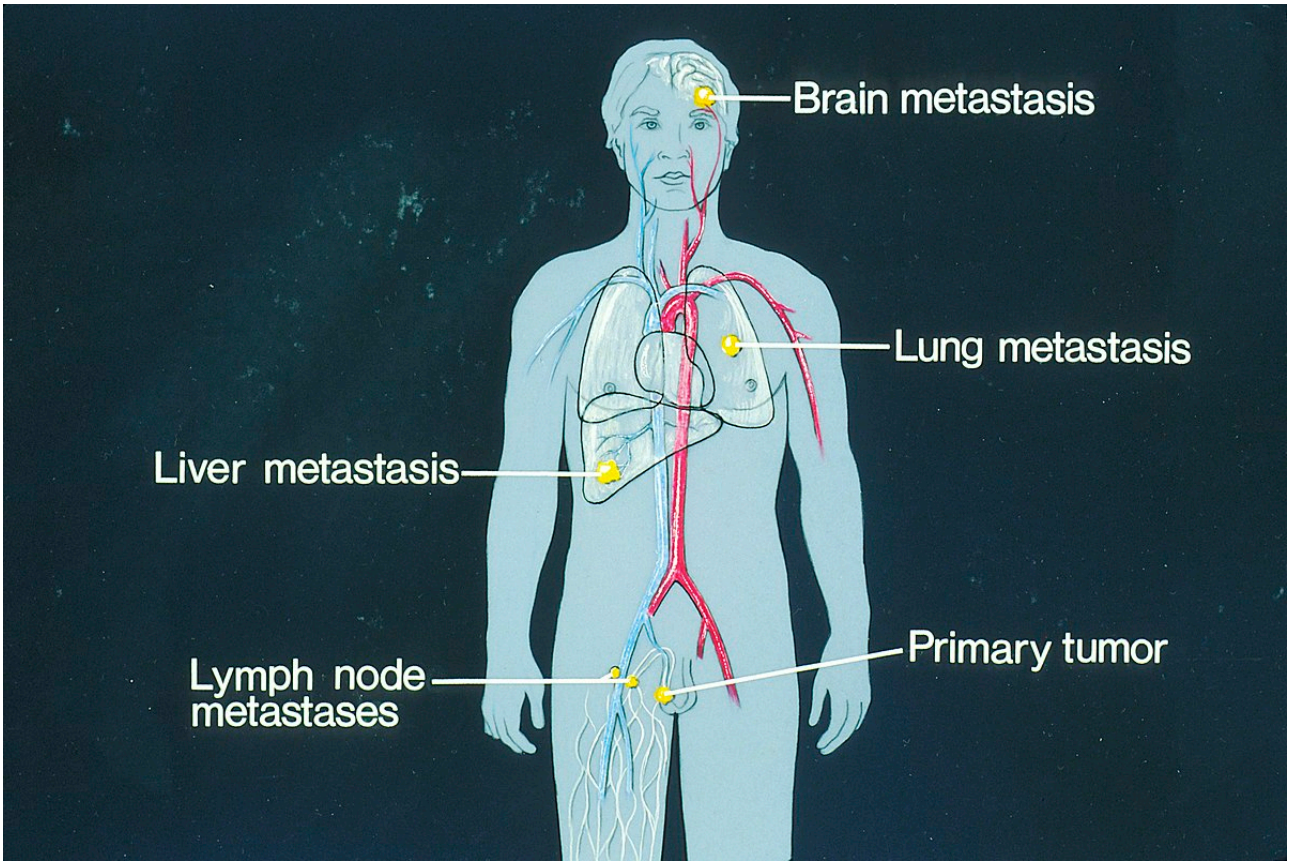


Figure 4.11 Metastasis

5. "Sites_of_potential_metastases_illustration.jpg" by unknown author, via National Cancer Institute is licensed in the Public Domain.

Common sites of metastasis include the following areas[6,7]:

- **Lungs:** The lungs are a frequent site of metastasis because they receive a large volume of blood from the body's circulation. Cancer cells circulating in the bloodstream can easily lodge in the small blood vessels of the lungs, leading to secondary tumor formation.
- **Liver:** The liver receives a robust blood supply and plays a significant role in blood filtration, making it another common site for metastasis.
- **Brain:** Cancer cells can reach the brain through the bloodstream or by direct extension from nearby structures.
- **Bones:** Many cancers, such as breast, lung, and prostate cancer, have a tendency to metastasize to the bones.
- **Lymph Nodes:** Lymph nodes are part of the lymphatic system and play a role in filtering lymph (a fluid that transports immune cells and waste products). Tumors located in close proximity to the lymph nodes, especially breast, gastrointestinal, urological, gynecological, and some skin cancers, are more likely to spread through the lymphatic system.
- **Bowel and Intestines:** The bowel and intestines, including the colon and rectum, are susceptible to metastasis, particularly in colorectal cancer. Cancer cells from the colon can also spread to nearby lymph nodes and to the liver.
- **Adrenal Glands:** The adrenal glands that sit atop the kidneys can be affected by metastatic cancer. The adrenal glands have a rich blood supply, making them potential targets for cancer cells circulating in the bloodstream.
- **Skin:** The skin is also a common site for cancer metastasis. Melanoma, a type of skin cancer, has a propensity to spread to other parts of the body,

6. Patel, A. (2020). Benign vs malignant tumors. *JAMA Oncology, 6*(9), 1488. https://jamanetwork.com/journals/jamaoncology/fullarticle/2768634

7. National Cancer Institute. (2020). *Metastatic cancer: When cancer spreads*. National Institutes of Health. https://www.cancer.gov/types/metastatic-cancer

including distant skin sites and internal organs.

- **Ovaries:** In women, ovarian metastasis can occur from cancers that have spread through the bloodstream or lymphatic system. Breast, colorectal, and stomach cancers are examples of cancers that can metastasize to the ovaries.
- **Kidneys:** Kidney metastasis can occur when cancer cells from other parts of the body reach the kidneys through the bloodstream. The kidneys filter the blood, making them a potential site for cancer cells to become trapped.

Metastasis is complex and involves several distinct steps, each of which contributes to the cancer's ability to establish secondary tumors in different organs and tissues. Read more details about the process of metastasis in the following box.

A Closer Look: Metastasis[8]

1. **Local Invasion:** The process of metastasis begins with the primary tumor growing and infiltrating nearby tissues. Cancer cells release enzymes that break down proteins surrounding cells. This enzymatic activity allows the cancer cells to break down barriers between healthy tissues, enabling them to spread into surrounding areas.
2. **Intravasation:** As the primary tumor grows, some cancer cells may invade nearby blood or lymphatic vessels. They enter these vessels by breaking through the vessel walls or

8. National Cancer Institute. (2020). *Metastatic cancer: When cancer spreads*. National Institutes of Health. https://www.cancer.gov/types/metastatic-cancer

migrating between cells that line the vessel walls. Once inside, cancer cells can be carried by the bloodstream or lymphatic system to distant sites in the body.

3. **Circulation:** Cancer cells that have entered the bloodstream or lymphatic system are carried throughout the body. They flow with the blood or lymphatic fluid, traveling to various organs and tissues.
4. **Adhesion:** Eventually, cancer cells carried by the bloodstream or lymphatic system come into contact with the blood vessels of other organs. To establish secondary tumors, cancer cells must adhere to the walls of these vessels. They use specific molecules to anchor themselves to the vessel walls at distant sites.
5. **Extravasation:** After adhering to the vessel walls, cancer cells must then cross the vessel walls to enter the surrounding tissue. They do this by squeezing through the vessel walls, a process known as **extravasation**.
6. **Microenvironment Adaptation:** Once cancer cells have successfully extravasated and entered a new tissue, they encounter a new microenvironment. The cells must adapt to the specific conditions of the tissue they have invaded. Some cancer cells may not survive in this new environment, but those that do can start to proliferate and form a secondary tumor.
7. **Secondary Tumor Formation:** Cancer cells that have successfully adapted to the new microenvironment begin to divide and multiply, forming a secondary tumor at the distant site. These secondary tumors are also referred to as metastatic tumors. Over time, these tumors can grow, invade nearby tissues, and disrupt the normal function of the affected organ.

View a supplementary YouTube video[9] from the National Cancer Institute on how cancer spreads: Metastasis: How Cancer Spreads.

When cancer spreads through metastasis, such as when colon cancer spreads to the liver, it is still medically treated as colon cancer even though the site is the liver.

Etiology of Cancer

Although the causes of many types of cancer remain unknown, there are specific elements that have been identified that enhance the risk of developing cancer. Three primary factors that have been shown to influence cancer development include the following:

1. **Exposure to Carcinogens:** A **carcinogen** is any substance capable of causing cancer. Carcinogens can come from many different types of sources, including industrial chemicals, tobacco smoke, pollutants, radiation, and viruses. These carcinogenic agents cause damage to cellular DNA, causing mutations within the cell. The mutations disrupt the normal regulatory mechanisms, allowing for abnormal cell growth and division. The extent and duration of exposure, as well as an individual's susceptibility, contribute to the overall impact of carcinogens in cancer development.[10]

9. National Cancer Institute. (2017, February 12). *Metastasis: How cancer spreads* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=fQwar_-QdiQ

10. National Cancer Institute. (n.d.). *Cancer risk factors.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/risk.html

2. **Genetic Predisposition:** Genetic predisposition refers to inherited mutations or variations in certain genes that can increase an individual's susceptibility to cancer. While not all cancers are directly inherited, certain genetic mutations can elevate the risk of developing specific types of cancer. Mutations in **tumor suppressor genes**, which regulate cell growth and prevent mutations, and **oncogenes**, which promote cell growth, are of particular significance. For instance, mutations in the BRCA1 and BRCA2 genes are associated with a higher risk of breast and ovarian cancers. Advances in genetic testing have enabled the identification of individuals at elevated risk in nearly every type of cancer, allowing for targeted monitoring and preventive interventions.[11]
3. **Immune Function:** A healthy functioning immune system is constantly scanning the body for abnormal cells and potential threats. A robust immune response can detect and eliminate cancerous cells before they take significant action. However, many cancer cells develop strategies to evade immune recognition, a phenomenon known as **immune evasion**. Cancer **immunosurveillance** is a dynamic process involving various immune cells, such as T cells and natural killer cells, as well as molecules like cytokines. Immunotherapy, a cutting-edge approach, aims to harness the power of the immune system to target and destroy cancer cells. For example, CAR-T cell therapy is an example of innovative treatment that manipulates immune function to combat cancer.[12]

Risk Factors for Cancer

An individual's cancer risk is impacted by numerous factors that may contribute to the development of the disease. It is important to understand

11. National Cancer Institute. (n.d.). *Cancer risk factors.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/risk.html

12. National Cancer Institute. (n.d.). *Cancer risk factors.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/risk.html

the mechanisms of **carcinogenesis**, a medical term for the development of cancer.

Risk factors for developing cancers include the following[13]:

- **Oncogene Activation:** Oncogene activation is a central mechanism in carcinogenesis. Oncogene activation occurs when specific genes within a cell's normal makeup become replicated out of control due to loss of cellular regulation or exposure to carcinogenic agents. These oncogenes are not inherently abnormal because they are part of every cell's genetic composition. The problem arises when the activity of oncogenes is not regulated, leading to unrestricted cell growth and division. This unchecked growth forms the basis of cancer development. See Figure 4.12[14] for an illustration of oncogene activation.

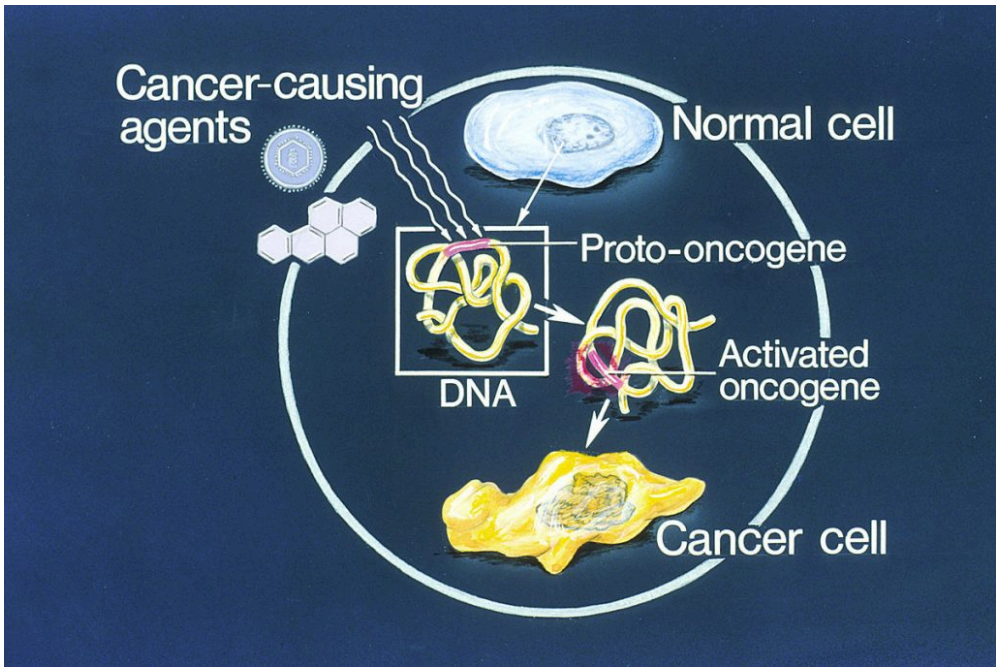


Figure 4.12 Oncogene Activation

13. National Cancer Institute. (n.d.). *Cancer risk factors.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/risk.html

14. "Oncogenes_illustration.jpg" by unknown author, via National Cancer Institute is licensed in the Public Domain.

- **Chemical Carcinogenesis: Chemical carcinogenesis** occurs due to exposure to various chemicals, drugs, and products encountered in everyday life. For example, tobacco is responsible for approximately 30% of cancer diagnoses in North America.[15] Carcinogenic chemicals can disrupt cellular processes and lead to DNA mutations.
- **Physical Carcinogenesis:** Two physical agents, radiation and chronic irritation, have been identified as contributors to cancer development. Ionizing radiation and ultraviolet (UV) radiation have been associated with DNA damage that can trigger oncogene activation and mutations. Chronic irritation, exemplified by the higher incidence of skin cancer in scar tissues of individuals with burn scars or other severe skin injuries, underscores the importance of cell division and DNA mutation in cancer risk.
- **Viral Carcinogenesis:** Viral carcinogenesis occurs when viruses infect human cells and disrupt the DNA strands. By inserting their genetic material into the host's DNA, these viruses can manipulate cellular processes and promote oncogene activation. Viral infections, such as human papillomavirus (HPV) and hepatitis B and C, have been linked to various cancers.
- **Dietary Factors:** Dietary habits play a role in cancer risk. Suspected factors include low fiber intake and high consumption of red meat and animal fats. Furthermore, additives, preservatives, and high-heat or grilling cooking methods may exert cancer-promoting effects.
- **Immune Function and Age:** The immune system plays a critical role in detecting and eliminating cancerous cells. Reduced immune function, often seen in immunosuppressed individuals, can increase cancer susceptibility. Age is also a significant risk factor for individuals over 60 due to a gradual decline in immune function and cellular repair mechanisms.
- **Genetic Risk:** Genetic predisposition, identified through genetic testing,

15. National Cancer Institute. (n.d.). *Cancer risk factors.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/risk.html

can provide valuable insights into an individual's susceptibility to certain types of cancer.

Prevention of Cancer

Prevention strategies are important for reducing cancer risk and optimizing client outcomes. Prevention strategies include primary, secondary, and tertiary prevention strategies.

Primary Prevention

Primary prevention involves strategies aimed at preventing the initial occurrence of cancer.[16,17] These strategies focus on reducing exposure to risk factors and promoting healthy behaviors to minimize the likelihood of cancer development.

Several key strategies fall under primary prevention[18,19]:

- **Avoid Known or Potential Carcinogens:** This involves identifying and avoiding substances or environmental factors known to increase the risk of cancer. For example, individuals are encouraged to avoid tobacco smoke, limit exposure to harmful chemicals, and adopt protective behaviors like using sunscreen to reduce the risk of skin cancer.

16. Colditz, G. A. (2022). Overview of cancer prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

17. Fletcher, G. S. (2022). Evidence-based approach to prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

18. Colditz, G. A. (2022). Overview of cancer prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

19. Fletcher, G. S. (2022). Evidence-based approach to prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

- **Modify Associated Factors:** Lifestyle modifications play a crucial role in primary prevention. Encouraging a balanced diet rich in fruits, vegetables, and whole grains, along with regular physical activity, can help reduce the risk of various cancers. Limiting alcohol consumption and maintaining a healthy weight are also important factors in cancer prevention.
- **Remove "At-Risk" Tissues:** Some individuals with precancerous conditions or high-risk genetic profiles might choose to undergo prophylactic surgeries to remove tissues that have a high likelihood of developing cancer. For example, individuals with certain genetic mutations linked to breast cancer might opt for preventive mastectomy to reduce their risk.
- **Vaccinate:** Certain vaccines can prevent infections that are strongly associated with cancer development. For example, the human papillomavirus (HPV) vaccine can significantly reduce the risk of cervical and HPV-related cancers in females and males. In addition, hepatitis B vaccination lowers the risk of developing liver cancer.

Secondary Prevention

Secondary prevention focuses on early detection and intervention to identify cancer at an early stage, when it is more treatable.[20,21] Screening strategies are key components of secondary prevention and include the following:

- **Screening Programs:** Regular screening tests aim to detect cancer before symptoms appear. Mammograms, Pap tests, colonoscopies, and prostate-specific antigen (PSA) tests are examples of screening tests that aid in the

20. Colditz, G. A. (2022). Overview of cancer prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

21. Fletcher, G. S. (2022). Evidence-based approach to prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

early detection.[22]

- **Early Diagnosis:** When cancer is detected through screening, it is often at an earlier stage, when treatment outcomes are better. Early diagnosis allows for more conservative treatment options, potentially avoiding more aggressive interventions like surgery, chemotherapy, or radiation therapy.
- **Reduced Mortality:** Successful secondary prevention can lead to reduced cancer-related mortality rates. By identifying and treating cancer in its early stages, the chances of successful treatment and long-term survival are significantly improved.
- **Improved Quality of Life:** Early detection and treatment can also lead to better overall quality of life for cancer survivors, as the need for extensive treatments and their associated side effects may be minimized.[23,24]

Tertiary Prevention

The goal of **tertiary prevention** in someone who is diagnosed with cancer is to manage symptoms, enhance quality of life, and reduce the risk of complications.[25,26]

22. Cancer Research UK. (n.d.). *Tests and scans*. https://www.cancerresearchuk.org/about-cancer/tests-and-scans

23. Colditz, G. A. (2022). Overview of cancer prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

24. Fletcher, G. S. (2022). Evidence-based approach to prevention. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

25. Loomans-Kropp, H. A. & Umar, A. (2019). Cancer prevention and screening: The next step in the era of precision medicine. *npj Precision Oncology, 3*. https://doi.org/10.1038/s41698-018-0075-9

26. Kisling, L.A., & Das, J.M. (2023). *Prevention Strategies*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537222/

Some examples of tertiary prevention are as follows[27,28]:

- Providing antiemetics to a client who has nausea and vomiting due to chemotherapy
- Obtaining a referral for palliative care
- Obtaining a referral to a rehabilitation center post-hospitalization for cancer-related issues
- Administering chemotherapy to prevent the metastasis of a primary tumor
- Referring the client to a support group consisting of others suffering from similar issues
- Educating the client on potential complications of their disorder, how to avoid complications, and what symptoms should be reported to their provider

Nursing Role in Prevention Strategies

Nurses are important in helping to ensure individuals participate in both primary and secondary prevention strategies. They have a critical role for providing client education regarding risk factors and surveillance strategies.

For example, nurses teach mnemonics such as "CAUTION" to help individuals become aware of early signs of cancer. These warning signs of cancer are as follows[29]:

27. Loomans-Kropp, H. A. & Umar, A. (2019). Cancer prevention and screening: The next step in the era of precision medicine. *npj Precision Oncology, 3*. https://doi.org/10.1038/s41698-018-0075-9

28. Kisling, L.A., & Das, J.M. (2023). *Prevention Strategies*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537222/

29. Cunha, J. P. (2022). *What are the seven warning signs of cancer?* eMedicineHealth. https://www.emedicinehealth.com/what_are_the_seven_warning_signs_of_cancer_caution/article_em.htm

C: Changes in bowel or bladder habits
A: A sore that does not heal
U: Unusual bleeding or discharge
T: Thickening or lump in the breast or elsewhere
I: Indigestion or difficulty swallowing
O: Obvious change in a wart or mole
N: Nagging cough or hoarseness

Types of Cancer

There are various types of cancers that originate in specific tissues or organs, with specific characteristics and behaviors. Cancer falls into two main categories: solid tumors and hematological malignancies. Some cancers grow slowly, while others are more aggressive. Table 4.3a provides an overview of major types of cancers, their descriptions, common risk factors, screening methods, and treatment options. It is important to remember that individual cases can vary widely, and health care providers offer personalized guidance regarding cancer prevention, detection, and treatment.

Table 4.3a. Types of Cancer[30,31,32,33]

30. Cancer Research UK. (n.d.). *Your cancer type*. https://www.cancerresearchuk.org/about-cancer/type

31. Cancer Research UK. (2021). *Treatment for cancer.* https://www.cancerresearchuk.org/about-cancer/treatment

32. Cancer Research UK. (n.d.). *Tests and scans.* https://www.cancerresearchuk.org/about-cancer/tests-and-scans

33. National Cancer Institute. (n.d.). *Cancer terms.* National Institutes of Health. https://training.seer.cancer.gov/disease/cancer/terms.html

Cancer Type	Description	Common Risk Factors	Screening and Diagnostic Tests	Treatment Options
Breast Cancer	Affects breast tissue, commonly in women but can occur in men	Gender, Age, and Family History	Mammography	Surgery, Radiation, Chemotherapy, Targeted Therapy, and Hormonal Therapy
Lung Cancer	Develops in lung tissues and often linked to smoking or exposure to harmful substances	Smoking and Radon Exposure	CT Scans and Sputum Tests	Surgery, Radiation, Chemotherapy, and Targeted Therapies
Prostate Cancer	Occurs in the prostate gland of men, usually slow-growing and common in older men	Age and Family History	PSA Blood Test	Surgery, Radiation, Chemotherapy, Targeted Therapy, and Hormone Therapy
Colorectal Cancer	Affects the colon or rectum, commonly adenocarcinomas	Age, Diet, and Family History	Colonoscopy	Surgery, Chemotherapy, Radiation, and Targeted Therapies
Skin Cancer	Develops in skin cells due to exposure to UV radiation from the sun or tanning beds	Sun Exposure and Fair Skin	Skin Exams	Surgery, Radiation, Immunotherapy, Targeted Therapy, and Topical Chemotherapy
Leukemia (Lymphocytic Cancer)	Blood cancer that affects bone marrow and blood cells	Genetic Factors	Blood Tests	Chemotherapy, Stem Cell Transplant, and Immunotherapy
Lymphoma	Cancer of the lymphatic system, includes Hodgkin and non-Hodgkin lymphomas	Immune System Disorders	Biopsy and Imaging	Chemotherapy, Radiation, and Immunotherapy
Ovarian Cancer	Occurs in the ovaries of women, often diagnosed at an advanced stage	Family History and Age	Pelvic Exams and Imaging	Surgery, Radiation, Chemotherapy, and Targeted Therapies
Pancreatic Cancer	Develops in the pancreas, often diagnosed at an advanced stage	Smoking and Obesity	Imaging and Biopsy	Surgery, Chemotherapy, and Radiation
Brain Cancer	Affects brain cells	Radiation Exposure and Family History	Imaging and Biopsy	Surgery, Radiation, and Chemotherapy

Myeloid Cancers	A group of blood cancers affecting myeloid cells in bone marrow, such as Acute Myeloid Leukemia, Chronic Myeloid Leukemia, Multiple Myeloma, etc.	Genetic Mutations	Blood Tests and Biopsy	Chemotherapy, Targeted Therapy, and Stem Cell Transplant

Staging

Staging of cancer is completed by a provider to determine how big a tumor is and whether or not it has metastasized to other parts of the body. This allows providers to tailor cancer treatment according to its stage.

There are a variety of ways to stage cancer, but two common staging modalities are the TNM system and stage grouping.

TNM System

- T: Tumor Size
- N: Number of lymph nodes involved
- M: If metastasis has occurred

With this staging system, there are numbers that follow each of the letters that provide more detail about tumor size, the number of lymph nodes involved, and if metastasis has occurred. For example, a tumor designated as "T1" is a smaller tumor than a tumor designated "T4." In regard to lymph nodes, "N0" means there is no cancer present in adjacent lymph nodes, whereas "N3" indicates multiple nearby lymph nodes have cancer present. For metastasis, "M0" means no metastasis has occurred, whereas "M1" indicates cancer has spread to distant parts of the body.[34]

34. National Cancer Institute. (2022). *Cancer staging.* National Institutes of Health. https://www.cancer.gov/about-cancer/diagnosis-staging/staging

Stage Grouping

Cancerous tumors can also be assigned an overall stage with stage grouping. With this staging system, tumors are designated Stage 0 to Stage IV. Stage 0 is also known as **carcinoma in situ**. This means that cancerous or abnormal cells are present, but they are localized to the initial layer of cells where they were first discovered. Stages I-III means that cancer exists, and the higher the number, the bigger the tumor is and the more it has invaded adjacent tissues. Stage IV cancer means that the cancer has spread to remote parts of the body. Generally, the lower the stage upon diagnosis, the better chance the client has for achieving a cure or entering remission.[35,36]

Oncological Emergencies

Oncological emergencies encompass a variety of clinical conditions that arise acutely in the client with cancer. These emergencies can be related to metabolic changes in the body that are associated with cancer, structural changes in which a cancerous tumor is impinging on other organs or

35. National Cancer Institute. (2022). *Cancer staging.* National Institutes of Health. https://www.cancer.gov/about-cancer/diagnosis-staging/staging

36. National Cancer Institute. (2022). *Cancer staging.* National Institutes of Health. https://www.cancer.gov/about-cancer/diagnosis-staging/staging

structures, or a result of cancer treatment.[37,38,39] See Table 4.3b for common oncological emergencies, related signs and symptoms, and treatment options.

Table 4.3b. Oncological Emergencies[40,41,42]

37. Higdon, M. L., Atkinson, C. J., & Lawrence, K. V. (2018). Oncological emergencies: Recognition and initial management. *American Family Physician, 97*(11), 741-748. https://www.aafp.org/pubs/afp/issues/2018/0601/p741.htm

38. Klemencic, S., & Perkins, J. (2019). Diagnosis and management of oncologic emergencies. *The Western Journal of Emergency Medicine, 20*(2), 316–322. https://doi.org/10.5811/westjem.2018.12.37335

39. Kim, J. T., Park, J. Y., Lee, H. J., & Cheon, Y. J. (2020). Guidelines for the management of extravasation. *Journal of Educational Evaluation for Health Professions, 17*, 21. https://doi.org/10.3352/jeehp.2020.17.21

40. Higdon, M. L., Atkinson, C. J., & Lawrence, K. V. (2018). Oncological emergencies: Recognition and initial management. *American Family Physician, 97*(11), 741-748. https://www.aafp.org/pubs/afp/issues/2018/0601/p741.htm

41. Klemencic, S., & Perkins, J. (2019). Diagnosis and management of oncologic emergencies. *The Western Journal of Emergency Medicine, 20*(2), 316–322. https://doi.org/10.5811/westjem.2018.12.37335

42. Kim, J. T., Park, J. Y., Lee, H. J., & Cheon, Y. J. (2020). Guidelines for the management of extravasation. *Journal of Educational Evaluation for Health Professions, 17*, 21. https://doi.org/10.3352/jeehp.2020.17.21

Oncological Emergency	Signs and Symptoms	Treatment
Hypercalcemia: Increased calcium levels caused by tumor invasion into bone or increased production of parathyroid hormone or vitamin D3.	Serum calcium level greater than 10.5 mg/dL Changes in cognition Weakness Loss of appetite, nausea, vomiting, constipation, or increased thirst Coma Increased urination Irregular heartbeat	Monitor albumin levels as the majority of calcium is protein bound Aggressive hydration Loop diuretics Bisphosphonates and/or calcitonin Steroids (if the cause of elevated calcium is due to overproduction of vitamin D3) Hemodialysis may be required Electrocardiogram
Tumor Lysis Syndrome: Tumor cells break down in response to cancer treatment and release intracellular contents into the bloodstream. Can also occur spontaneously in some cancers. This disrupts the normal balance of electrolytes in the body.	Increased serum levels of uric acid, phosphorus, and potassium Decreased levels of calcium Signs of kidney failure or elevated BUN and creatinine Irregular heartbeat Seizures Fatigue Nausea and vomiting	Electrocardiogram Aggressive hydration Monitor urine output Decrease intake of foods containing phosphorus and potassium Hemodialysis may be required Phosphate binders Calcium supplementation Rasburicase to decrease uric acid levels
Superior Vena Cava Syndrome: Compression of the superior vena cava by a cancerous tumor.	Edema of the face, neck, or upper extremities Jugular vein distention Cough, shortness of breath at rest, or hoarse voice Chest/shoulder pain	Radiation or chemotherapy to reduce the tumor size Steroids Stenting of the superior vena cava to prevent compression
Syndrome of Inappropriate Antidiuretic Hormone (SIADH): When cancerous tumors produce excessive antidiuretic hormone. Can also be caused by some chemotherapy medications. Leads to water retention.	Low sodium levels Decreased osmolarity of the blood Concentrated urine Nausea, vomiting, or constipation Weakness	Fluid restriction of 500 to 1000 mL/day Hypertonic saline may be used Monitor urine output
Extravasation of Chemotherapy Medications: When chemotherapy seeps into surrounding tissues instead of going into the bloodstream.	Pain, edema, or redness at site of extravasation Blister formation and necrosis at site of extravasation	Halt the infusion as soon as extravasation is noted Aspirate any remaining drug from cannula Leave cannula of access device in place until plan of action is determined (plan will vary based on particular medication) Cold or warm compresses (approach depends on particular medication) Give antidote if available Elevate affected limb

General Medical Interventions for Cancer

Cancer treatment commonly involves a combination of many different therapies in order to optimize client outcomes. Medical interventions continue to evolve with advancements in technology and emerging medical research. Surgical and medical interventions offer specific approaches to cancer treatment, respective of the type and stage of cancer, the client's overall health, and the treatment goals.

Surgery

Surgery is a common treatment option for various types of cancer. It involves the physical removal of cancerous tissues from the body. Surgical interventions can serve multiple purposes in cancer care.[43] See Table 4.3c for examples of common surgeries performed for cancer.

Table 4.3c. Examples of Surgeries Performed For Cancer[44]

Surgery Type	Description	Example
Prophylaxis Surgery	Removes at-risk tissue to prevent cancer development.	Removing a benign mole from a sun-exposed area.
Diagnosis Surgery	Removes suspected lesion for examination and testing.	Biopsy of a suspicious lump.
Curative Surgery	Focuses on complete removal of all cancerous tissue.	Surgical removal of a localized tumor.
Control Surgery	Focuses on partial removal of tumor to increase efficacy of other treatments.	Debulking surgery to reduce tumor size.
Palliative Surgery	Aims to improve quality of life by alleviating symptoms.	Removing a tumor causing pain.
Reconstruction/Rehabilitation Surgery	Enhances function and appearance post-cancer treatment.	Breast reconstruction after mastectomy.

43. Cancer Research UK. (2021). *Treatment for cancer.* https://www.cancerresearchuk.org/about-cancer/treatment

44. Cancer Research UK. (2021). *Treatment for cancer.* https://www.cancerresearchuk.org/about-cancer/treatment

Radiation

Radiation therapy uses high-energy rays or particles to target and damage cancer cells. This treatment can be systemic or localized, meaning it aims to destroy or shrink tumors while minimizing damage to surrounding healthy tissue.[45]

It can serve to cure, control, or relieve symptoms of the disease by damaging cancer cells through exposure to ionizing radiation.

When cells are subjected to ionizing radiation, the particles within the cell's nucleus undergo rearrangement, resulting in the release of a substantial amount of intracellular energy.[46] The energy emitted by radioactive elements can vary in its ability to penetrate tissues and inflict damage to cells. See Figure 4.13[47] for an image of a client undergoing radiation therapy.

45. National Cancer Institute. (2019). *Radiation therapy to treat cancer.* National Institutes of Health. https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy

46. Mitin, T. (2023). Radiation therapy techniques in cancer treatment. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

47. "Radiation_therapy_for_cancer.jpg" by Jakembradford is licensed under CC BY-SA 4.0

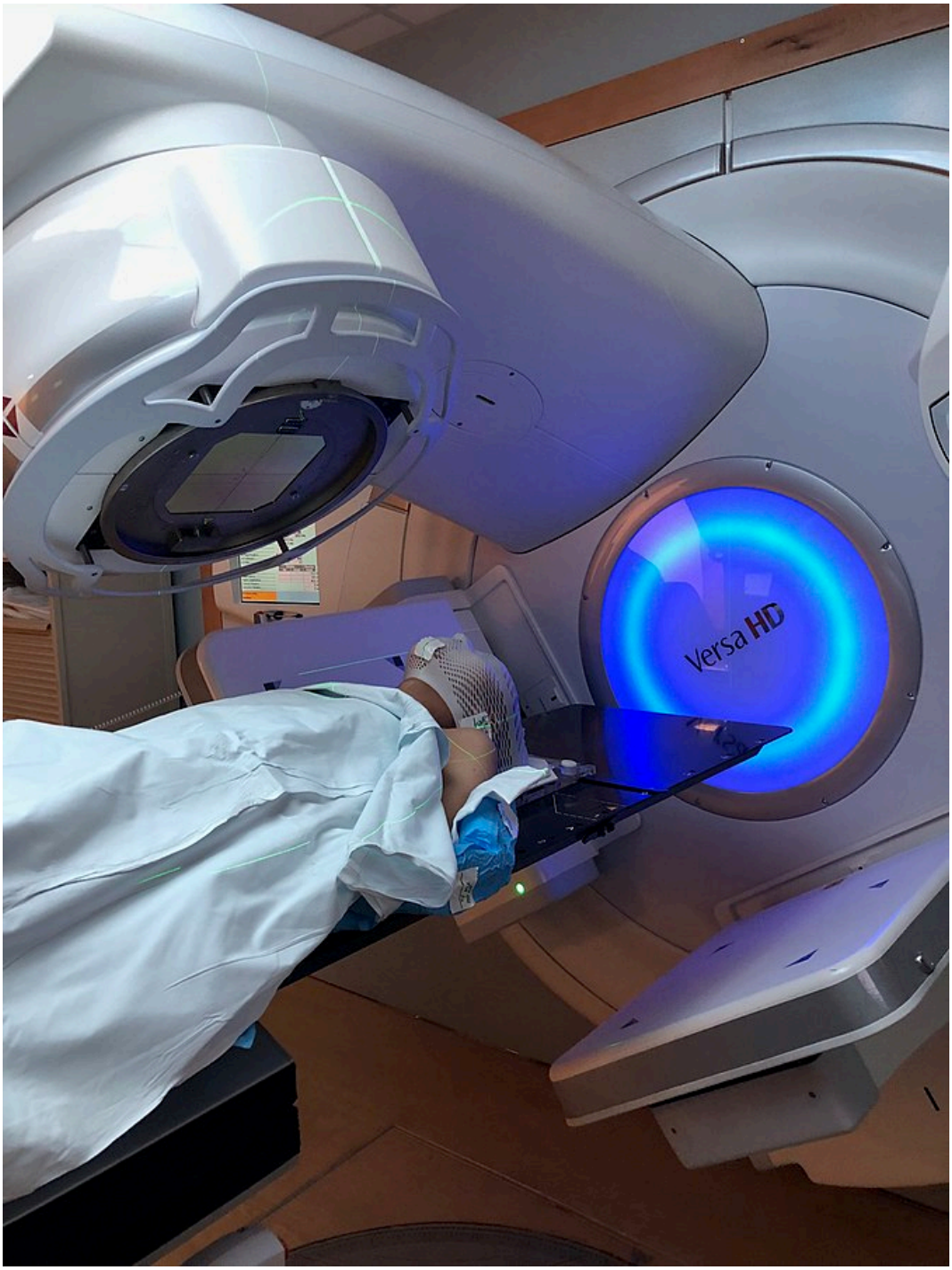


Figure 4.13 Radiation Therapy

Radiation therapy has localized effects, impacting tissues within the radiation path, rather than systemic effects associated with chemotherapy. For instance, when treating lung cancer with radiation to the chest area, changes like skin alterations and hair loss are observed solely within the chest region

subjected to radiation. This localized targeting is a key advantage of radiation therapy.

There is a limit to the amount of radiation an area of the body can safely receive over the course of an individual's lifetime. Depending on how much radiation an area has already been treated with, a client may be able to have radiation therapy to that area a second time. But, if one area of the body has already received the safe lifetime dose of radiation, another area might still be treated if the distance between the two areas is large enough.[48]

There are different methods for delivering radiation therapy, including teletherapy and brachytherapy.

- **External beam radiation therapy: Teletherapy**, or external beam radiation therapy, comes from a machine that aims radiation at the client's cancer. The machine is large, and it may be noisy. The machine does not touch the client, but can move around them, sending radiation to the cancer from many directions. External beam radiation therapy is a local treatment, which means it treats a specific part of the body. For example, if the client has lung cancer, radiation is only provided to the chest, not the whole body.[49]
- **Internal radiation therapy:** Internal radiation therapy is a treatment in which a source of radiation is put inside the body near the tumor site. It is often used for specific cancers like cervical, prostate, or thyroid cancer. The radiation source can be solid or liquid. Internal radiation therapy with a solid source is called **brachytherapy**. In this type of treatment, seeds, ribbons, or capsules that contain a radiation source are placed near the

48. National Cancer Institute. (2019). *Radiation therapy to treat cancer.* National Institutes of Health. https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy

49. National Cancer Institute. (2019). *Radiation therapy to treat cancer.* National Institutes of Health. https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy

tumor and will either remain in place to deliver radiation over a period of time or be removed. Like external beam radiation therapy, brachytherapy is a local treatment and treats only a specific part of your body. Clients undergoing brachytherapy emit radiation for a certain period, creating a potential exposure hazard to others during that time and requiring specific precautions.[50,51] For example, soluble isotopes can be ingested or injected to treat thyroid cancer. These isotopes are eventually eliminated through the individual's urine and stool, causing a radioactive risk to others. These radioactive wastes should not be handled directly by nurses or family members and must be managed according to agency policy. After the isotope is fully eliminated from the client's body, neither the client nor their waste products pose a radioactive risk.

Chemotherapy

Chemotherapy involves the use of drugs to destroy or slow the growth of cancer cells.[52] Chemotherapy treatment employs chemical agents to kill cancer cells and increase the individual's survival. Chemotherapy drugs can be administered orally, subcutaneously, intramuscularly, or intravenously. They enter the bloodstream and kill cancer cells throughout the body.

Chemotherapy has **cytotoxic** effects within the body, meaning it impacts all

50. Mitin, T. (2023). Radiation therapy techniques in cancer treatment. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

51. National Cancer Institute. (2019). *Radiation therapy to treat cancer.* National Institutes of Health. https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy

52. Lichtman, S. (2021). Systemic chemotherapy for cancer in older adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

cells that are rapidly dividing.[53] This effect is important for killing cancer cells but also impacts other cells that divide rapidly, such as those in hair follicles. This is why many individuals being treated with certain types of chemotherapy may experience hair loss. The goal of chemotherapy is to find balance between eradicating cancer cells and minimizing harm to normal tissues. Providers closely monitor the dose and impact of chemotherapy agents, titrating the medication to help achieve a desired effect while minimizing harmful side effects.

Chemotherapy is used for these purposes[54]:

- **Adjuvant Chemotherapy:** Given after surgery or radiation therapy to kill any remaining cancer cells and lower the risk of recurrence.
- **Neoadjuvant Chemotherapy:** Administered before surgery or radiation to shrink tumors and make them more manageable for surgical removal or radiation treatment.
- **Systemic Chemotherapy:** Used to treat cancers that have metastasized to other parts of the body. It is effective against rapidly dividing cells.

Because of the potential risks associated with exposure to chemotherapy agents, only specifically trained or oncology certified nurses (OCN) administer chemotherapy, based on agency policy. Oncology certified nurses provide specialized care for clients with cancer after completing additional courses and successfully passing a certification exam. Nurses who administer chemotherapy follow specific protocols and guidelines when handling chemotherapy or clients' urine and stool to decrease potential risks associated with exposure to these hazardous substances.

Personal protective equipment (PPE) is a critical component of ensuring nurse safety related to chemotherapy. PPE helps create a barrier between the

53. Lichtman, S. (2021). Systemic chemotherapy for cancer in older adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

54. Lichtman, S. (2021). Systemic chemotherapy for cancer in older adults. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

nurse and the hazardous substances, preventing direct contact and reducing the potential for exposure. The use of PPE is guided by established guidelines from organizations such as the Occupational Safety & Health Administration (OSHA) and the Oncology Nursing Society (ONS).

Specific types of PPE used to enhance nurse safety related to the administration of chemotherapy are as follows:

- **Eye Protection:** Goggles or face shields prevent exposure to potentially harmful chemicals and aerosolized particles. This protects the eyes from accidental splashes or airborne contaminants.
- **Masks:** Masks are worn to protect the respiratory system from inhaling airborne particles or droplets that may contain chemotherapy drug residues.
- **Nitrile Gloves:** Nitrile gloves are made of synthetic rubber that resists punctures and harsh chemicals and add an extra layer of protection to the hands.
- **Gown:** Protective gowns are worn to cover clothing and minimize the risk of contamination. These gowns act as a barrier against direct contact with chemotherapy drugs from clients who are receiving chemotherapy.

In addition to PPE, nurses are trained in proper handling techniques of chemotherapy, spill management, waste disposal, and decontamination procedures. These guidelines ensure that nurses have the knowledge and tools needed to minimize their risks associated with exposure to chemotherapy drugs.

Additional Therapies

Additional types of cancer treatment mobilize the body's own defense mechanisms and target specific cancer cells, including immunotherapy, targeted therapy, photodynamic therapy, hormonal therapy, and vaccine therapy:

- **Immunotherapy:** Immunotherapy boosts the body's immune system to

identify and attack cancer cells. It can include immune checkpoint inhibitors, cancer vaccines, and adoptive T-cell therapy.[55]

- **Targeted Therapy:** Targeted therapy targets specific molecules or genetic alterations that drive cancer growth. It aims to disrupt specific pathways involved in cancer development. For example, imatinib is a medication used as targeted therapy to inhibit a specific molecular target that is overactive in leukemias.[56]
- **Photodynamic Therapy:** Photodynamic therapy involves a photosensitizing agent and light to destroy cancer cells. It's used primarily for skin, lung, and esophageal cancers.[57]
- **Hormonal Therapy:** Hormonal therapy is used to treat hormone-sensitive cancers like breast and prostate cancer. It involves blocking or lowering the levels of hormones that promote cancer growth. For example, tamoxifen, a selective estrogen receptor modulator (SERM), is commonly used to treat hormone receptor-positive breast cancer.[58]
- **Vaccine Therapy:** Cancer vaccines are directed against the cells of one's own body. Treated cancer cells are injected into clients with cancer to enhance their immune response against cancer and prolong survival. The immune system has the capability to detect these cancer cells and proliferate faster than the cancer cells do, thus overwhelming the cancer in a similar way as they do for viruses. Cancer vaccines are being

55. Shoushtari, A. N. (2023). Principles of cancer immunotherapy. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

56. Atkins, M. B. (2023). Overview of the treatment of renal cell carcinoma. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

57. Maytin, E. V., & Warren, C. B. (2022). Photodynamic therapy. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

58. Pritchard, K. I. (2023). Adjuvant endocrine and targeted therapy for postmenopausal women with hormone receptor-positive breast cancer. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

developed for malignant melanoma and renal (kidney) cell carcinoma.[59]

Bone Marrow Transplantation & Stem Cell Treatment

Bone marrow transplantation and stem cell treatment are advanced medical interventions that have revolutionized cancer treatment. These procedures harness the remarkable regenerative potential of stem cells.

Bone marrow transplantation involves the replacement of damaged or diseased bone marrow with healthy stem cells to restore the body's ability to produce essential blood cells.[60] The bone marrow plays a crucial role in generating red blood cells, white blood cells, and platelets. In cancer cases, such as leukemia, lymphoma, and multiple myeloma, the bone marrow's ability to produce healthy blood cells is compromised due to the aggressive nature of these diseases or the effects of chemotherapy and radiation treatments.[61]

During a bone marrow transplant, a client receives either their own healthy stem cells (autologous transplant) or those from a compatible donor (allogeneic transplant). **Autologous transplants** are typically used when the client's own stem cells are collected, purified, and then reinfused following intensive chemotherapy or radiation to destroy cancer cells.**Allogeneic transplants** involve obtaining stem cells from a matching donor, often a sibling or unrelated donor, and then transplanting them into the client after preparatory treatments. These transplanted stem cells migrate to the bone

59. Cancer Research UK. (2021). *Treatment for cancer.* https://www.cancerresearchuk.org/about-cancer/treatment

60. Cancer Research UK. (2021). *Treatment for cancer.* https://www.cancerresearchuk.org/about-cancer/treatment

61. American Cancer Society. (2020). *How stem cell and bone marrow transplants are used to treat cancer.* https://www.cancer.org/

marrow and begin producing new, healthy blood cells, aiding in the recovery of the client's immune system and blood cell count.[62]

Stem cell treatment uses stem cells to replace damaged tissues, enhance the body's natural healing processes, and combat cancerous growth.[63] **Stem cells** are undifferentiated cells with the unique ability to differentiate into different cell types, making them invaluable for regenerative medicine. Stem cell treatment may involve using a client's own stem cells or donor-derived stem cells to rebuild tissues damaged by cancer or its treatments.[64, 65]

62. American Cancer Society. (2020). *How stem cell and bone marrow transplants are used to treat cancer*. https://www.cancer.org/

63. National Cancer Institute. (2015). *Stem cell transplants in cancer treatment*. National Institutes of Health. https://www.cancer.gov/about-cancer/treatment/types/stem-cell-transplant

64. American Cancer Society. (2020). *How stem cell and bone marrow transplants are used to treat cancer*. https://www.cancer.org/

65. National Cancer Institute. (2015). *Stem cell transplants in cancer treatment*. National Institutes of Health. https://www.cancer.gov/about-cancer/treatment/types/stem-cell-transplant

4.4 Applying the Nursing Process to Cancer Treatment

Nurses play a crucial role in caring for clients with cancer. Clients with cancer often require extensive, prolonged support to manage symptoms and prevent complications.

Assessment

Focused assessments and diagnostic tests are based on the type of cancer diagnosed.

Nursing Diagnoses

Clients who have been diagnosed with cancer may experience a wide variety of signs and symptoms related to the type of cancer diagnosed and the medical treatments implemented. Nurses assess for signs and symptoms of common nursing diagnoses resulting from cancer treatment, including the following[1]:

- Pain
- Risk for Infection
- Impaired Integrity of Skin and Mucous Membranes
- Fatigue
- Decreased Activity Intolerance
- Imbalanced Nutrition: Less than Body Requirements
- Constipation
- Diarrhea
- Fluid and Electrolyte Imbalance

1. Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladewig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

- Disturbed Body Image
- Fear
- Hopelessness
- Powerlessness
- Spiritual Distress
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating specific expected outcome statements for identified nursing diagnoses customized to each client.

Sample expected outcomes for common nursing diagnoses related to cancer are as follows:

- *The client will identify and verbalize feelings related to cancer diagnosis and treatment*.
- *The client will remain free from infection*.
- *The client will identify three measures to conserve energy and manage fatigue*.
- *The client will express meaning and purpose in life*.

Nursing Interventions

Nursing priorities for clients with cancer include the following[2,3,4]:

- Managing pain
- Preventing infection
- Promoting skin integrity
- Managing treatment-related side effects such as fatigue and gastrointestinal side effects
- Facilitating nutritional intake
- Providing health teaching, health promotion, and psychosocial support
- Addressing grief and loss
- Managing end-of-life care

Managing Pain

Pain is a common experience for clients with cancer due to the invasive nature of the disease. Cancer cells can invade surrounding tissues and nerves, causing inflammation, pressure, or injury, which triggers the body's natural response to perceive it as painful. This pain can be related to the cancer itself,

2. Chan, R. J., Teleni, L., McDonald, S., Kelly, J., Mahony, J., Ernst, K., Patford, K., Townsend, J., SIngh, M., & Yates, P. (2020). Breast cancer nursing interventions and clinical effectiveness: A systematic review. *BMJ Supportive & Palliative Care 10*(3), 276-286. http://dx.doi.org/10.1136/bmjspcare-2019-002120

3. Alfaro-Díaz, C., Svavarsdottir, E. K., Esandi, N., Klinke, M. E., & Canga-Armayor, A. Effectiveness of nursing interventions for patients with cancer and their family members: A systematic review. *Journal of Family Nursing, 28*(2), 95-114. https://doi.org/10.1177/10748407211068816

4. Vera, M. (2024). *12 cancer nursing care plans.* Nurselabs. https://nurseslabs.com/cancer-nursing-care-plans/

surgery, radiation therapy, chemotherapy, or other treatment and can significantly impact a client's quality of life.[5]

Nurses play a crucial role in assessing pain, implementing appropriate pain relief interventions, and monitoring the effectiveness of pain management strategies. Interventions may include administering pain medications, encouraging nonpharmacological pain relief techniques, and advocating for clients' comfort.

> Read more information about pain assessment and management in the "Comfort" chapter of Open RN *Nursing Fundamentals, 2e*. Using the WHO ladder when managing pain in clients with cancer is discussed in the "Pain Management" section of this chapter.

Preventing Infection

Many clients diagnosed with cancer are immunocompromised as a result of the disease or treatment(s) and are at significantly increased risk for infection. If a client has an abnormally low neutrophil count, they are at high risk for rapidly developing severe infections and becoming septic. Nurses play a crucial role in implementing infection prevention measures, assessing for new signs of infection, and monitoring the effectiveness of treatment for infection. Review infection protection measures in Table 4.4.

Table 4.4. Infection Prevention Measures

5. Vera, M. (2024). *12 cancer nursing care plans*. Nurselabs. https://nurseslabs.com/cancer-nursing-care-plans/

Intervention	Description
Hand Hygiene	Encourage clients, visitors, and health care providers to perform thorough handwashing with soap and water or alcohol-based hand sanitizer before and after interactions.
Central Line Care	Follow strict protocols for the insertion, maintenance, and care of central lines to minimize infection risk.
Oral Care	Promote good oral hygiene to prevent oral infections, which can be particularly problematic for clients undergoing chemotherapy.
Neutropenic Precautions	Implement precautions to minimize the risk of infections due to low neutrophil (white blood cell) count. These include isolation, mask-wearing, and strict hygiene.
Environmental Cleanliness	Maintain a clean and sanitized environment in client rooms, treatment areas, and waiting rooms.
Vaccination	Ensure that clients and their close contacts are up-to-date on vaccinations, including flu and pneumonia vaccines, to prevent vaccine-preventable infections.
Education	Educate clients and their families about infection prevention measures, recognizing early signs of infection, and when to seek medical attention.
Avoiding Fresh Fruits and Vegetables	For clients with compromised immune systems, advise against consuming raw or unwashed fruits and vegetables to reduce the risk of foodborne infections.
Catheter Care	If the client has a urinary catheter, ensure proper insertion, maintenance, and hygiene to prevent urinary tract infections.
Wound Care	Properly assess and care for any wounds or surgical sites to prevent infections.
Personal Protective Equipment (PPE)	Train health care providers and clients on the correct use of PPE, such as gloves, masks, gowns, and eye protection.
Hydration and Nutrition	Support clients in maintaining good nutrition and hydration, as this can help support their immune system during treatment.
Limiting Visitors	Limit the number of visitors and enforce infection control measures for those who do visit.
Respiratory Hygiene	Teach visitors and staff to cover their mouths and noses when coughing or sneezing to prevent the spread of respiratory infections.
Skin Integrity	Monitor and maintain the integrity of the client's skin to prevent breakdown and potential entry points for infections. Clients undergoing cancer treatments often require central venous access devices (such as central lines or ports) for administration of chemotherapy and repetitive blood work. Nurses ensure aseptic insertion, maintenance, and care of these devices to prevent infections and other skin complications.
Proper Disposal of Medical Waste	Ensure that all medical waste, including used needles and other sharps, is disposed of safely to prevent accidental exposures.

Promoting Skin Integrity

Clients with cancer often undergo biopsies, surgical interventions, and radiation treatments that cause surgical wounds or impaired skin integrity. These sites require careful nursing assessment and management to promote healing and prevent infection and other complications. Nursing interventions include repositioning, changing dressings, and providing health teaching regarding skin care and good nutrition to promote healing.

Managing Treatment-Related Side Effects

Although specially trained nurses administer chemotherapy according to prescribed protocols and guidelines, all nurses caring for clients diagnosed with cancer assess their overall health, monitor for potential side effects of treatments, and provide health teaching related to treatments.

Cancer and its treatments can lead to various distressing symptoms such as fatigue, nausea, vomiting, loss of appetite, diarrhea, constipation, mouth sores, and weight loss. Nurses assess the client's symptoms, provide supportive care, and administer medications to alleviate discomfort.

FATIGUE

Fatigue is a common and distressing symptom experienced by many clients with cancer. It can significantly impact their quality of life and daily functioning. Cancer-related fatigue may be caused by various factors, including the disease itself, side effects of treatment, emotional distress, and anemia.[6]

Nurses implement a variety of interventions to address fatigue, including energy management techniques, administering blood transfusions, and promoting rest and optimal nutrition.

> Review nursing interventions for promoting energy management in the "Iron-Deficiency Anemia" section of the "Hematological Alterations" chapter.

6. Vera, M. (2024). *12 cancer nursing care plans*. Nurselabs. https://nurseslabs.com/cancer-nursing-care-plans/

GASTROINTESTINAL SYMPTOMS AND NUTRITIONAL INTAKE

Clients with cancer are susceptible to developing **stomatitis**, a condition characterized by inflammation and ulcers in the oral mucous membranes due to the effects of chemotherapy and radiation therapy. See Figure 4.14[7] for an image of stomatitis. Clients are also at risk for developing additional gastrointestinal side effects such as nausea, vomiting, diarrhea, constipation, mouth sores, and decreased appetite that can cause weight loss and other complications. Nursing interventions for nausea and vomiting include administering antiemetics, IV fluids, and electrolyte replacement, as well as implementing nonpharmacological interventions for nausea. Nurses collaborate with dieticians to assess nutritional status, address dietary challenges, and provide guidance on maintaining adequate nutrition to support recovery and treatment tolerance.



Figure 4.14 Stomatitis

7. "Stomatitis.jpg" by https://www.scientificanimations.com/ is licensed under CC BY-SA 4.0

Nursing interventions for preventing stomatitis include providing good oral hygiene, such as gentle brushing with a soft toothbrush and regular rinsing with a nonalcoholic mouthwash and encouraging clients to maintain adequate oral hydration. Additionally, early recognition of oral candidiasis (thrush) and notification of the health care provider lead to prompt treatment of this potential side effect of many medications.[8]

- Review nursing assessments and interventions related to facilitating good nutrition in the "Applying the Nursing Process" section of the "Nutrition" chapter of Open RN *Nursing Fundamentals, 2e*.

- Review the pathophysiology of nausea and vomiting and related medications in the "Antiemetics" section of the "Gastrointestinal" chapter of Open RN *Nursing Pharmacology, 2e*.

Bowel function in clients with cancer is often affected based on the type and location of the cancer, as well as the specific treatment being received. Constipation may occur due to various factors such as side effects of medications (such as opioids), reduced physical activity, and dehydration. Conversely, diarrhea is a common side effect of chemotherapy and radiation therapy and can result in fluid and electrolyte imbalances. Gastrointestinal symptoms, bowel patterns, intake and output, and weight trends should be monitored for clients receiving cancer treatment.

8. Vera, M. (2024). *12 cancer nursing care plans*. Nurselabs. https://nurseslabs.com/cancer-nursing-care-plans/

- Review concepts related to diarrhea and constipation and common medications used to treat these conditions in the "Antidiarrheal Medications and Laxatives" section of the "Gastrointestinal" chapter of Open RN *Nursing Pharmacology, 2e*.

- Review nursing care related to fluid and electrolyte imbalances in the "Fluids and Electrolytes" chapter of Open RN *Nursing Fundamentals, 2e*.

Providing Health Teaching and Promoting Health

The diagnosis and treatment of cancer can lead to feelings of fear, hopelessness, powerlessness, and spiritual distress compounded by changes in one's physical appearance, functional abilities, and social relationships. These feelings can significantly impact a client's well-being and ability to cope with the challenges of chronic illness, making it crucial for nurses to provide psychosocial support.[9]

Nurses educate clients about their diagnosis, treatments, potential side effects, and self-care techniques. They empower clients to make informed decisions, manage their treatment regimens, and report side effects that may require medical attention.

Nurses encourage verbalization of feelings, offer emotional support, and connect clients with appropriate resources like counseling or support groups.

9. Vera, M. (2024). *12 cancer nursing care plans*. Nurselabs. https://nurseslabs.com/cancer-nursing-care-plans/

Nurses encourage clients to discuss feelings and concerns about the effects of cancer and associated treatments on their daily functioning and performance of their various roles such as a spouse, parent, caregiver, or employee. Nurses acknowledge the difficulties the client may be experiencing and provide anticipatory guidance related to side effects they may experience (such as buying a wig for anticipated hair loss) or changes that may affect their personal, home, or worklife as they undergo treatment.[10]

Nurses act as advocates for clients, ensuring they receive appropriate care and support. They collaborate with the health care team, address clients' concerns, and facilitate communication between clients and providers.

Addressing Grief and Loss and Providing End-of-Life Care

Clients diagnosed with cancer typically experience feelings of loss and an associated grieving process as they adapt to changes in their body that impact their daily life and role performance. Spiritual distress is common in clients experiencing serious illness and nurses promote healthy coping and resilience.

For clients in advanced stages of cancer, nurses provide compassionate end-of-life care to clients and their families. This includes symptom control, emotional support, and ensuring client comfort and dignity in their final moments. Additionally, providing spiritual care has been shown to improve clients' health and quality of life, including how they experience pain, cope with stress and suffering, and approach the end of life.[11]

10. Vera, M. (2024). *12 cancer nursing care plans*. Nurselabs. https://nurseslabs.com/cancer-nursing-care-plans/

11. Puchalski, C., Jafari, N., Buller, H., Haythorn, T., Jacobs, C., & Ferrell, B. (2020). Interprofessional spiritual care education curriculum: A milestone toward the provision of spiritual care. *Journal of Palliative Medicine, 23*(6), 777–784. https://doi.org/10.1089/jpm.2019.0375

- Review information about grief and loss, common end-of-life symptoms, and related nursing care in the "Grief and Loss" chapter of Open RN *Nursing Fundamentals, 2e*.

- Review information about how nurses provide spiritual care in the "Spirituality" chapter in Open RN *Nursing Fundamentals, 2e*.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

4.5 Autoimmune and Hypersensitivity Reactions

The body's inflammatory and immune responses are essential defense mechanisms designed to protect us against various threats, such as infections and cancer. These responses involve activation of immune cells, release of signaling molecules, and initiation of inflammatory processes to help eliminate harmful invaders and promote tissue repair.

There are instances when an individual's immune system becomes overly reactive, resulting in an excessive or prolonged inflammatory response that occurs at an inappropriate time or against harmless substances. This kind of exaggerated reaction can damage normal tissues and cause a range of health issues. Such responses are referred to as hypersensitivity reactions or allergic responses.

Hypersensitivity Reactions

Hypersensitivities reflect a range of exaggerated immune responses triggered by exposure to specific antigens.[1] These immune reactions can vary widely in their intensity, causing a range of effects that span from discomfort to severe and life-threatening conditions. When the immune system perceives an antigen as a threat, it can lead to a heightened and often disproportionate response.

Allergic responses are a specific type of hypersensitivity reactions that arise when the immune system reacts to **allergens**, substances that are generally harmless to most individuals.[2] Common allergens include pollen, dust mites, pet dander, certain foods, and insect venom. When a person with allergies

1. Immunodeficiency UK. (2018). *Allergy and hypersensitivity*. https://www.immunodeficiencyuk.org/

2. Immunodeficiency UK. (2018). *Allergy and hypersensitivity*. https://www.immunodeficiencyuk.org/

encounters these allergens, their immune system goes into overdrive, releasing histamines and other inflammatory molecules that trigger symptoms such as itching, sneezing, wheezing, hives, or in severe cases, anaphylactic shock. See Table 4.5 for a summary of hypersensitivity reactions.[3,4]

Table 4.5. Hypersensitivity Reactions

3. Immunodeficiency UK. (2018). *Allergy and hypersensitivity.* https://www.immunodeficiencyuk.org/

4. Justiz, Vaillant, A.A., Vashisht, R., & Zito, P. M. (2023). *Immediate Hypersensitivity Reactions*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513315/

Hypersensitivity Type	Description	Mechanism	Examples	Nursing Interventions
Type 1 Hypersensitivity (Immediate)	Also known as atopic allergy; this is the most common type of hypersensitivity reaction. It involves rapid and excessive immune responses to harmless antigens (allergens) that lead to allergic reactions.	Upon initial exposure, sensitization occurs, involving the production of IgE antibodies against the allergen. Upon subsequent exposure, the allergen binds to IgE antibodies on mast cells and basophils, triggering the release of inflammatory mediators like histamine.	Inhaled allergens (pollens, animal dander), ingested allergens (foods, drugs), injected allergens (bee venom, drugs), and contacted allergens (latex, environmental proteins). Anaphylactic reactions can occur, involving widespread blood vessel dilation, decreased cardiac output, and bronchoconstriction.	Provide antihistamines, short-acting beta agonists, and corticosteroids as prescribed; administer epinephrine for anaphylactic reactions; and educate clients about allergen avoidance.
Type 2 Hypersensitivity (Cytotoxic)	This type involves antibodies targeting antigens on cell surfaces, leading to the destruction or dysfunction of the affected cells.	Antibodies (IgG, IgM) bind to antigens on cell surfaces, triggering immune-mediated destruction through complement activation or antibody-dependent cell-mediated cytotoxicity.	Hemolytic transfusion reactions, autoimmune hemolytic anemia, and drug-induced cytotoxic reactions.	Monitor for signs of hemolysis, administer blood product transfusions as needed, implement plasmapheresis as prescribed, and provide supportive care.
Type 3 Hypersensitivity (Immune Complex)	Immune complexes formed between antibodies and soluble antigens deposit in various tissues, leading to localized inflammation and tissue damage.	Immune complexes attract neutrophils, causing inflammation and tissue damage at the site of deposition.	Post-streptococcal glomerulonephritis, serum sickness, systemic lupus erythematosus, and rheumatoid arthritis.	Administer anti-inflammatory medications, monitor for signs of tissue damage, provide pain relief, and educate clients on self-care.
Type 4 Hypersensitivity (Delayed)	This type involves cell-mediated immune responses mediated by T cells, causing inflammation and tissue damage.	Sensitized T cells recognize antigens presented by antigen-presenting cells, releasing cytokines that recruit inflammatory cells and induce tissue damage.	Contact dermatitis, tuberculin skin test reactions, and graft rejection.	Administer corticosteroids for severe reactions, provide wound care for dermatitis, and monitor graft sites for signs of rejection.
Type 5 - Stimulated (Autoimmune Reaction)	The immune system mistakenly attacks the body's own cells and tissues as if they were foreign antigens, leading to chronic inflammation and tissue damage.	Autoantibodies and autoreactive T cells target self-antigens, causing immune-mediated damage to various tissues and organs.	Rheumatoid arthritis, systemic lupus erythematosus, multiple sclerosis, and type 1 diabetes.	Administer immunosuppressive medications, manage symptoms, provide emotional support, and educate clients on self-management.

Read more about "Rheumatoid Arthritis" in the "Musculoskeletal Alterations" chapter, "Diabetes Mellitus" in the "Endocrine Alterations" chapter, and "Multiple Sclerosis" in

the “Nervous System Alterations” chapter, and “Systemic Lupus Erythematosus” in the following section of this chapter.

Anaphylaxis

Anaphylaxis is a Type I hypersensitivity reaction that occurs rapidly and systemically, and if not promptly treated, it can be fatal. It involves a severe and often sudden immune response triggered by the release of inflammatory mediators in response to an allergen. During an anaphylactic reaction, the body experiences a cascade of symptoms that can affect multiple systems.

Clients experiencing anaphylaxis can have various signs and symptoms. They may experience feelings of uneasiness, apprehension, or a sense of impending doom. Generalized itching and urticaria (hives) can manifest as raised, red, and itchy skin lesions. Erythema and angioedema, characterized by localized swelling often around the eyes, lips, and throat, may occur. Additionally, congestion and rhinorrhea (runny nose) may occur, leading to dyspnea (difficulty breathing) and respiratory distress. In severe cases, anaphylaxis can cause bronchoconstriction and swelling of the throat, leading to obstruction of the airway, a potentially life-threatening condition. Recognition of symptoms and signs of anaphylaxis and prompt intervention are crucial. Treatment typically involves the administration of epinephrine to counteract the systemic effects of anaphylaxis and stabilize the client’s condition.[5,6]

Interventions for treating anaphylaxis are outlined in the following box.

5. Immunodeficiency UK. (2018). *Allergy and hypersensitivity.* https://www.immunodeficiencyuk.org/

6. Justiz, Vaillant, A.A., Vashisht, R., & Zito, P. M. (2023). *Immediate Hypersensitivity Reactions*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513315/

Interventions for Anaphylaxis[7,8]:

- Assess respiratory function to monitor for signs of airway obstruction or distress.
- Establish or stabilize the airway if necessary to ensure proper breathing and oxygenation.
- Provide supplemental oxygen to maintain adequate oxygen saturation levels.
- Stay with the client to provide continuous monitoring and support.
- Administer epinephrine (1:1000) as the first-line drug for anaphylaxis; the recommended dose is 0.3-0.5 mL, usually given intramuscularly in the thigh. Epinephrine helps counteract the severe effects of the allergic reaction by increasing heart rate, improving breathing, and reducing blood vessel dilation.
- Administer antihistamines to help relieve itching, hives, and other allergic symptoms.
- Administer a beta-adrenergic agonist (such as albuterol) to help relax bronchial smooth muscles and alleviate bronchoconstriction.
- Administer corticosteroids, either intravenously or orally,

7. Immunodeficiency UK. (2018). *Allergy and hypersensitivity*. https://www.immunodeficiencyuk.org/

8. Justiz, Vaillant, A.A., Vashisht, R., & Zito, P. M. (2023). *Immediate Hypersensitivity Reactions*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513315/

to help reduce inflammation and prevent delayed allergic reactions.

- Continuously monitor the client's vital signs, respiratory status, and overall response to interventions.
- Prepare for potential additional interventions, such as intravenous fluids, if the client's condition warrants it.
- Provide education and support to the client and family regarding anaphylaxis triggers, emergency action plans, and the proper use of epinephrine auto-injectors if applicable.



RN Recap: Type 1 Hypersensitivity (Immediate) Reaction

View a supplementary YouTube video overview of Type 1 hypersensitivity (immediate) reaction[9]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1078#oembed-1

9. Open RN Project. (2024, March 25). *Health Alterations – Chapter 4 – Type 1 Immediate hypersensitivity reaction* [Video]. YouTube. CC BY-NC 4.0 https://www.youtube.com/watch?v=KQj7aHVem-0



RN Recap: Type 2 Hypersensitivity (Cytotoxic) Reaction

View a supplementary YouTube video overview of Type 2 hypersensitivity (cytotoxic) reaction[10]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1078#oembed-2



RN Recap: Type 3 Hypersensitivity Reaction

View a brief YouTube video overview of a Type 3 hypersensitivity reaction[11]:

One or more interactive elements has been excluded from this

10. Open RN Project. (2024, March 25).*Health Alterations – Chapter 4 – Type 2 Cytotoxic reaction [Video]. YouTube.* CC BY-NC 4.0 *https://www.youtube.com/watch?v=mlkTixljv-0*

11. Open RN Project. (2024, June 23). *Health Alterations – Chapter 4 – Type 3 Hypersensitivity reaction* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/opvj_7lKBWc?si=uFU3dwyAHguJxTFo

version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1078#oembed-3



RN Recap: Type 4 Hypersensitivity Reaction

View a brief YouTube video overview of a Type 4 hypersensitivity reaction[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1078#oembed-4



RN Recap: Type 5 Autoimmune Reactions

View a brief YouTube video overview of Type 5 autoimmune reactions[13]:

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 4 – Type 4 Hypersensitivity reaction* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/N1bmV6oflhk?si=AHOkqituul2BVfDI

13. Open RN Project. (2024, June 23). *Health Alterations – Chapter 4 –*

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1078#oembed-5

Type 5 Autoimmune reactions [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/VrPq0y3DJ1A?si=Yu5m9GS4oa4t2KAK

4.6 Systemic Lupus Erythematosus

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease that can affect various different organs and tissues in the body. It is characterized by the immune system mistakenly attacking healthy cells and tissues, leading to inflammation and damage. SLE is known for its diverse and fluctuating symptoms, which can range from mild to severe and can affect nearly any part of the body.

In SLE, the immune system loses its ability to differentiate between foreign substances (like viruses or bacteria) and the body's healthy tissues. This leads to the production of autoantibodies that attack the body's own cells and tissues. SLE often follows a pattern of flare-ups (periods of increased disease activity with symptoms) and remissions (periods of reduced or absent symptoms). Exacerbation can be triggered by stress, infections, sunlight exposure, or certain medications.

Various demographic factors elevate the risk of SLE. Women, particularly those between the ages of 15 and 40, are susceptible to SLE. Additionally, individuals of African American, Asian, or Native American descent exhibit a higher prevalence and increased risk for SLE.[1]

The symptoms of SLE vary widely from person to person. They can range from mild to severe, and they may come and go. Common symptoms can include arthritis, fatigue, and a classic rash that appears on the face across the nose and cheeks called a "butterfly rash."[2] See Figure 4.15[3] for an image of a butterfly rash associated with lupus.

1. A.D.A.M. Medical Encyclopedia [Internet]. *Systemic lupus erythematosus*. (2023). https://medlineplus.gov/ency/article/000435.htm

2. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Systemic lupus erythematosus (lupus).* National Institutes of Health. https://www.niams.nih.gov/health-topics/lupus

3. "Lupusfoto.jpg" by Doktorinternet is licensed under CC BY-SA 4.0



Figure 4.15 Butterfly Rash on the Face Associated With SLE

Assessment

Signs and symptoms of SLE may be found across various body systems and can fluctuate. See Table 4.6 for a summary of potential manifestations of SLE across body systems.

Table 4.6. Potential Manifestations of SLE Across Body Systems[4,5,6]

4. A.D.A.M. Medical Encyclopedia [Internet]. *Systemic lupus erythematosus*. (2023). https://medlineplus.gov/ency/article/000435.htm

5. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Systemic lupus erythematosus.* National Institutes of Health. https://www.niams.nih.gov/health-topics/lupus

6. MedlinePlus [Internet]. *Systemic lupus erythematosus*. (2023). https://medlineplus.gov/genetics/condition/systemic-lupus-erythematosus/

Body System	Manifestations
Skin	Rash or reaction to sunlight exposure, **malar rash** (butterfly-shaped rash across the cheeks and nose), and **discoid rash** (raised red patches with scaling, scarring)
Musculoskeletal	Joint pain and swelling (arthralgia), often affecting multiple joints; morning stiffness; and joint deformities
Cardiovascular	Pericarditis (pericardial friction rub), endocarditis (heart murmur), and valve involvement
Renal	**Proteinuria** (protein in urine) or **hematuria** (blood in urine), suggesting kidney inflammation
Neurological	Headaches, cognitive dysfunction, memory loss, or peripheral neuropathy
Pulmonary	**Pleuritis** (inflammation of chest wall) or **pleural effusion** (accumulation of fluid in the space around the lungs)
Gastrointestinal	Abdominal pain, nausea, vomiting, or diarrhea
Ophthalmic	Vision changes, dry eyes, eye pain, or **retinopathy** (inflammation of the retina affecting vision)
Psychological	Anxiety, depression, or mood swings

Diagnostic Testing

There are no specific tests to diagnose lupus. Health care providers use several criteria to support the diagnosis. Diagnostic testing for SLE may include the following laboratory tests[7,8]:

7. MedlinePlus [Internet]. *Systemic lupus erythematosus*. (2023). https://medlineplus.gov/genetics/condition/systemic-lupus-erythematosus/

8. Justiz, Vaillant, A.A., Goyal, A., & Varacallo, M. A. (2023). *Systemic Lupus*

- **Antinuclear Antibody (ANA):** Detects the presence of antibodies that attack the body's own cells.
- **Complement Levels (C3 & C4):** Measures complement proteins that are suppressed in SLE.
- **Erythrocyte Sedimentation Rate (ESR) and C-reactive Protein (CRP):** These tests identify signs of inflammatory processes within the body.
- **Skin Biopsy:** A skin biopsy may be performed when skin manifestations are present.

Nursing Diagnoses

Nursing diagnoses encompass a range of physical, emotional, and lifestyle-related challenges. Common nursing diagnoses for individuals with SLE include the following:

- Chronic Pain
- Fatigue
- Risk for Impaired Skin Integrity
- Disturbed Body Image

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Sample expected outcomes for a client diagnosed with SLE are as follows:

- *The client will verbalize three nonpharmacological pain management techniques by the end of the teaching session.*
- *The client will report improved energy levels within one week of medication therapy.*

Erythematosus. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK535405/

- *The client will verbalize two skin care techniques to prevent skin breakdown by the end of the teaching session.*
- *The client will verbalize feelings related to body image changes within two weeks.*

Interventions

Medical Interventions

Medical interventions for SLE focus on medication therapy.

MEDICATION THERAPY

Medication therapy aims to reduce symptoms and flare-ups with a variety of classes of medication[9,10]:

- **Nonsteroidal Anti-Inflammatory Drugs (NSAIDs):** NSAIDS (i.e., ibuprofen and naproxen) reduce inflammation, alleviate mild joint pain, and manage musculoskeletal symptoms.
- **Corticosteroids:** Corticosteroids like prednisone reduce inflammation in severe or organ-threatening manifestations of SLE.
- **Immunosuppressant Agents:** Medications like azathioprine, methotrexate, and mycophenolate mofetil may be prescribed to suppress the immune system and control disease activity in individuals experiencing severe symptoms who are not responding to other medications.
- **Antimalarials:** Antimalarial medications like hydroxychloroquine and

9. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Systemic lupus erythematosus.* National Institutes of Health. https://www.niams.nih.gov/health-topics/lupus

10. MedlinePlus [Internet]. *Systemic lupus erythematosus*. (2023). https://medlineplus.gov/genetics/condition/systemic-lupus-erythematosus/

chloroquine may be prescribed for their anti-inflammatory properties to manage joint pain, skin rashes, and fatigue and to prevent flare-ups.

- **Biological Response Modifiers:** Biological response modifiers like belimumab and rituximab target specific components of the immune system to control inflammation and reduce disease activity.
- **Calcineurin Inhibitors:** Calcineurin inhibitors like tacrolimus or cyclosporine may be prescribed in certain cases to suppress the immune response.

Nursing Interventions

PROVIDE HEALTH TEACHING

Nurses educate clients about SLE, its potential complications, and the importance of adhering to treatment plans. Information on lifestyle modifications is provided, including sun protection, balanced nutrition, and exercise. Clients receiving immunosuppressant medications are taught about the importance of good hand hygiene and avoiding individuals with infections to reduce the risk of complications.

PROVIDE PSYCHOSOCIAL SUPPORT

Nurses actively listen and provide therapeutic communication to encourage a client's open communication about the emotional impact of living with a chronic illness. Nurses facilitate access to support groups or counseling services to promote effective coping strategies.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client,

reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

4.7 Learning Activities

Learning Activities

Breast Cancer Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Sarah Smith, a 45-year-old female, presents to the clinic with a chief complaint of discovering a lump in her left breast during self-examination. She reports no associated pain and has no other significant medical history. She has a family history of breast cancer, with her mother diagnosed at age 55. Physical examination reveals a palpable mass in the upper outer quadrant of the left breast. A mammogram and ultrasound are ordered for further evaluation.

1. As a nurse caring for Sarah, how would you approach providing emotional support and addressing her concerns related to her family history of breast cancer?
2. What nursing interventions would you prioritize to assist Sarah in coping with the anxiety and uncertainty surrounding her breast cancer diagnosis and the upcoming diagnostic procedures?

1. "Breast Cancer Case Study" by Open RN is licensed by CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=1091#h5p-15

"Malignancy Autoimmune Glossary Cards" by Open RN is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=1091#h5p-16

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https://wtcs.pressbooks.pub/healthalts/?p=1091#h5p-18

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- Test your knowledge on the immune system using this NCLEX Next Generation-style drop down dyad question. You

may reset and resubmit your answers to this question an unlimited number of times.[2]



- Test your knowledge on hypersensitivity reactions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[3]

2. "Immune System Drop Down Dyad" by Kellea Ewen for OpenRN is licensed under CC BY-NC 4.0

3. "Pediatric Hypersensitivity Bowtie" by Jennifer Hinz and OpenRN is licensed under CC BY-NC 4.0

IV Glossary

Acquired immunity: Refers to immunity that develops with exposure to various antigens as an individual's immune system builds a defense. (Chapter 4.2)

Adaptive immune response: Activated when the nonspecific, innate immune response is insufficient to control an infection; requires the body's exposure to a pathogen to recognize it as a threat in order for it to respond. (Chapter 4.2)

Adjuvant chemotherapy: Given after surgery or radiation therapy to kill any remaining cancer cells and lower the risk of recurrence. (Chapter 4.3)

Allergens: Substances that are generally harmless to most individuals but may induce an allergic response in some. Common allergens include pollen, dust mites, pet dander, certain foods, and insect venom. (Chapter 4.5)

Allergic responses: A specific form of hypersensitivity reactions that arise when the immune system reacts to allergens. (Chapter 4.5)

Allergy: An inflammatory response due to a hypersensitivity to a substance that most people's bodies perceive as harmless. (Chapter 4.2)

Allogeneic transplants: A procedure that involves obtaining stem cells from a matching donor, often a sibling or unrelated donor, and then transplanting them into the client after preparatory treatments. (Chapter 4.3)

Anaphylaxis: A life-threatening Type I hypersensitivity reaction that occurs rapidly and systemically, and if not promptly treated, it can be fatal. (Chapter 4.5)

Antibodies: Proteins that destroy pathogens based on their antigens. (Chapter 4.2)

Antigens: Markers that tell the immune system whether something in the body is harmful or not; found on viruses, bacteria, cancer cells, and even normal cells of the body. (Chapter 4.2)

Autoimmune disease: Caused by the body's inability to distinguish its own healthy cells from abnormal cells or pathogens, producing antibodies that attack its own tissues. (Chapter 4.2)

Autoimmune reactions: Actions within the body where one's own immune

system accidentally initiates a response against the body's own healthy cells, tissues, or organs. (Chapter 4.1)

Autologous transplants: A procedure where the client's own stem cells are collected, purified, and then reinfused following intensive chemotherapy or radiation to destroy cancer cells. (Chapter 4.3)

B cells: Cells that produce antibodies that are used to attack invading bacteria, viruses, and toxins. (Chapter 4.2)

Benign: Cells that grow and divide in a more controlled manner, remaining localized to a certain area. (Chapter 4.3)

Bone marrow transplantation: The replacement of damaged or diseased bone marrow with healthy stem cells to restore the body's ability to produce essential blood cells. (Chapter 4.3)

Brachytherapy: A procedure where radioactive materials are placed directly inside or very close to the tumor. (Chapter 4.3)

Carcinogen: Any substance capable of causing cancer. (Chapter 4.3)

Carcinogenesis: The process of cancer development in the body. (Chapter 4.3)

Carcinoma in situ: Also known as Stage 0; cancerous or abnormal cells are present, but they are localized to the initial layer of cells where they were first discovered. (Chapter 4.3)

Chemical carcinogenesis: Occurs due to exposure to various chemicals, drugs, and products encountered in everyday life. (Chapter 4.3)

Chemotherapy: The use of medications to destroy or slow the growth of cancer cells. (Chapter 4.3)

Chyle: Lipids and fat-soluble vitamins absorbed in the small intestine (Chapter 4.2)

C-reactive protein: High levels of C-reactive protein in blood samples indicate a serious infection or other medical condition is causing inflammation. (Chapter 4.2)

Curative surgery: Surgery that aims to completely remove the cancerous tumor when it is localized and hasn't spread to other parts of the body. (Chapter 4.3)

Cytokines: Proteins secreted by cells that act as chemical messengers in immune responses. (Chapter 4.2)

Cytokine storm: A severe immune reaction in which the body releases too many cytokines into the blood too quickly; can occur as a result of an infection, autoimmune condition, or other disease. Signs and symptoms include high fever, inflammation, severe fatigue, and nausea. (Chapter 4.2)

Cytotoxic: Effects within the body that impact cells that are rapidly dividing. (Chapter 4.3)

Discoid rash: Raised red patches with scaling and scarring. (Chapter 4.6)

Extravasation: A process by which cancer cells cross into surrounding tissues by squeezing through vessel walls. (Chapter 4.3)

Helper T cells: Use chemical messengers to activate the adaptive immune response by stimulating B cells to make antibodies and help develop killer T cells. (Chapter 4.2)

Hematuria: Blood in urine. (Chapter 4.6)

Histamine: Released during the immune response and a primary cause of allergies and anaphylactic shock. (Chapter 4.2)

Humoral immunity: Refers to the function of B cells and their production of antibodies to destroy pathogens in the interstitial spaces. (Chapter 4.2)

Hypercalcemia: Increased calcium levels caused by tumor invasion into bone or increased production of parathyroid hormone or vitamin D3. (Chapter 4.3)

Hypersensitivities: A range of exaggerated immune responses triggered by exposure to specific antigens. (Chapter 4.5)

Immune evasion: Strategies developed by cancer cells to evade immune recognition. (Chapter 4.3)

Immune system: The complex collection of cells and organs that destroys or neutralizes pathogens that would otherwise cause infection, disease, or death. (Chapter 4.2)

Immunization: A method to trigger an individual's acquired immune response and prevent future disease. (Chapter 4.2)

Immunodeficiency: Results from a failure or absence of lymphocytes, phagocytes, and the complement system; can be caused by either primary or secondary reasons. (Chapter 4.2)

Immunoglobulins: Specific types of antibodies that provide immediate

protection against an antigen, but do not provide long-lasting protection. (Chapter 4.2)

Immunological memory: Refers to the ability of the adaptive immune response to mount a stronger and faster immune response upon reexposure to a pathogen. (Chapter 4.2)

Immunosurveillance: The immune process involving T cells, natural killer cells, and cytokines to target and destroy cancer cells. (Chapter 4.3)

Immunotherapy: Therapies that enable one's own immune system to target and destroy cancer cells. (Chapter 4.3)

Inflammation: Characterized by heat, redness, pain, and swelling but is an important process that recruits immune defenses to eliminate pathogens, remove damaged and dead cells, and initiate repair mechanisms. (Chapter 4.2)

Innate immune response: Defends the body against pathogens through physical defenses and internal defenses; present from the moment we are born. (Chapter 4.2)

Interstitial space: The space between individual cells in the tissues. (Chapter 4.2)

Killer T cells: Directly kill cells that have been invaded by a virus or are otherwise abnormal; also known as cytotoxic cells. (Chapter 4.2)

Lymph: A fluid that transports immune cells and waste products. (Chapter 4.2)

Lymphatic system: The system of vessels, cells, and organs that transports fluid called lymph to the bloodstream and also filters pathogens from the blood. (Chapter 4.2)

Lymphedema: The accumulation of fluid in interstitial spaces. (Chapter 4.2)

Lymph node: Store immune system cells that help the body fight infection and also filter the lymph fluid to remove foreign material such as bacteria and cancer cells. (Chapter 4.2)

Lymphocyte: A type of white blood cell that fights infection. (Chapter 4.2)

Macrophages: Created from monocytes, a type of white blood cell, and can destroy multiple pathogens. (Chapter 4.2)

Malar rash: Butterfly-shaped rash across the cheeks and nose. (Chapter 4.6)

Malignant cells: Abnormal cells that have the ability to invade and harm tissues. (Chapter 4.1, Chapter 4.3)

Metastasize: The spread of cancerous cells through the blood or lymphatic system to different areas of the body. (Chapter 4.3)

Neoadjuvant chemotherapy: Medication administered before surgery or radiation to shrink tumors and make them more manageable for surgical removal or radiation treatment. (Chapter 4.3)

Neutrophils: The most abundant type of white blood cells. (Chapter 4.2)

Oncogene activation: Occurs when specific genes within a cell's normal makeup become replicated out of control due to loss of cellular regulation or exposure to carcinogenic agents. (Chapter 4.3)

Oncogenes: Substances that promote cell growth. (Chapter 4.3)

Oncological emergencies: A variety of emergency conditions that can arise in a client with cancer. These emergencies can be related to metabolic changes in the body that are associated with cancer, structural changes in which a cancerous tumor is impinging on other organs or structures, or a result of cancer treatment. (Chapter 4.3)

Palliative surgery: Surgery that focuses on relieving symptoms and improving the client's quality of life. (Chapter 4.3)

Passive immunity: The transfer of immunity due to antibodies that are produced in a body other than one's own. (Chapter 4.2)

Pathogens: Microorganisms that cause infection. (Chapter 4.2)

Personal protective equipment (PPE): Barriers between the health care provider and hazardous substances to prevent direct contact and reduce the potential for exposure. (Chapter 4.3)

Phagocytosis: The process of specific white blood cells engulfing and destroying pathogens. (Chapter 4.2)

Pleural effusion: Accumulation of fluid in the space around the lungs. (Chapter 4.6)

Pleuritis: Inflammation of chest wall. (Chapter 4.6)

Primary prevention: Strategies aimed at preventing the initial occurrence of cancer. (Chapter 4.3)

Proteinuria: Protein in urine. (Chapter 4.6)

Radiation therapy: Therapy using high-energy rays or particles to target and damage cancer cells. (Chapter 4.3)

Retinopathy: Inflammation of the retina affecting vision. (Chapter 4.6)

Secondary prevention: Strategies focused on early detection and intervention to identify cancer at an early stage. (Chapter 4.3)

Spleen: Stores and filters red blood cells and functions as the location of immune responses to blood-borne pathogens. (Chapter 4.2)

Staging: Completed by a health care provider to determine how big a tumor is and whether or not it has metastasized to other parts of the body. (Chapter 4.3)

Stem cells: Undifferentiated cells with the unique ability to differentiate into different cell types. (Chapter 4.3)

Stem cell treatment: Treatment that encompasses various techniques and focuses on using stem cells to replace damaged tissues, enhance the body's natural healing processes, and combat cancerous growth. (Chapter 4.3)

Stomatitis: A condition characterized by inflammation and ulcers in the oral mucous membranes due to the effects of chemotherapy and radiation therapy. (Chapter 4.4)

Superior vena cava syndrome: Compression of the superior vena cava by a cancerous tumor. (Chapter 4.3)

Syndrome of inappropriate antidiuretic hormone (SIADH): When cancerous tumors produce excessive antidiuretic hormone. Can also be caused by some chemotherapy medications. Leads to water retention. (Chapter 4.3)

Systemic chemotherapy: Medications used to treat cancers that have spread to distant parts of the body that are effective against rapidly dividing cells. (Chapter 4.3)

Systemic lupus erythematosus (SLE): A chronic autoimmune disease that can affect various different organs and tissues in the body, characterized by the immune system mistakenly attacking healthy cells and tissues, leading to inflammation and damage. (Chapter 4.6)

T cells: Cells that destroy the body's own cells that have been taken over by viruses or become cancerous. (Chapter 4.2)

Teletherapy: Therapy involving directing radiation beams from outside the body toward the tumor. (Chapter 4.3)

Tertiary prevention: A type of prevention that focuses on managing symptoms, enhancing the quality of life, and reducing the risk of complications for someone who is diagnosed with cancer. (Chapter 4.3)

Thymus gland: An organ found in the space between the sternum and the aorta; place where immature T cells mature. (Chapter 4.2)

Tonsils: Lymphoid nodules located along the inner surface of the pharynx and are important in developing immunity to oral pathogens. (Chapter 4.2)

Tumor lysis syndrome: Tumor cells break down in response to cancer treatment and release intracellular contents into the bloodstream. Can also occur spontaneously in some cancers. This disrupts the normal balance of electrolytes in the body. (Chapter 4.3)

Tumor suppressor genes: Genes that regulate cell growth and prevent mutations. (Chapter 4.3)

Type 1 Hypersensitivity (Immediate): The most common type of hypersensitivity reaction that involves rapid and excessive immune responses to harmless allergens. (Chapter 4.5)

Type 2 Hypersensitivity (Cytotoxic): A hypersensitivity reaction that involves antibodies targeting antigens on cell surfaces, leading to the destruction or dysfunction of the affected cells. (Chapter 4.5)

Type 3 Hypersensitivity (Immune Complex): A hypersensitivity reaction that involves immune complexes formed between antibodies and soluble antigens that deposit in various tissues, leading to localized inflammation and tissue damage. (Chapter 4.5)

Type 4 Hypersensitivity (Delayed): A hypersensitivity reaction that involves cell-mediated immune responses mediated by T cells, causing inflammation and tissue damage. (Chapter 4.5)

Type 5 Stimulated (Autoimmune Reaction): A hypersensitivity reaction that occurs when the immune system mistakenly attacks the body's own cells and tissues as if they were foreign antigens, leading to chronic inflammation and tissue damage. (Chapter 4.5)

Vaccine: An agent administered by injection, orally, or by nasal spray that

provides active acquired immunity to a particular infectious disease. (Chapter 4.2)

PART V

CHAPTER 5 CARDIOVASCULAR ALTERATIONS

5.1 Cardiovascular Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with cardiovascular disorders
- Explain the pathophysiology of cardiovascular disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Recognize the value of therapeutic communication in caring for the client with cardiovascular disorders
- Consider use of common pharmacological and nonpharmacological measures for the client with cardiovascular disorders
- Interpret common laboratory and diagnostic tests
- Contribute to the plan of nursing care for clients with alterations in the cardiovascular system

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=83#h5p-39

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The cardiovascular system consists of the heart and a complex network of arteries and veins to transport oxygenated and deoxygenated blood throughout the body. The heart serves as the main pumping mechanism to transport oxygenated blood throughout the body and deliver deoxygenated blood to the lungs. The healthy functioning of the cardiovascular system is foundational to the health of all other body systems because the transportation of oxygen directly impacts the cellular functioning of all tissues and organs. If oxygenated blood is not delivered to cells, they cease functioning and begin to die. The cardiovascular system also transports blood to the kidneys and liver where the blood is filtered, and wastes are removed.

Cardiovascular disease (CVD) refers to diseases affecting the heart or blood vessels. CVD accounts for over 19 million deaths annually throughout the world and is the leading cause of death.[1,2] Health care systems continuously strategize to treat and prevent cardiovascular alterations, and billions of health care dollars are spent on medications, diagnostics treatments, and medical interventions. Yet, some risk factors related to the development of cardiovascular disease remain aligned to lifestyle choices such as smoking,

1. American Heart Association. (2024). *2024 heart disease & stroke statistical update fact sheet*. https://www.heart.org/-/media/PHD-Files-2/Science-News/2/2024-Heart-and-Stroke-Stat-Update/2024-Statistics-At-A-Glance-final_2024.pdf

2. World Health Organization. (2023). *Cardiovascular diseases.* https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1

physical activity, and diet.[3] Nurses play a critical role in effective health teaching to help prevent CVD.

This chapter will explore cardiovascular alterations and the interplay of medical interventions and holistic approaches to promoting cardiovascular health and optimal quality of life for those diagnosed with a cardiovascular disease.

3. World Health Organization. (2023). *Cardiovascular diseases.* https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1

5.2 Review of Anatomy & Physiology of the Cardiovascular System

Heart

Location of the Heart

The human heart is located within the thoracic cavity, medially between the lungs in the space known as the mediastinum. The great veins, the superior and inferior venae cavae, and the great arteries, the aorta and pulmonary trunk, are attached to the superior surface of the heart, called the base. The base of the heart is located at the level of the third costal cartilage, as seen in Figure 5.1.[1] The inferior tip of the heart, the apex, lies just to the left of the sternum between the junction of the fourth and fifth ribs. It is important to remember the position of the heart when placing a stethoscope on the chest of a client and listening for heart sounds.[2]

1. "Position of the Heart in the Thorax" by OpenStax College is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/19-1-heart-anatomy

2. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

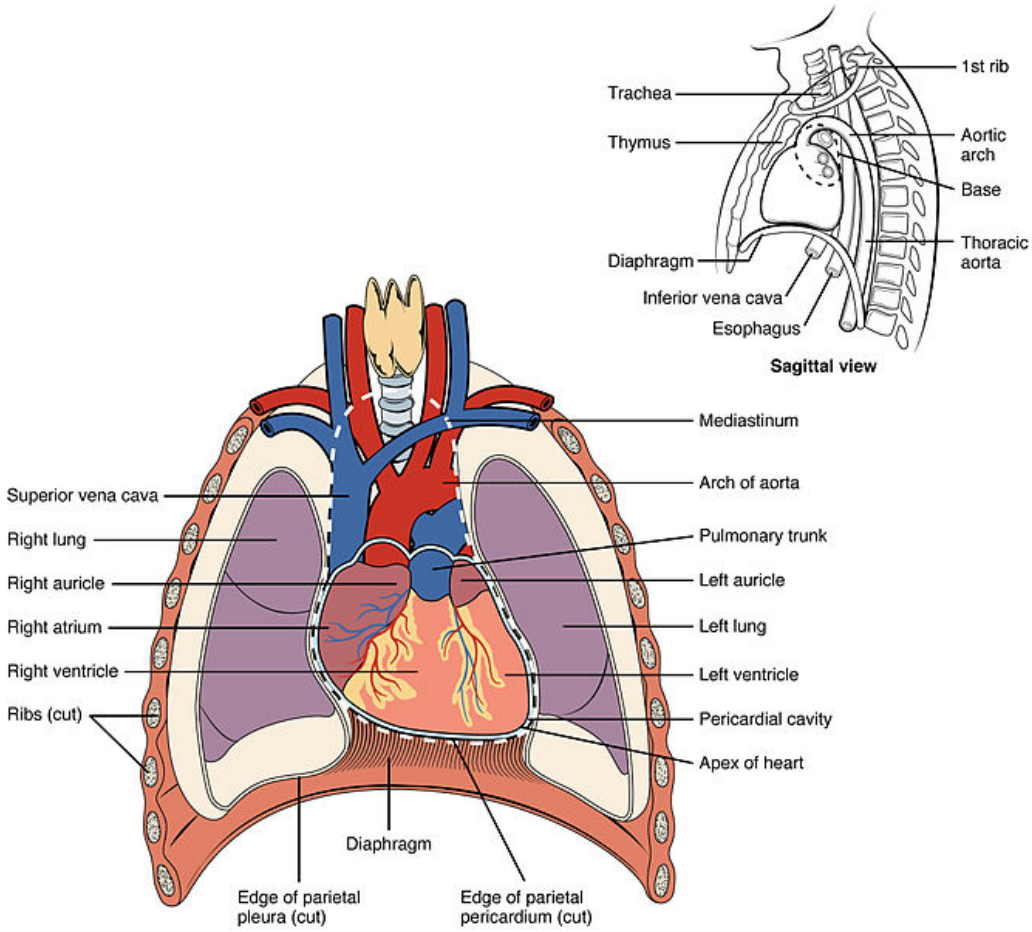


Figure 5.1 Position of the Heart in the Thoracic Cavity

Chambers and Circulation Through the Heart

The heart consists of four chambers: two atria and two ventricles. The right atrium receives deoxygenated blood from the systemic circulation, and the left atrium receives oxygenated blood from the lungs. The atria contract to push blood into the lower chambers, the right ventricle and the left ventricle. The right ventricle contracts to push blood into the lungs, and the left ventricle is the primary pump that propels blood to the rest of the body.

There are two distinct but linked circuits in the human circulation called the pulmonary and systemic circuits. The pulmonary circuit transports blood to and from the lungs, where it picks up oxygen and delivers carbon dioxide for exhalation. The systemic circuit transports oxygenated blood to virtually all of the tissues of the body and returns deoxygenated blood and carbon dioxide

to the heart to be sent back to the pulmonary circulation. See Figure 5.2[3] for an illustration of blood flow through the heart and blood circulation throughout the body.[4]

3. "Dual System of the Human Blood Circulation" by OpenStax College is licensed under CC By 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/19-1-heart-anatomy

4. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

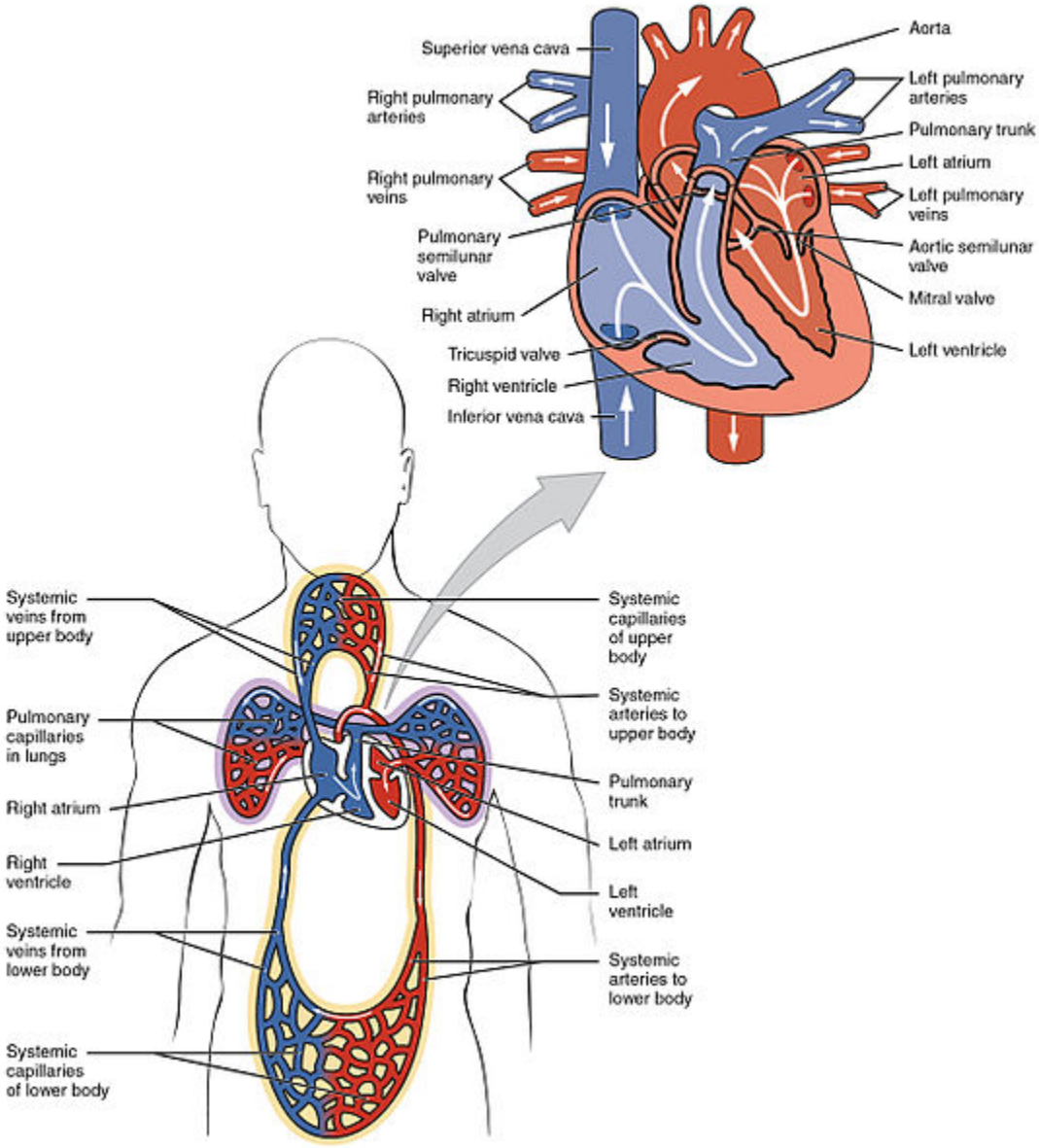


Figure 5.2 Chambers of the Heart and Blood Circulation to the Lungs and Throughout the Body

Blood also circulates through the coronary arteries with each beat of the heart. The left coronary artery distributes blood to the left side of the heart, and the right coronary distributes blood to the right atrium, portions of both ventricles, and the heart conduction system. See Figure 5.3[5] for an illustration

5. "Surface Anatomy of the Heart" by OpenStax College is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/19-1-heart-anatom

of the coronary arteries. When a client has a myocardial infarction, a blood clot lodges in one of these coronary arteries that perfuse the heart tissue. If a significant area of muscle tissue dies from lack of perfusion, the heart is no longer able to pump.

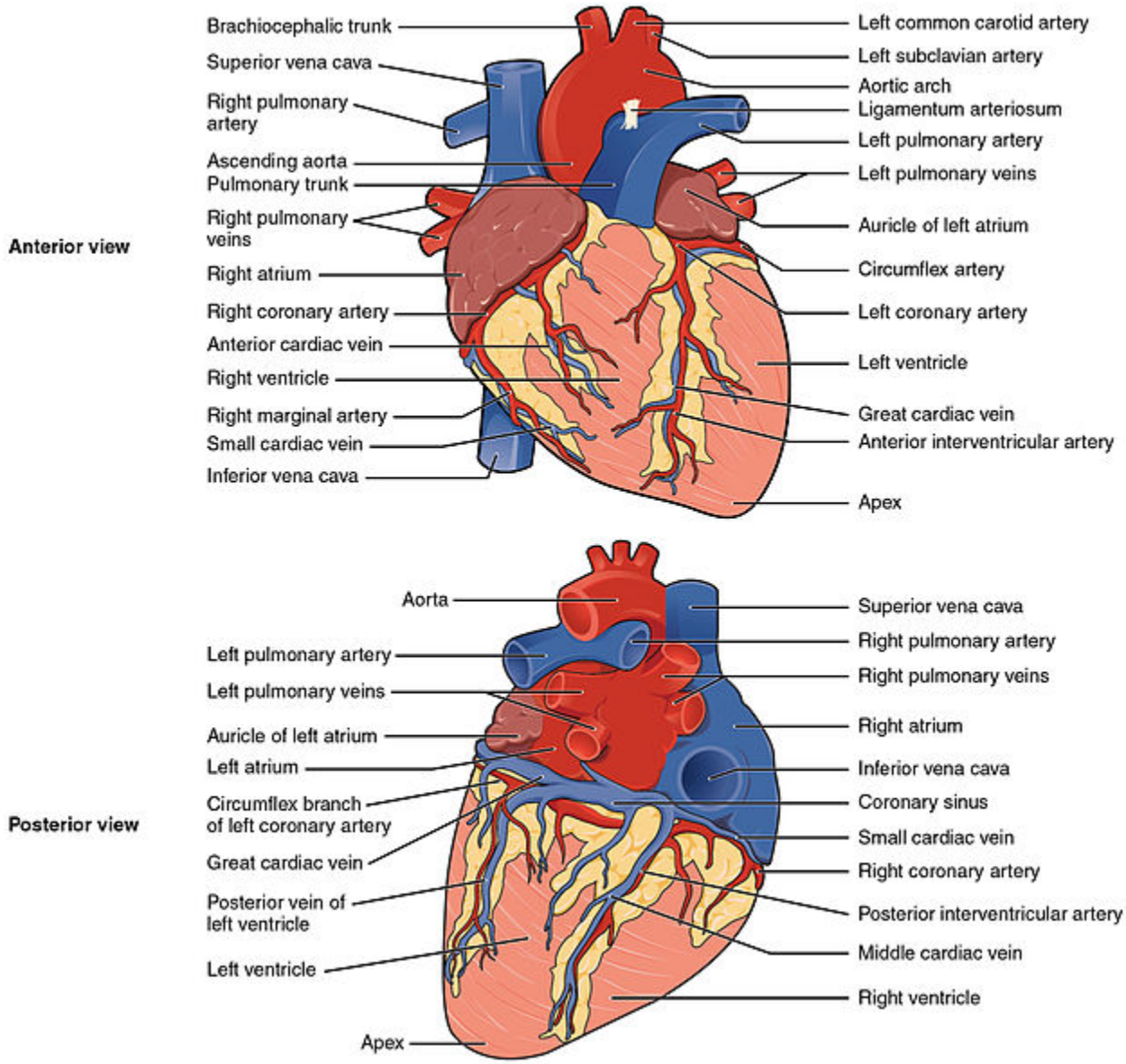


Figure 5.3 Coronary Arteries of the Heart

Conduction System of the Heart

Contractions of the heart are stimulated by the electrical conduction system. The components of the cardiac conduction system include the sinoatrial (SA) node, the atrioventricular (AV) node, the bundle of His, the left and right

bundle branches, and the Purkinje fibers. See Figure 5.4[6] for an image of the conduction system of the heart.

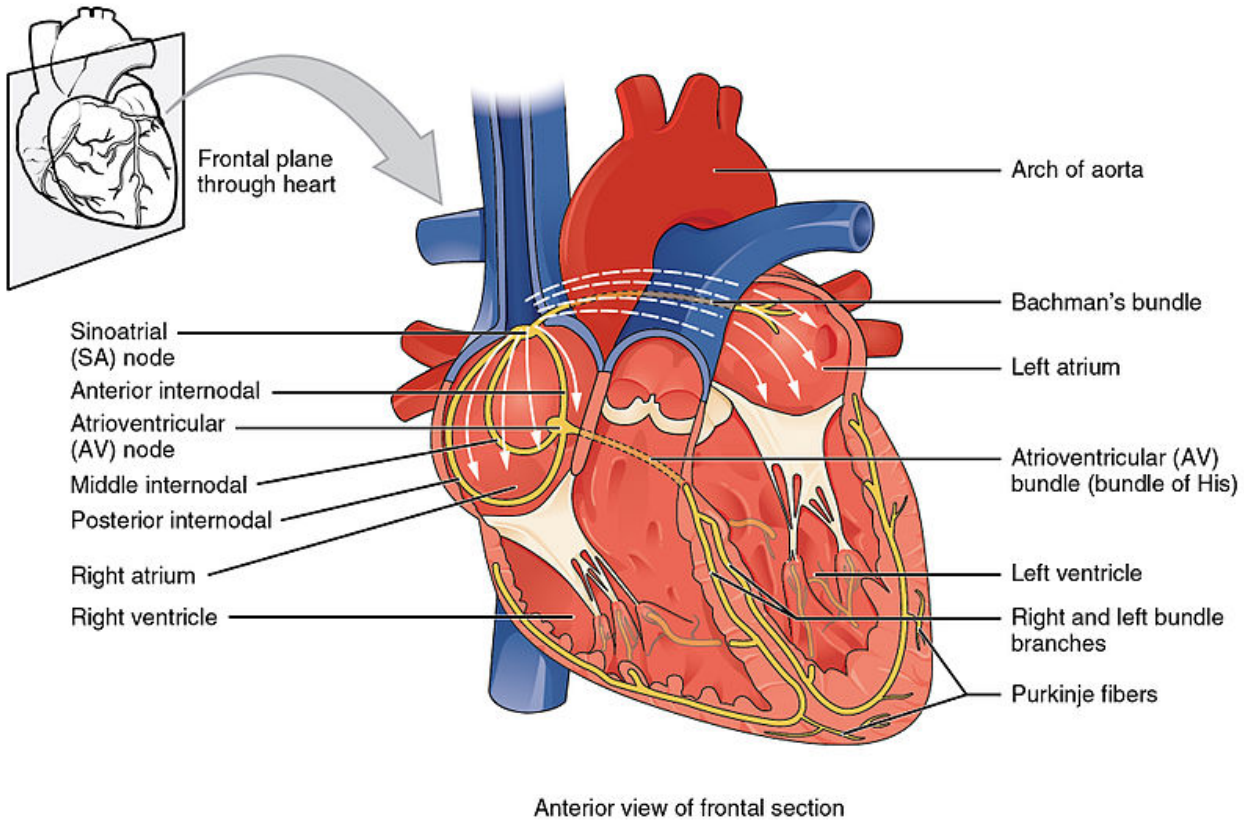


Figure 5.4 Components of the Cardiac Conduction System

Normal cardiac rhythm is established by the **sinoatrial (SA) node**. The SA node has an intrinsic rate of 60-100 beats per minute and is known as the pacemaker of the heart. It initiates the **sinus rhythm** or normal electrical pattern followed by contraction of the heart. The SA node initiates the action potential, which sweeps across the atria through the AV node to the bundle branches and Purkinje fibers, and then spreads to the contractile fibers of the ventricle to stimulate the contraction of the ventricle.[7]

6. "2018 Conduction System of the Heart" by OpenStax College is licensed under CC BY 4.0. Access it for free at https://openstax.org/books/anatomy-and-physiology/pages/19-2-cardiac-muscle-and-electrical-activity

7. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O.,

CARDIAC CONDUCTIVE CELLS

Sodium (Na), potassium (K), and calcium (Ca2) ions play critical roles in cardiac conduction. Conductive cells contain a series of sodium ion channels that allow influx of sodium ions that cause the membrane potential to rise slowly and eventually cause spontaneous depolarization. Calcium ion channels open and Ca2 enters the cell, further depolarizing it. As the calcium ion channels then close, the K channels open, resulting in repolarization. When the membrane potential reaches approximately −60 mV, the K channels close and Na channels open, and the prepotential phase begins again. This phenomenon explains the autorhythmicity properties of cardiac muscle. Calcium ions play two critical roles in the physiology of cardiac muscle: conduction and contraction. In addition to depolarization, calcium ions also cause myosin to form cross bridges with the muscle cells that then provide the power stroke of contraction. Medications called calcium channel blockers thus affect both the conduction and contraction roles of calcium in the heart.[8]

FOCUS ON CLINICAL PRACTICE: THE ECG

Surface electrodes placed on specific anatomical sites on the body can record the heart's electrical signals. This tracing of the electrical signal is called an electrocardiogram (ECG), also historically abbreviated EKG. Careful analysis of an ECG reveals a detailed picture of both normal and abnormal heart function and is an indispensable clinical diagnostic tool. A normal ECG tracing is

Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

8. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

presented in Figure 5.5.[9] Each component, segment, and interval is labeled and corresponds to important electrical events.

There are five prominent components of the ECG: the P wave; the Q, R, and S components; and the T wave. The small P wave represents the depolarization of the atria. The large QRS complex represents the depolarization of the ventricles, which requires a much stronger impulse because of the larger size of the ventricular cardiac muscle. The ventricles begin to contract as the QRS reaches the peak of the R wave. Lastly, the T wave represents the repolarization of the ventricle. Several cardiac disorders can cause an altered conduction of the electrical signal through the heart, resulting in an abnormal rate or rhythm called **dysrhythmia** (also called arrhythmia).[10]

9. "2022_Electrocardiogram.jpg" by OpenStax College is licensed under CC BY 3.0.

10. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

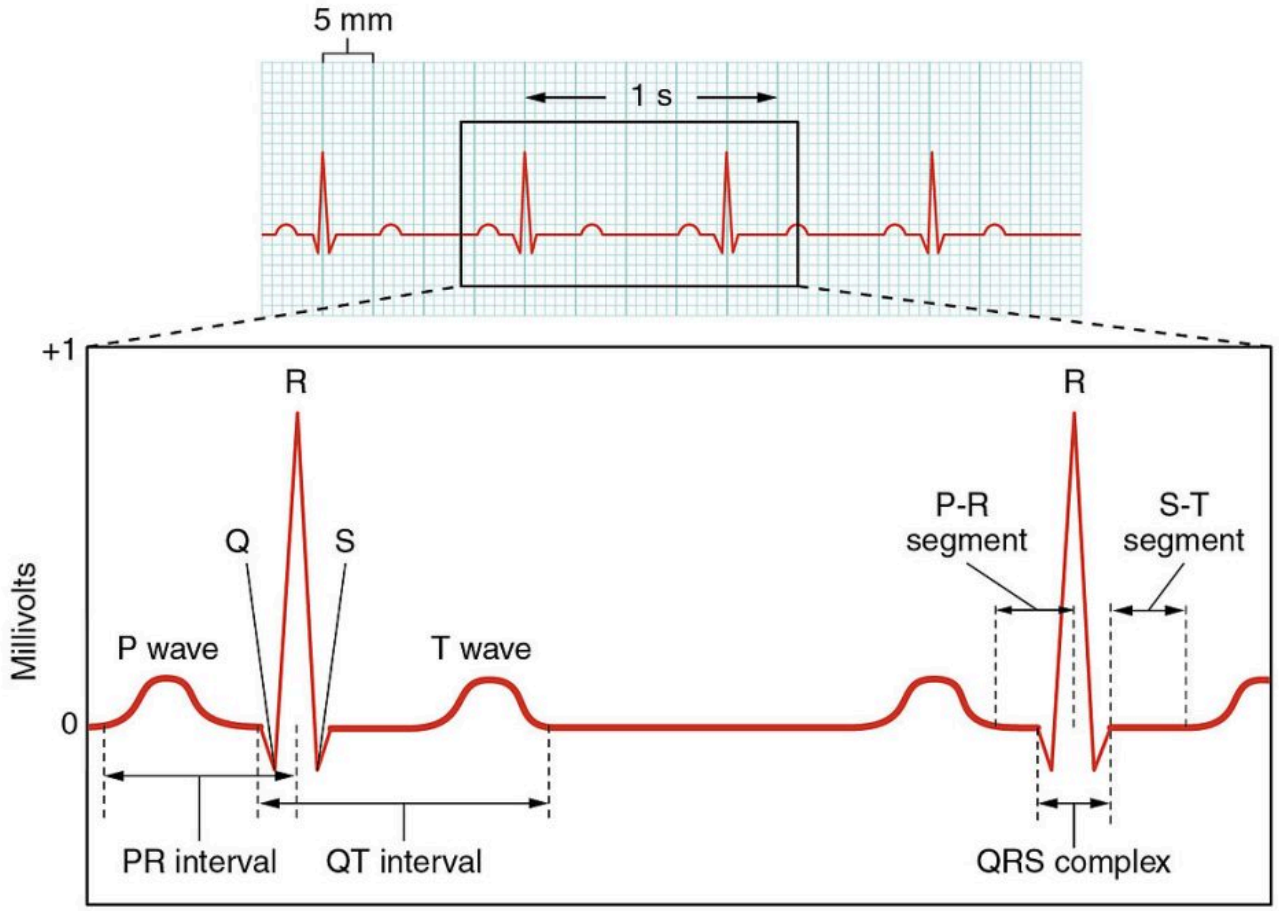


Figure 5.5 Components of an ECG Reading

Cardiac Cycle

The period of time that begins with contraction of the atria and ends with ventricular relaxation is known as the cardiac cycle. The period of contraction that the heart undergoes while it pumps blood into circulation is called **systole**. The period of relaxation that occurs as the chambers fill with blood is called **diastole**.

Phases of the Cardiac Cycle

At the beginning of the cardiac cycle, both the atria and ventricles are relaxed, referred to as diastole. During diastole, blood flows into the right atrium from the superior and inferior venae cavae and into the left atrium from the four pulmonary veins. Contraction of the atria follows depolarization, which is represented by the P wave of the ECG. Just prior to atrial contraction, the

ventricles contain approximately 130 mL of blood in a resting adult. This volume is known as the end diastolic volume or **preload**. As the atrial muscles contract, pressure rises within the atria, and blood is pumped into the ventricles.

Ventricular systole follows the depolarization of the ventricles and is represented by the QRS complex in the ECG. During the ventricular ejection phase, the contraction of the ventricular muscle causes blood to be pumped out of the heart. This quantity of blood is referred to as **stroke volume (SV)**. Ventricular relaxation, or diastole, follows repolarization of the ventricles and is represented by the T wave of the ECG.[11]

Cardiac Output

Cardiac output (CO) is a measurement of the amount of blood pumped by each ventricle in one minute. To calculate this value, multiply stroke volume (SV), the amount of blood pumped by the left ventricle, by the heart rate (HR) in beats per minute. It can be represented mathematically by the following equation: CO = HR × SV. Factors influencing CO are summarized in Figure 5.6[12] and include autonomic innervation by the sympathetic and parasympathetic nervous systems, hormones such as epinephrine, preload, contractility, and afterload. Each of these factors is further discussed below.[13] SV is also used to

11. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

12. "2031 Factors in Cardiac Output.jpg" by OpenStax College is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/19-4-cardiac-physiology

13. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*.

calculate ejection fraction, which is the portion of the blood that is pumped or ejected from the heart with each contraction.

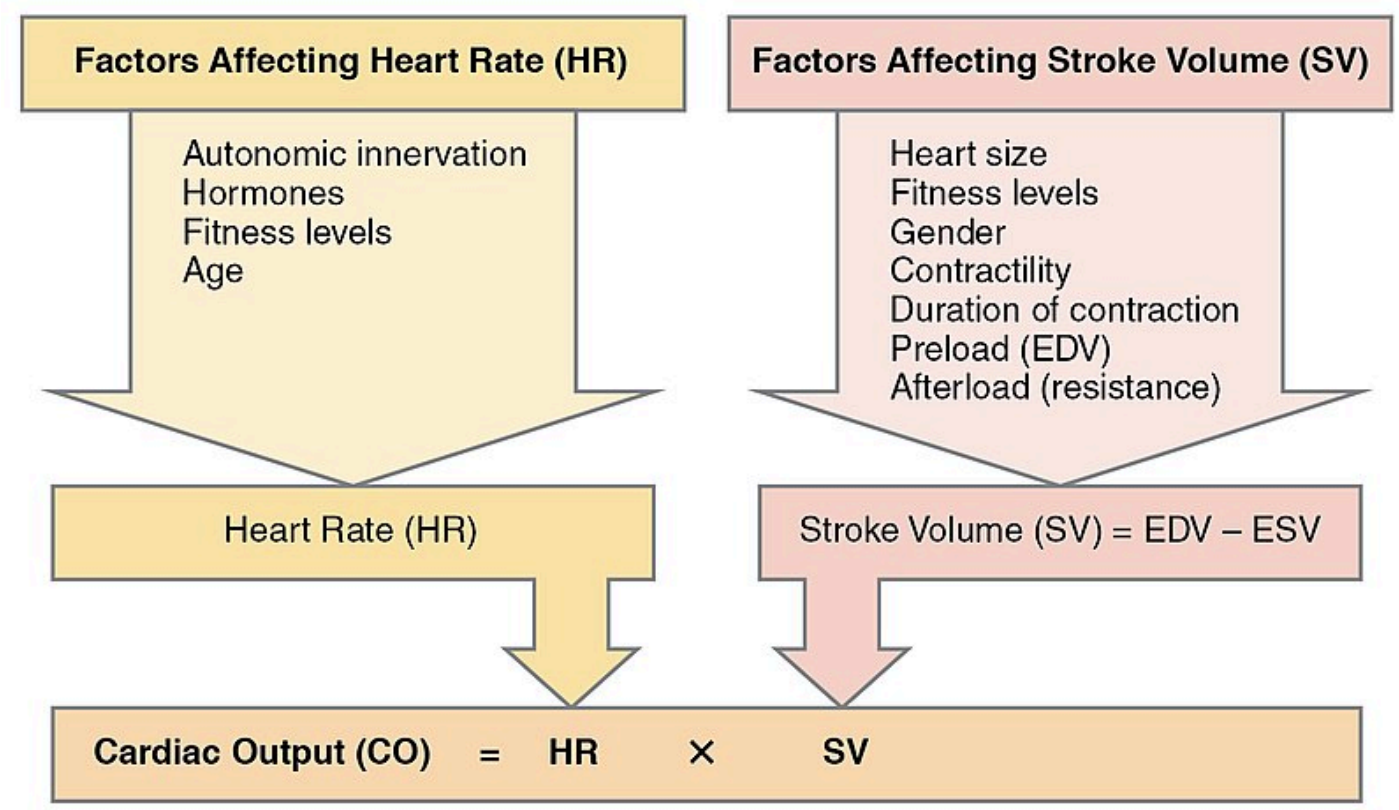


Figure 5.6 Factors Affecting Cardiac Output

Heart Rate

Heart rate (HR) can vary considerably, not only with exercise and fitness levels, but also with age. Newborn resting HRs may be 120 -160 bpm. HR gradually decreases until young adulthood and then gradually increases again with age. For an adult, normal resting HR will be in the range of 60–100 bpm. **Bradycardia** is the condition in which resting rate drops below 60 bpm, and **tachycardia** is the condition in which the resting rate is above 100 bpm.

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Correlation Between Heart Rate and Cardiac Output

Conditions that cause increased HR also trigger an initial increase in SV. However, as the HR rises, there is less time spent in diastole and, consequently, less time for the ventricles to fill with blood. As HR continues to increase, SV gradually decreases due to less filling time. In this manner, tachycardia will eventually cause decreased cardiac output.

Autonomic Nervous Stimulation of Heart Rate and Contractility

Sympathetic stimulation increases the heart rate and contractility, whereas parasympathetic stimulation decreases the heart rate. See Figure 5.7 for an illustration of the ANS stimulation of the heart.[14] Sympathetic stimulation causes the release of the neurotransmitter norepinephrine (NE), which shortens the repolarization period, thus speeding the rate of depolarization and contraction and increasing the HR. It also opens sodium and calcium ion channels, allowing an influx of positively charged ions.

NE binds to the Beta-1 receptor. Some cardiac medications (for example, beta-blockers) work by blocking these receptors, thereby slowing HR and lowering blood pressure. However, an overdose of beta-blockers can lead to bradycardia and even stop the heart.[15]

14. "2032 Automatic Innervation.jpg" by OpenStax College is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/19-4-cardiac-physiology

15. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

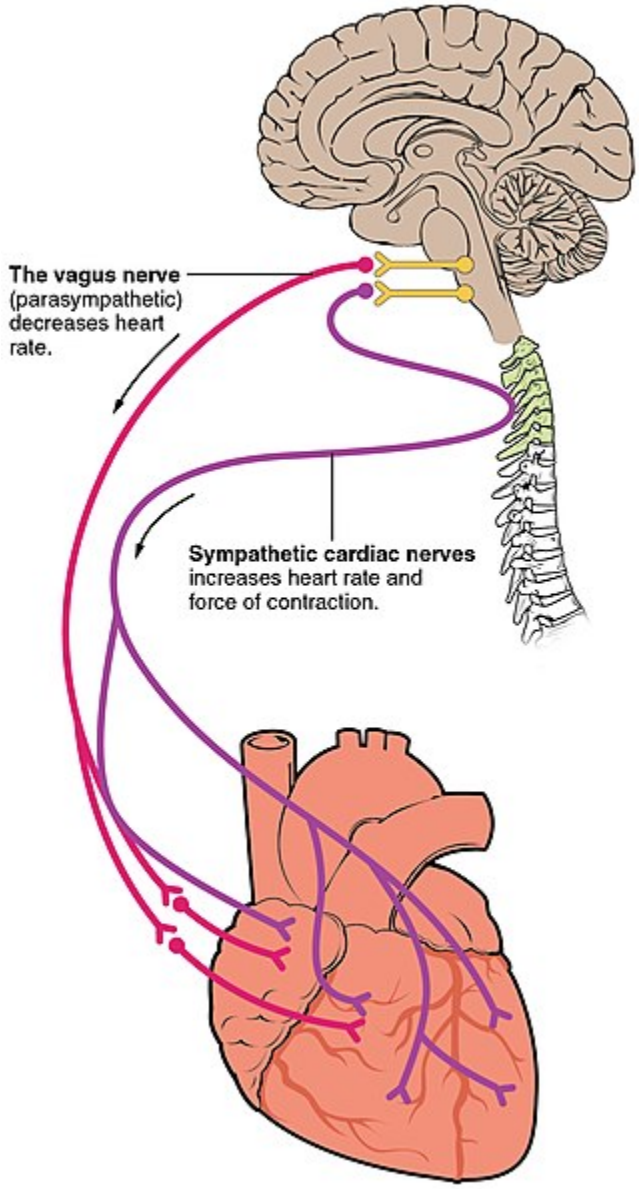


Figure 5.7 ANS Stimulation of the Heart Includes Sympathetic and Parasympathetic Stimulation

Stroke Volume

Many of the same factors that regulate HR also impact cardiac function by altering SV. Three primary factors that affect stroke volume are **preload**, or the stretch on the ventricles prior to contraction; **contractility**, or the force or strength of the contraction itself; and **afterload**, the force the ventricles must generate to pump blood against the resistance in the vessels. Many

cardiovascular medications affect cardiac output by affecting preload, contractility, or afterload.[16]

Preload

Preload reflects the degree of myocardial stretch of muscle tissue at the end of diastole and before contraction. Preload is another way of describing end diastolic volume (EDV). Therefore, the greater the EDV is, the greater the preload is. One of the primary factors to consider is filling time, the duration of ventricular diastole during which filling occurs. Any sympathetic stimulation to the venous system will also increase venous return to the heart, which contributes to ventricular filling and preload. Medications such as diuretics decrease preload by causing the kidneys to excrete more water, thus decreasing blood volume.

Contractility

Contractility refers to the force of the contraction of the heart muscle, which controls SV. Factors that increase contractility are described as **positive inotropic factors**, and those that decrease contractility are described as **negative inotropic factors**.

Not surprisingly, sympathetic stimulation is a positive inotrope, whereas parasympathetic stimulation is a negative inotrope. The drug digoxin is used to lower HR and increase the strength of the contraction. It works by inhibiting the activity of an enzyme (ATPase) that controls movement of calcium, sodium, and potassium into heart muscle. Inhibiting ATPase increases calcium in heart muscle and, therefore, increases the force of heart contractions.

16. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

Negative inotropic agents include hypoxia, acidosis, hyperkalemia, and a variety of medications such as beta-blockers and calcium channel blockers.

Afterload

Afterload refers to the force that the ventricles must develop to pump blood effectively against the resistance in the vascular system. Any condition that increases resistance requires a greater afterload to force open the semilunar valves and pump the blood, which decreases cardiac output. On the other hand, any decrease in resistance reduces the afterload and then increases cardiac output. Figure 5.8[17] summarizes the major factors influencing cardiac output. Calcium channel blockers such as amlodipine, verapamil, nifedipine, and diltiazem can be used to reduce afterload and increase cardiac output.[18]

17. "2036 Summary of Factors in Cardiac Output.jpg" by OpenStax College is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/19-4-cardiac-physiology

18. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

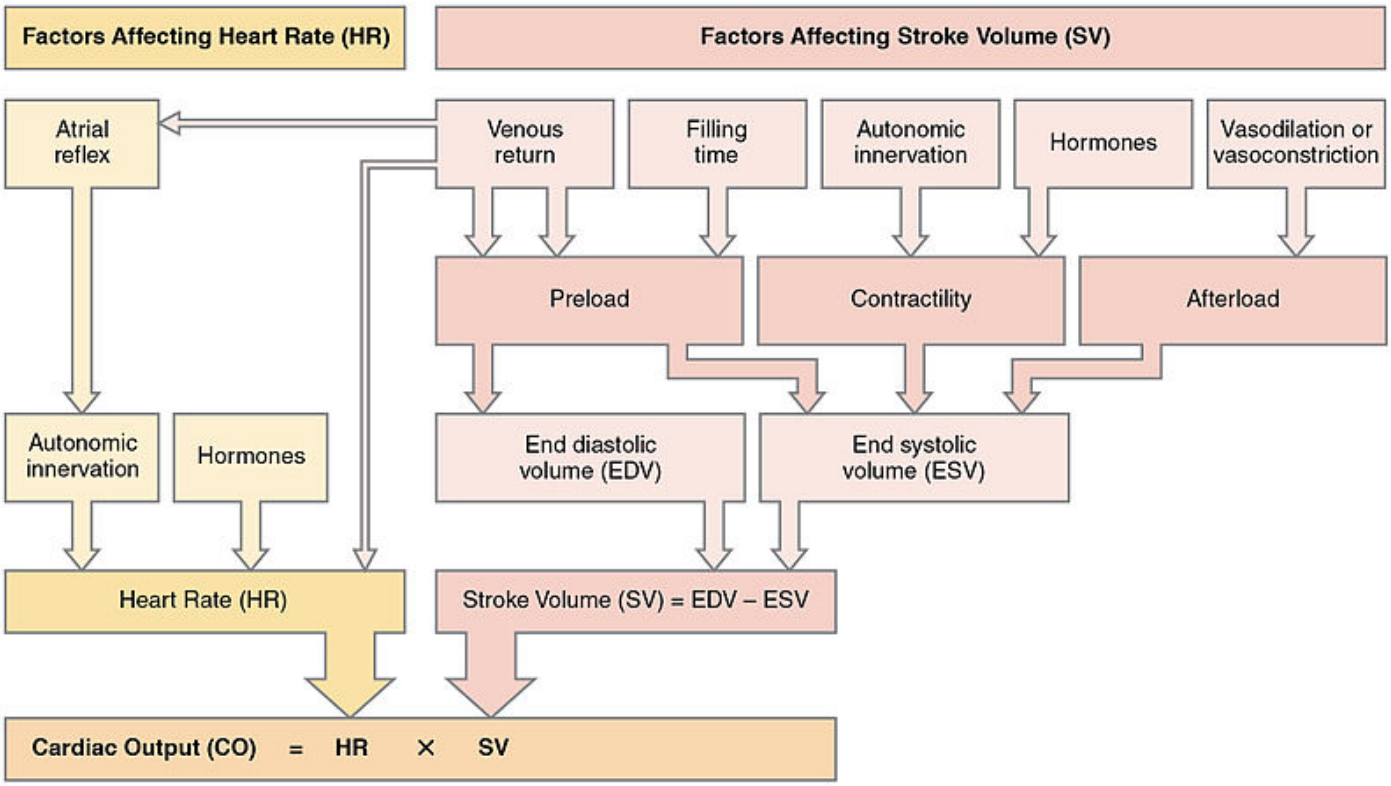


Figure 5.8 Factors Affecting Cardiac Output

After blood is pumped out of the left ventricle into the aorta, it is carried through the body via the systemic arteries. An **artery** is a blood vessel that carries blood away from the heart, where it branches into ever-smaller arterioles and eventually into tiny capillaries. See Figure 5.9[19] for an illustration of the systemic arteries that carry oxygenated blood throughout the body to organs and tissues, as indicated by the red color.

19. "2120_Major_Systemic_Artery.jpg" by OpenStax College is licensed under CC BY 3.0

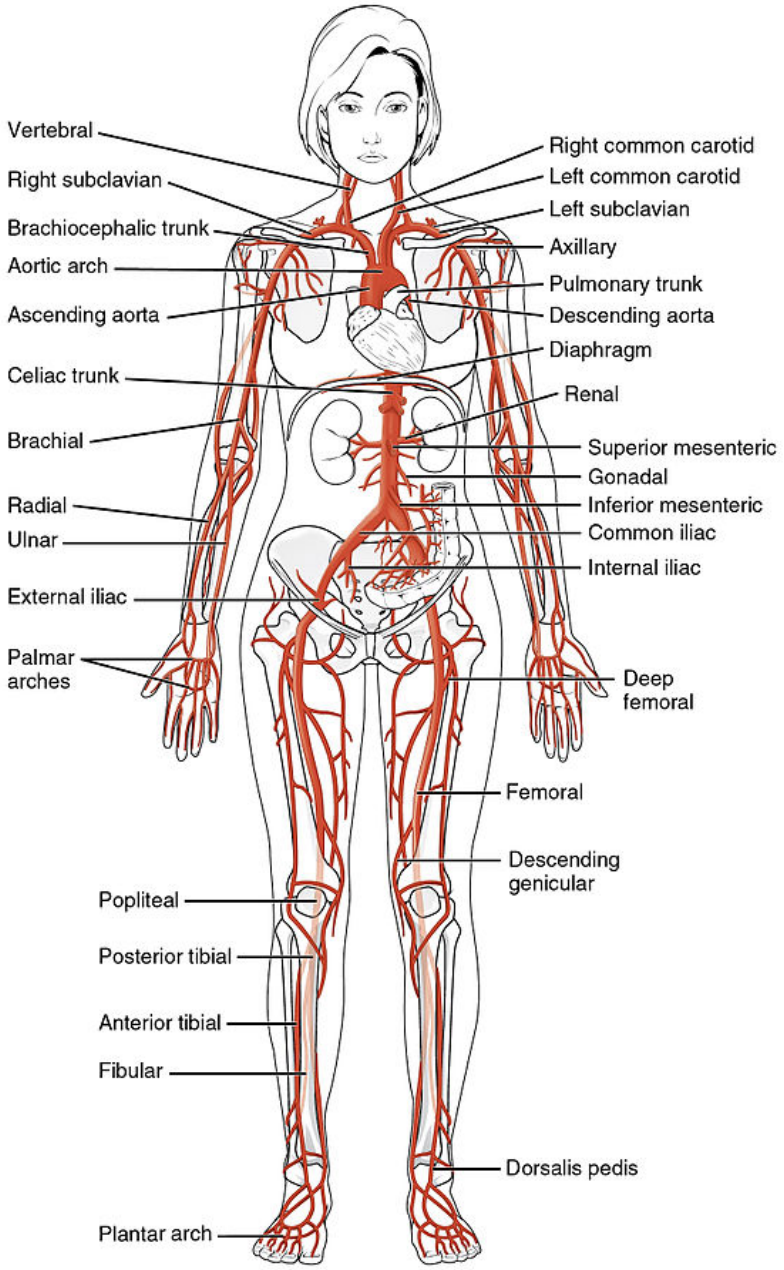


Figure 5.9 Systemic Arteries

Oxygen and nutrients are exchanged with cells at the **capillary** level. A capillary is a microscopic channel that supplies blood to the tissue cells where nutrients and wastes are exchanged at the cellular level. Capillaries connect arterioles and **venules**, small veins. See Figure 5.10[20] for an illustration of capillaries supplying blood to tissue cells.

20. "Illu_capillary_en.jpg" by Unknown author is licensed in the Public Domain

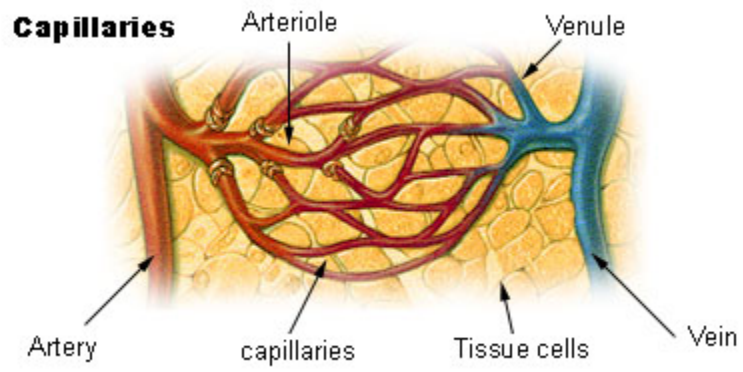


Figure 5.10 Capillaries

Venules carry blood to **veins**, a larger blood vessel that returns blood to the heart. Compared to arteries, veins are thin-walled, low-pressure vessels. Larger veins are also equipped with valves that promote the unidirectional flow of blood toward the heart and prevent backflow caused by the inherent low blood pressure in veins, as well as the pull of gravity. See Figure 5.11[21] for an illustration of the systemic veins.

21. "2131_Major_S" by ystematic_Veins.jpg" by OpenStax College is licensed under CC BY 3.0

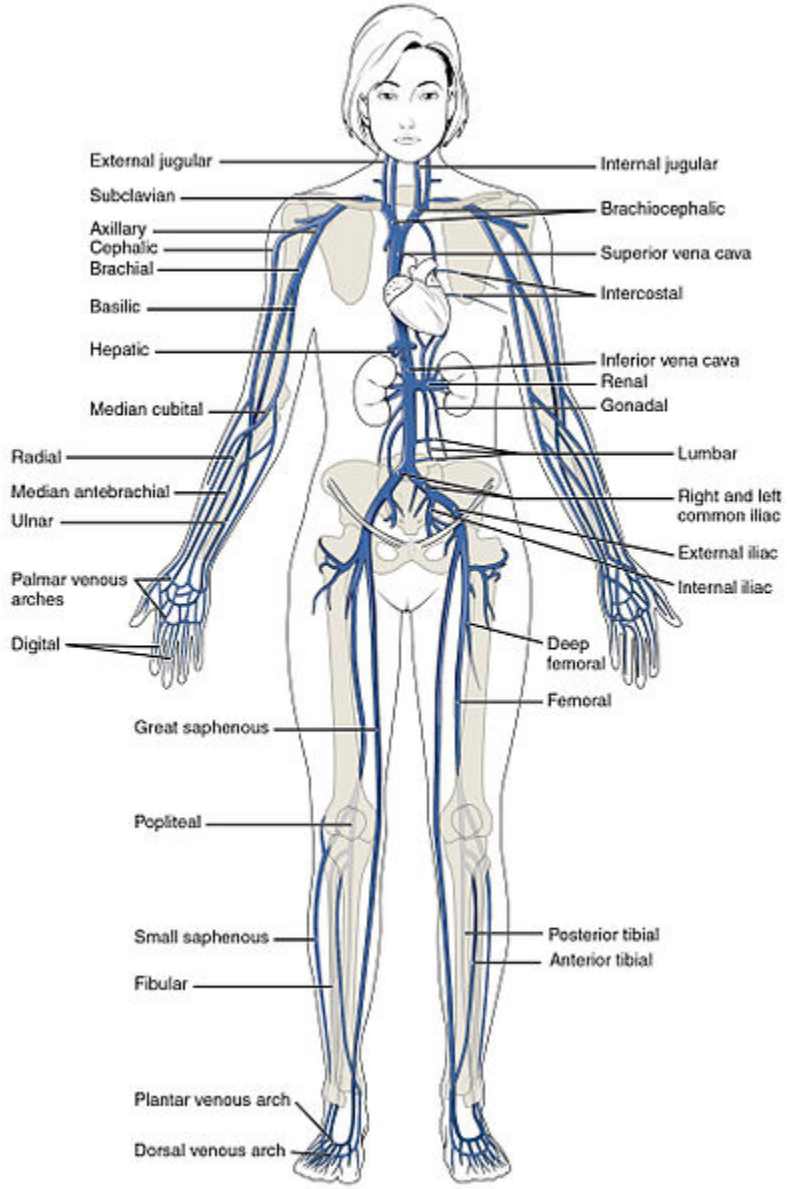


Figure 5.11 Systemic Veins

In addition to their primary function of returning blood to the heart, veins may be considered blood reservoirs because systemic veins contain approximately 64 percent of the blood volume at any given time. Approximately 21 percent of the venous blood is located in venous networks within the liver, bone marrow, and integument. This volume of blood is referred to as **venous reserve**. Through venoconstriction, this reserve volume of blood can get back to the heart more quickly for redistribution to other parts of the circulation. Nitroglycerin is an example of a medication that causes arterial and venous vasodilation. It is used for clients with angina to

decrease cardiac workload and increase the amount of oxygen available to the heart. By causing vasodilation of the veins, nitroglycerin decreases the amount of blood returned to the heart, which then decreases preload. It also reduces afterload by causing vasodilation of the arteries and reducing peripheral vascular resistance.[22]

Transportation of Blood

The systemic circulation transports blood and its components for physiological processes that occur throughout the body:

- The right ventricle pumps deoxygenated blood through the pulmonary arteries away from the heart to the lungs. Note this is the only place where arteries carry deoxygenated blood. Oxygen from the air breathed into the lungs diffuses into the pulmonary circulation in the alveoli. The pulmonary veins return oxygenated blood to the left atria of the heart, which moves into the left ventricle where it is pumped out to the rest of the body via the aorta to the systemic arteries.
- Nutrients from the foods eaten are absorbed in the digestive tract, where they diffuse into the systemic circulation and are transported throughout the body.
- Systemic arteries carry blood to the liver, where wastes are filtered out of the blood in the form of bile and nutrients and medications are metabolized.
- Systemic arteries carry blood to the kidneys, where wastes are filtered out and urine is created.
- Endocrine glands scattered throughout the body release hormones into the bloodstream, where they are transported to distant target cells.

22. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

Pulse

Each time the heart ejects blood forcefully into the circulation, the arteries expand and recoil to accommodate the surge of blood moving through them. This expansion and recoiling of the arterial wall is called the **pulse** and allows us to measure heart rate. The pulse can be palpated manually by placing the tips of the fingers across an artery that runs close to the body surface, such as the radial artery or the common carotid artery. Common pulse sites are shown in the Figure 5.12[23] below.

23. "2110_Pulse_Sites.jpg" by OpenStax College is licensed under CC BY 3.0

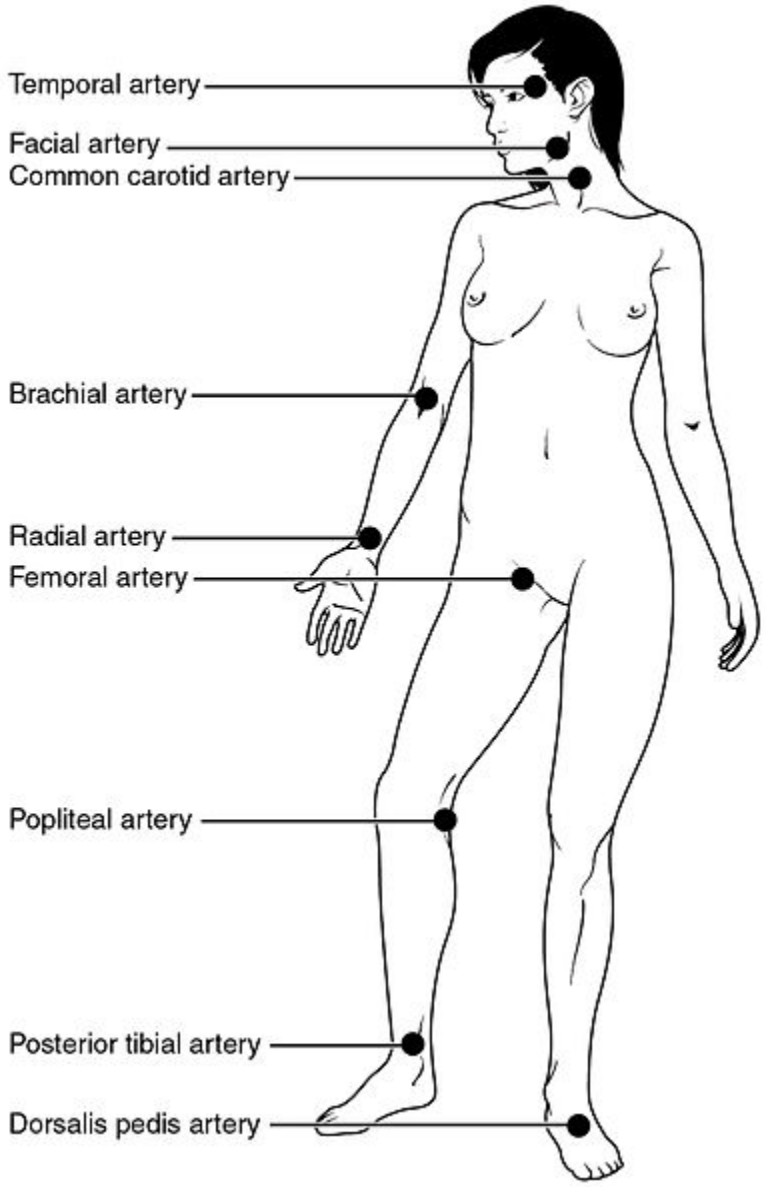


Figure 5.12 Pulse Sites

Both the rate and the strength of the pulse are important clinically. A high pulse rate can be temporarily caused by physical activity, but an extended fast or irregular pulse indicates a cardiac condition. The pulse strength indicates the strength of ventricular contraction, cardiac output, and perfusion. Recall that cardiac output is the amount of blood pumped by the heart per minute, and **perfusion** is the passage of blood through the blood vessels. If the pulse is strong, then cardiac output is high and perfusion to that site is good. If the pulse is weak, cardiac output is low or perfusion is impaired, and medical intervention may be warranted.

Blood Flow and Blood Pressure

Blood flow refers to the movement of blood through a vessel, tissue, or organ. **Blood pressure** is the force exerted by blood on the walls of the blood vessels. In clinical practice, this pressure is measured in mm Hg and is typically obtained using a sphygmomanometer (a blood pressure cuff) on the brachial artery of the arm. When systemic arterial blood pressure is measured, it is recorded as a ratio of two numbers expressed as systolic pressure over diastolic pressure (e.g., 120/80 is a normal adult blood pressure). The systolic pressure is the higher value (typically around 120 mm Hg) and reflects the arterial pressure resulting from the ejection of blood during ventricular contraction or systole. The diastolic pressure is the lower value (usually about 80 mm Hg) and represents the arterial pressure of blood during ventricular relaxation or diastole.

Three primary variables influence blood flow and blood pressure:

- Cardiac output
- Compliance of vessels
- Volume of the blood

Any factor that causes cardiac output to increase will elevate blood pressure and promote blood flow. Conversely, any factor that decreases cardiac output will decrease blood flow and blood pressure. See the previous “Cardiac Output” subsection for more information about factors that affect cardiac output.

Compliance is the ability of any compartment to expand to accommodate increased content. A metal pipe, for example, is not compliant, whereas a balloon is. The greater the compliance of an artery, the more effectively it is able to expand to accommodate surges in blood flow without increased resistance or blood pressure. When vascular disease causes arteriosclerosis (i.e., stiffening of arteries), compliance is reduced and resistance to blood flow is increased. The result is higher blood pressure within the vessel and reduced blood flow.

There is a relationship between blood volume, blood pressure, and blood flow. As an example, water may merely trickle along a creek bed in a dry

season but rush quickly and under great pressure after a heavy rain. Similarly, as blood volume decreases, blood pressure and flow decrease, but when blood volume increases, blood pressure and flow increase.

Low blood volume, called **hypovolemia**, may be caused by bleeding, dehydration, vomiting, severe burns, or by diuretics used to treat hypertension. Treatment typically includes intravenous fluid replacement. Excessive fluid volume, called **hypervolemia**, is caused by retention of water and sodium, as seen in clients with heart failure, liver cirrhosis, and some forms of kidney disease. Treatment may include the use of diuretics that cause the kidneys to eliminate sodium and water.[24]

Edema

Despite the presence of valves within larger veins, over the course of a day, some blood will inevitably pool in the lower limbs, due to the pull of gravity. Any blood that accumulates in a vein will increase the pressure within it. Increased pressure will promote the flow of fluids out of the capillaries and into the interstitial fluid. The presence of excess fluid around the cells leads to a condition called **edema**. See Figure 5.13[25] for an image of a client with pitting edema. Edema can also be generalized and non-pitting.

24. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

25. "Combinpedal.jpg" by James Heilman, MD is licensed under CC BY-SA 3.0



Figure 5.13 Pitting Edema

Most people experience a daily accumulation of fluid in their tissues, especially if they spend much of their time on their feet. However, clinical edema goes beyond normal swelling and requires medical treatment. Edema has many potential causes, including heart failure, severe protein deficiency, and renal failure. Diuretics such as furosemide are used to treat edema by causing the kidneys to eliminate sodium and water.[26] Read additional

26. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O.,

information about how to assess and document pitting edema in the "Assessment" subsection of the "General Cardiovascular System Assessment" section of this chapter.

Homeostatic Regulation of the Cardiovascular System

To maintain homeostasis in the cardiovascular system and provide adequate blood to the tissues, blood flow must be redirected continually to the tissues as they become more active. For example, when an individual is exercising, more blood will be directed to skeletal muscles, the heart, and the lungs. On the other hand, following a meal, more blood is directed to the digestive system. Only the brain receives a constant supply of blood regardless of rest or activity. Three homeostatic mechanisms ensure adequate blood flow and ultimately perfusion of tissues: autonomic nervous system, endocrine system, and autoregulatory mechanisms.

Autonomic Nervous System, Baroreceptors, and Chemoreceptors

The autonomic nervous system plays a critical role in the regulation of vascular homeostasis based on baroreceptors and chemoreceptors. Baroreceptors are specialized stretch receptors located within the aorta and carotid arteries that respond to the degree of stretch caused by the presence of blood and then send impulses to the cardiovascular center to regulate blood pressure. Baroreceptors sense changes in the level of pressure within the vessels. In addition to the baroreceptors, chemoreceptors monitor levels of oxygen, carbon dioxide, and hydrogen ions (pH). Chemoreceptors sense changes in the level of oxygen within the blood. When the cardiovascular center in the brain receives this input, it triggers a reflex that maintains homeostasis.

Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

Endocrine Regulation

Endocrine control over the cardiovascular system involves catecholamines, epinephrine, and norepinephrine, as well as several hormones that interact with the kidneys in the regulation of blood volume.

EPINEPHRINE AND NOREPINEPHRINE

The catecholamines epinephrine and norepinephrine are released by the adrenal medulla and are a part of the body's sympathetic or fight-or-flight response. They increase heart rate and force of contraction, while temporarily constricting blood vessels to organs not essential for flight-or-fight responses and redirecting blood flow to the liver, muscles, and heart.

ANTIDIURETIC HORMONE

Antidiuretic hormone (ADH), also known as vasopressin, is secreted by the hypothalamus. The primary trigger prompting the hypothalamus to release ADH is increasing osmolarity of tissue fluid, usually in response to significant loss of blood volume. ADH signals its target cells in the kidneys to reabsorb more water, thus preventing the loss of additional fluid in the urine. This will increase overall fluid levels and help restore blood volume and pressure.

RENIN-ANGIOTENSIN-ALDOSTERONE SYSTEM

The **renin-angiotensin-aldosterone system (RAAS)** also has a major effect on the cardiovascular system. Specialized cells in the kidneys respond to decreased blood flow by secreting renin into the blood. Renin converts the plasma protein angiotensinogen into its active form—Angiotensin I. Angiotensin I circulates in the blood and is then converted into Angiotensin II in the lungs. This reaction is catalyzed by the enzyme called angiotensin-converting enzyme (ACE). Medications that impact angiotensin, such as angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs) target this step in the RAAS in an effort to decrease blood pressure.

Angiotensin II is a powerful vasoconstrictor that greatly increases blood pressure. It also stimulates the release of ADH and aldosterone, a hormone produced by the adrenal cortex. Aldosterone then increases the reabsorption of sodium into the blood by the kidneys. Because water follows sodium, there is an increase in the reabsorption of water, which increases blood volume and blood pressure. See Figure 5.14[27] for an illustration of the renin-angiotensin-aldosterone system. See Figure 5.15 [28] for a summary of the effect of hormones involved in renal control of blood pressure.

27. "2626 Renin Aldosterone Angiotensin.jpg" by OpenStax College is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/25-4-microscopic-anatomy-of-the-kidney

28. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

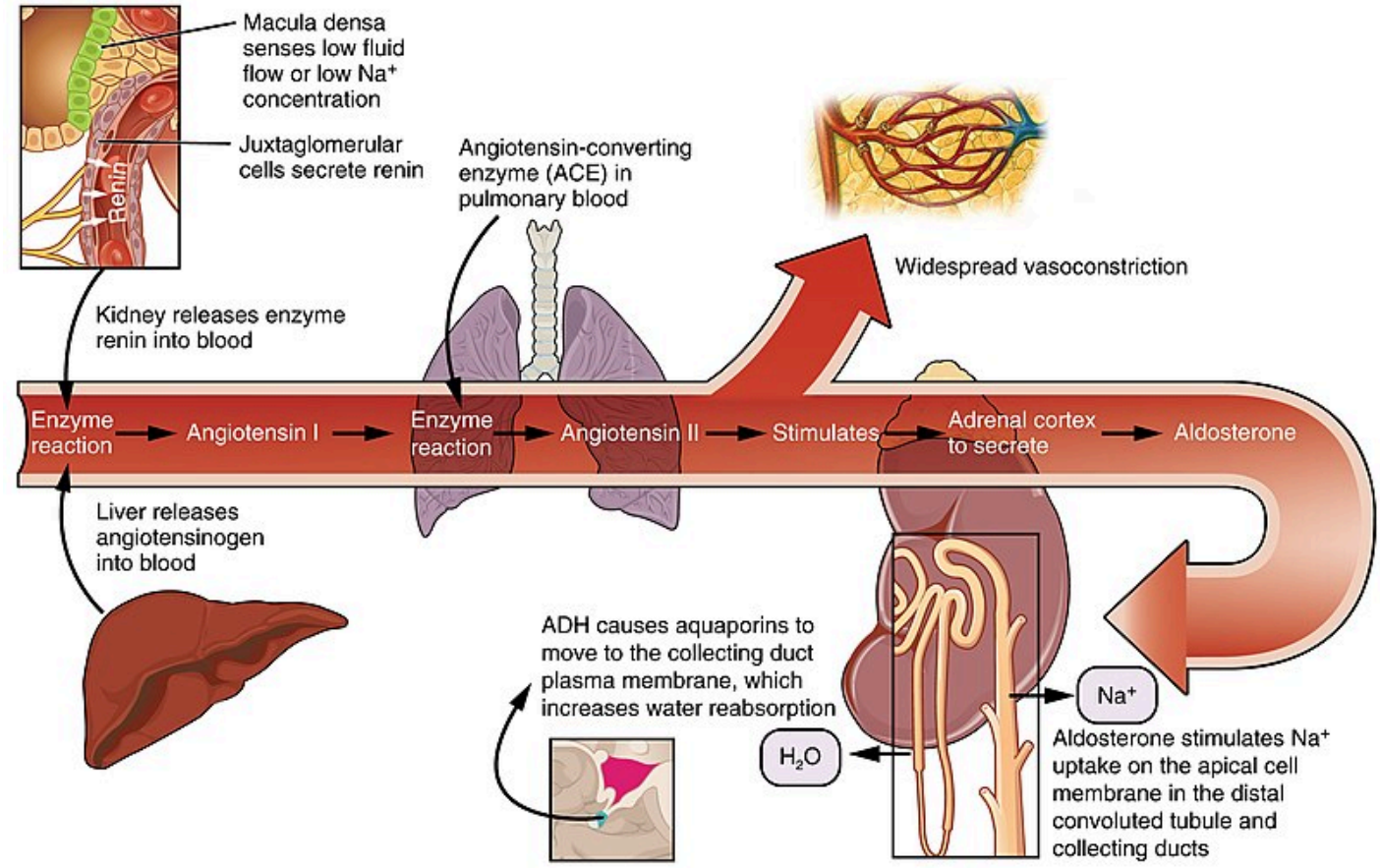


Figure 5.14 Renin-Angiotensin-Aldosterone System

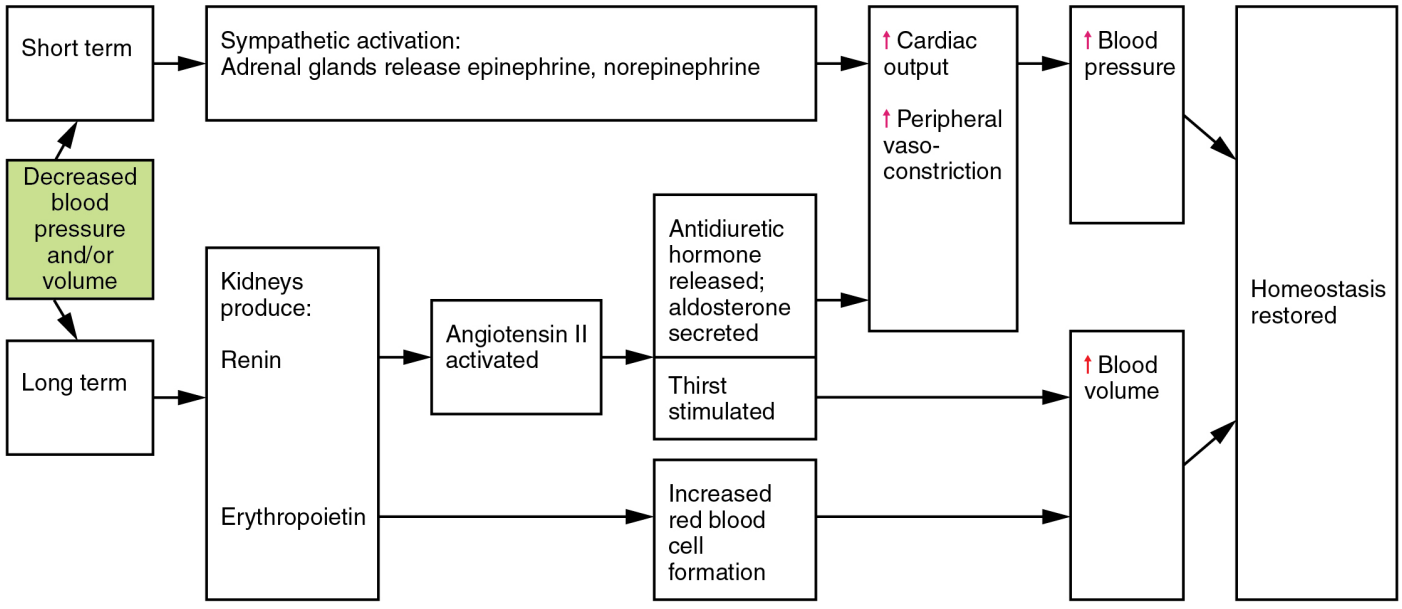


Figure 5.15 Hormones involved in renal control of blood pressure

Autoregulatory Mechanisms of Perfusion

Local, autoregulatory mechanisms allow each region of tissue to adjust its blood flow—and thus its perfusion. These mechanisms are affected by sympathetic and parasympathetic stimulation, as well as endocrine factors. See Table 5.2 for a summary of these factors and their effects.[29]

Table 5.2. Effects of Nervous System, Endocrine, and Local Controls on the Vasoconstriction and Vasodilation of Arterioles

Control	Factor	Vasoconstriction	Vasodilation
Autonomic Nervous System	Sympathetic stimulation	Arterioles within integument, abdominal viscera, and mucosa membrane; skeletal muscles (at high levels); varied in veins and venules	Arterioles within heart; skeletal muscles at low to moderate levels
	Parasympathetic	No known innervation for most	Arterioles in external genitalia; no known innervation for most other arterioles or veins
Endocrine	Epinephrine	Similar to sympathetic stimulation for extended flight-or-fight responses; at high levels, binds to specialized alpha (α)-receptors	Similar to sympathetic stimulation for extended fight-or-flight responses; at low to moderate levels, binds to specialized beta (β)-receptors
	Norepinephrine	Similar to epinephrine	Similar to epinephrine
	Angiotensin II	Powerful generalized vasoconstrictor; also stimulates release of aldosterone and ADH	N/A
	ADH	Moderately strong generalized vasoconstrictor; also causes body to retain more fluid via kidneys, increasing blood volume and pressure	N/A

29. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

5.3 General Cardiovascular System Assessment

When evaluating a client for possible disorders of the cardiovascular system, the nurse must attend to individual and population risk factors, cultural influence, and socioeconomic factors that may impact preventative and curative health. Client health history, physical examination findings, and diagnostic test results will also play an important role in cardiovascular system assessment.

Risk Factors & Social Determinants of Health Related to Cardiovascular System

Cardiovascular disease (CVD) remains a significant global health concern, requiring providers to conduct a comprehensive risk assessment to guide client prevention and management strategies. A thorough client history is foundational for evaluating CVD risk, encompassing both modifiable and nonmodifiable risk factors. Understanding contributing risk factors provides essential insights into understanding an individual's susceptibility to developing CVD and helps health care professionals tailor interventions effectively.

In the context of client history, identifying modifiable risk factors is crucial. **Modifiable risk factors** are risk factors that an individual can control through their actions, behavior, or lifestyle choices. These include factors such as tobacco use, physical activity, dietary habits, stress management, and sleep habits. **Metabolic syndrome** is a group of conditions that increases a person's risk of coronary heart disease, diabetes, and stroke. The conditions include elevated blood pressure, blood glucose, and triglyceride levels, as well as increased waist circumference.[1] Understanding an individual's modifiable risk

1. National Heart, Lung, and Blood Institute. (2022). *What Is metabolic*

factors allows health care providers to provide specific educational interventions to help prevent cardiovascular disease.[2]

Nutritional history, in particular, plays a pivotal role in cardiovascular health. See Figure 5.16[3] for an image illustrating healthy food choices. When first assessing cardiovascular risk, it can be helpful for individuals to provide a 24-hour food intake log. Providers may ask for individuals to record this for a brief period of time, often one to three days to help understand dietary patterns. Understanding an individual's food and fluid intake over a brief period provides insight on dietary patterns and identifies deficiencies or excesses. It can be especially helpful to examine an individual's saturated and trans fat intake, as well as cholesterol, salt, and dietary sugar.[4,5]

syndrome? National Institutes of Health. https://www.nhlbi.nih.gov/health/metabolic-syndrome

2. Wilson, P. (2023). Overview of established risk factors for cardiovascular disease. *UpToDate*. https://www.uptodate.com/

3. "food1.jpg" by bigbrand . is licensed under CC BY 2.0

4. Fawzy, A. M., & Lip, G. Y. H. (2021). Cardiovascular disease prevention: Risk factor modification at the heart of the matter. *The Lancet Regional Health Western Pacific, 17*, 100291. https://pubmed.ncbi.nlm.nih.gov/34734203/

5. American Heart Association. (2024). *Understand your risks to prevent a heart attack*. https://www.heart.org/en/health-topics/heart-attack/understand-your-risks-to-prevent-a-heart-attack



Figure 5.16 Healthy Food Choices

Assessing nonmodifiable risk factors is also important. **Nonmodifiable risk factors** are those that cannot be changed. Age, gender, and ethnic origin all contribute to an individual's CVD risk profile. Gathering information about chronic diseases, family history, and medication history helps in gauging potential risk. Family history and genetics play a crucial role in assessing overall risk. A positive family history of coronary artery disease (CAD) in a first-degree relative emerges as a major risk factor, often outweighing other factors such as hypertension, obesity, diabetes, or even sudden cardiac death. Understanding the age, health status, and cause of death of immediate family members helps in gauging the genetic predisposition to CVD.

Social history, including occupation and lifestyle, also provides context for identifying environmental risk factors. By systematically addressing these factors, health care professionals can form a comprehensive risk assessment foundation.[6]

Cultural Factors

Recognizing the role of cultural beliefs and practices in cardiovascular health is integral to a holistic risk assessment. Dietary preferences and lifestyle habits by individuals based on their cultural beliefs may impact their CVD risk. Figure 5.17[7] emphasizes the potential impact of cultural beliefs and practices on dietary preferences. Considering these cultural aspects helps nurses tailor interventions that are culturally responsive and more likely to be effective with diverse clients.[8,9]

6. Wilson, P. (2023). Overview of established risk factors for cardiovascular disease. *UpToDate*. https://www.uptodate.com/

7. "family-setting-the-table-for-dinner" by August de Richlieu, via Pexels.com is licensed under CC0

8. Boudi, F. B. (2021). *Risk factors for coronary artery disease*. Medscape. https://emedicine.medscape.com/article/164163-overview

9. Schultz, W. M., Heval, K., Lisko, J., Varghese, T., Shen, J., Sandesara, P., Quyyumi, A. A., Taylor, H., Gulati, M., Harold, J., Mieres, J., Ferdinand, K., Menash, G., & Sperling, L. (2018). Socioeconomic status and cardiovascular outcomes. *Circulation, 137*(20), 2166-2178. https://doi.org/10.1161/circulationaha.117.029652



5.17 Cultural Influences on Dietary Preferences

Involving family members and/or significant others responsible for cooking and shopping is invaluable when providing dietary teaching. By engaging them in discussions about healthy food choices and meal preparation, the

nurse ensures that interventions align with cultural values and family dynamics, fostering positive, long-term health outcomes.

Socioeconomic Factors

Socioeconomic factors significantly influence cardiovascular risk, contributing to health disparities observed across different populations. Understanding the impact of an individual's economic status is essential, as financial limitations can impact their access to healthy foods and health care resources.[10]

Additional socioeconomic factors like income, education, and access to health care can also amplify or mitigate CVD risk. Individuals from disadvantaged backgrounds may face challenges in adopting healthy lifestyles due to limited resources or stressful environments. Access to healthy foods, such as fruits and vegetables, may pose a challenge in areas with limited grocery stores or markets. Additionally, nutritious foods are often more expensive and may create a financial burden for individuals with limited income. These factors contribute to health inequalities and highlight the importance of addressing socioeconomic determinants of cardiovascular health.[11]

See the following box for a case scenario illustrating risk factor identification.

10. Schultz, W. M., Heval, K., Lisko, J., Varghese, T., Shen, J., Sandesara, P., Quyyumi, A. A., Taylor, H., Gulati, M., Harold, J., Mieres, J., Ferdinand, K., Menash, G., & Sperling, L. (2018). Socioeconomic status and cardiovascular outcomes. *Circulation, 137*(20), 2166-2178. https://doi.org/10.1161/circulationaha.117.029652

11. Schultz, W. M., Heval, K., Lisko, J., Varghese, T., Shen, J., Sandesara, P., Quyyumi, A. A., Taylor, H., Gulati, M., Harold, J., Mieres, J., Ferdinand, K., Menash, G., & Sperling, L. (2018). Socioeconomic status and cardiovascular outcomes. *Circulation, 137*(20), 2166-2178. https://doi.org/10.1161/circulationaha.117.029652

Case Scenario: Risk Factor Identification

Maria Angleso is a 45-year-old woman who presents to the clinic for a routine check-up. She has a family history of coronary artery disease (CAD) with her father experiencing a heart attack at the age of 55. Maria is concerned about her cardiovascular health and wants to assess her risk factors. She mentions that she recently lost her job and is now experiencing financial stress. She is also the primary caregiver for her elderly mother, who has limited mobility and requires specialized care.

1. Based on the following scenario, assess Maria for cardiovascular risk factors.

Financial Stress: *The recent job loss and financial stress can impact Maria's cardiovascular health. Stress can lead to unhealthy coping mechanisms, such as poor dietary choices or increased tobacco/alcohol use. Addressing stress management strategies will be crucial.*

Dietary Habits: *Maria's dietary habits, influenced by her financial situation, may include the consumption of processed or unhealthy foods due to budget constraints. Addressing her nutritional choices and providing guidance on budget-friendly, heart-healthy meal options can help mitigate this risk factor.*

Physical Activity: *Because Maria is the primary caregiver for her elderly mother, she may have limited time for physical activity. Encouraging her to incorporate short, regular bouts of physical activity into her daily routine can be beneficial.*

Stress Management: *The combined stressors of job loss and caregiving responsibilities can impact her mental well-being. Strategies such as mindfulness, relaxation techniques, or counseling can be explored to manage stress effectively.*

Family History of CAD: *Maria's family history of CAD with her father having a heart attack at 55 is a nonmodifiable risk factor. It indicates a genetic predisposition to cardiovascular issues, which should be considered when assessing her overall risk.*

Age: *Maria is 45 years old, which is a nonmodifiable risk factor for cardiovascular disease. Middle age is a critical period for assessing CVD risk.*

Caregiver Role: *While being a caregiver itself is not a traditional nonmodifiable risk factor, in this scenario, her role as a primary caregiver is nonmodifiable. It affects her ability to allocate time for certain lifestyle modifications.*

2. Identify risk factors as modifiable or nonmodifiable.

Modifiable: Financial Stress, Dietary Habits, Physical Activity, Stress Management

Nonmodifiable: Family History, Age, Caregiver Role

General Assessment of Cardiovascular System

A comprehensive assessment is essential because cardiovascular disease can impact the functioning of all body systems if the transportation of blood, nutrients, oxygen, and waste products to and from various organs and tissues is affected. A comprehensive assessment includes health history, physical examination, laboratory studies, and diagnostic testing. This section will discuss the generalities of a comprehensive assessment related to the cardiovascular system. Additional details related to specific diseases are described in each cardiovascular condition section in the remainder of the chapter.

Health History

A detailed medical and family history may reveal an underlying cardiovascular disorder. Document personal or family history of cardiovascular disease such

as heart attack, heart arrhythmias, valvular disorders, stroke, high blood pressure, high cholesterol, or diabetes. Heart disease in first-degree relatives such as parents, siblings, or children can indicate genetic risk for CVD and other cardiac conditions.

Personal risk factors should also be assessed, including the following[12]:

- Past or current tobacco use, including the type and amount consumed and the length of exposure
- Caffeine intake
- Alcohol use, including the number of drinks per week
- Drug use

Physical Assessment

Conducting a thorough examination of all body systems provides the nurse with cues regarding potential cardiovascular disorders. Early identification of abnormal findings and notification of the health care provider can lead to prompt intervention and management and improve client outcomes. Table 5.3a summarizes assessments for each body system for abnormal findings that can be related to cardiovascular disease.

12. Centers for Disease Control and Prevention. (2023). *About heart disease*. https://www.cdc.gov/heart-disease/about/?CDC_AAref_Val=https://www.cdc.gov/heartdisease/about.htm

Table 5.3a. Abnormal Findings by Body System Related to CVD[13,14,15,16,17,18]

13. Colucci, W. S., & Borlaug, B. A. (2022). Heart failure: Clinical manifestations and diagnosis in adults. *UpToDate*. https://www.uptodate.com/

14. Basile, J., & Bloch, M. J. (2023). Overview of hypertension in adults. *UpToDate*. https://www.uptodate.com/

15. Crea, F., Kolodgie, F., Finn, A. & Virmani, R. (2022). Mechanisms of acute coronary syndromes related to atherosclerosis. *UpToDate*. https://www.uptodate.com/

16. Neschis, D. G., & Golden, M. A. (2022). Clinical features and diagnosis of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

17. Dalman, R. L., & Mell, M. (2023). Overview of abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

18. Spelman, D. (2022). Complications and outcome of infective endocarditis. *UpToDate*. https://www.uptodate.com/

Body System	Abnormal Findings Related to Possible CVD
Cardiovascular	Irregular heart rhythm: Arrhythmias Bradycardia/Tachycardia Abnormal heart sounds (i.e., murmurs, gallops): Valve disease Elevated blood pressure: Hypertension Weak or absent peripheral pulses: CVD, heart failure, and peripheral vascular disease Edema: Heart failure **Jugular venous distention (JVD)** (distended jugular vein when client is positioned at 45 degrees): Right-sided heart failure Crackles in the lung bases: Left-sided heart failure Cyanosis: CVD or peripheral vascular disease Venous insufficiency: Peripheral edema Arterial insufficiency: Atherosclerosis and arteriosclerosis
Respiratory	**Dyspnea** (shortness of breath), especially on exertion: Coronary artery disease or heart failure **Orthopnea** (dyspnea when lying flat): Heart failure **Paroxysmal nocturnal dyspnea** (sudden nighttime breathlessness): Heart failure Cough with frothy sputum: Pulmonary edema associated with heart failure
Neurological	Altered mental status, confusion, or disorientation: Hypoxia from CVD Weakness or paralysis on one side of the body, difficulty speaking or slurred speech: Stroke or cerebral aneurysm Numbness and tingling (peripheral vascular disease)
Renal	Decreased urine output: Heart failure
Gastrointestinal	**Ascites** (abdominal distention): Right-sided heart failure Hepatomegaly and Splenomegaly: Right-sided heart failure
Integumentary	Thickened nails: Impaired oxygen delivery from peripheral vascular disease Pale, cool extremities: Peripheral vascular disease Hair loss on the lower extremities: Peripheral vascular disease Nonhealing wounds or ulcers on the lower extremities: Peripheral vascular disease Venous staining: Peripheral vascular disease

Focused Cardiovascular System Assessment

A focused cardiovascular assessment involves assessment of the **precordium** (area over the heart) to identify signs of potential abnormalities, as well as peripheral assessments.

PRECORDIUM ASSESSMENT

Assessment of the precordium involves inspection, palpation, and auscultation of heart tones.[19]

Inspection

- Chest Configuration: View the chest configuration for any abnormalities, such as **pectus excavatum** (depression of the chest) or **pectus carinatum** (protrusion of the chest).
- Pulsations: Observe any abnormal pulsations or heaves (visible or palpable movements of the chest wall) in the precordial area, which could be indicative of cardiac hypertrophy.

Palpation

- Apical Impulse: Palpate for the **point of maximal impulse (PMI)**, which is the location where the apex of the heart touches the chest wall. It is usually found in the fifth intercostal space at or just medial to the midclavicular line. Note the size, location, and amplitude of the PMI.
- Thrills: Use the palm of your hand to palpate for **thrills** (vibratory sensations) over the precordium, particularly in areas where murmurs are suspected.

Auscultation

- Follow a systematic pattern when auscultating heart sounds. See Figure 5.18[20] for an illustration of thoracic landmarks for auscultation. The traditional order is as follows:

19. Meyer, T. E. (2022). Auscultation of heart sound. *UpToDate*. https://www.uptodate.com/

20. "Cardiac Auscultation Areas" by Meredith Pomietlo for Chippewa Valley Technical College is licensed under CC BY 4.0

    - Aortic area: Second right intercostal space
    - Pulmonic area: Second left intercostal space
    - Erb's point: Third left intercostal space
    - Tricuspid area: Fourth left intercostal space at the lower left sternal border
    - Mitral area (also referred to as "apical"): Fifth left intercostal space at the midclavicular line
- In each of these areas, listen for the normal heart sounds (S1 and S2). **S1** is the first heart sound, often described as "lub," and corresponds to the closure of the atrioventricular valves (mitral and tricuspid valves). **S2** is the second heart sound, described as "dub," and corresponds to the closure of the semilunar valves (aortic and pulmonic valves). S2 may occur during inspiration, which is considered a normal variation.
- Listen for additional heart sounds, such as S3, S4 murmurs, and pericardial friction rub:
    - **S3** (also known as a ventricular gallop) is a low frequency heart sound heard shortly after the second heart sound and preceding the normal first heart sound.
    - **S4** (also known as an atrial gallop) is heard late in the cardiac cycle, just before the first heart sound.
    - **Murmurs** are whooshing or swishing sounds made by rapid, choppy (turbulent) blood flow through the heart that may indicate valvular heart abnormalities. Note the timing, intensity, and location of any murmurs.
    - **Pericardial friction rub** is a high-pitched, scratchy sound that occurs when the inflamed pericardial layers rub against each other. It is typically heard in clients with pericarditis.

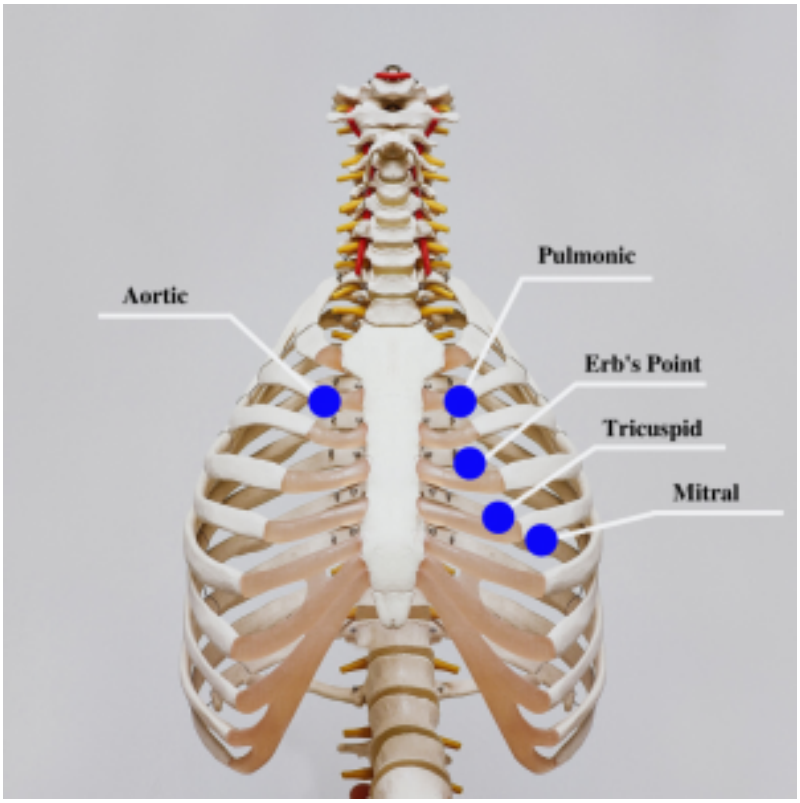


Figure 5.18 Cardiac Auscultation Areas

PERIPHERAL ASSESSMENT

Edema

Edema occurs as a result of a buildup of fluid within the tissues. If edema is present on inspection, palpate the area to determine if the edema is pitting or nonpitting. Press on the skin to assess for indentation, ideally over a bony structure, such as the tibia. If no indentation occurs, it is referred to as nonpitting edema. If indentation occurs, it is referred to as pitting edema.

Note the depth of the indention and how long it takes for the skin to rebound back to its original position. The indentation and time required to rebound to the original position are graded on a scale from 1 to 4. Edema rated at 1+ indicates a barely detectable depression with immediate rebound, and 4+ indicates a deep depression with a time lapse of over 20 seconds

required to rebound. See Figure 5.19[21] for an illustration of grading edema. Additionally, it is helpful to note edema may be difficult to observe in larger clients. It is also important to monitor for sudden changes in weight, which is considered a probable sign of fluid volume overload.

Grade 1	**0–2 mm indentation; rebounds immediately.**
Grade 2	**3–4 mm indentation; rebounds in < 15 seconds.**
Grade 3	**5–6 mm indentation; up to 30 seconds to rebound.**
Grade 4	**8 mm indentation; > 20 seconds to rebound.**

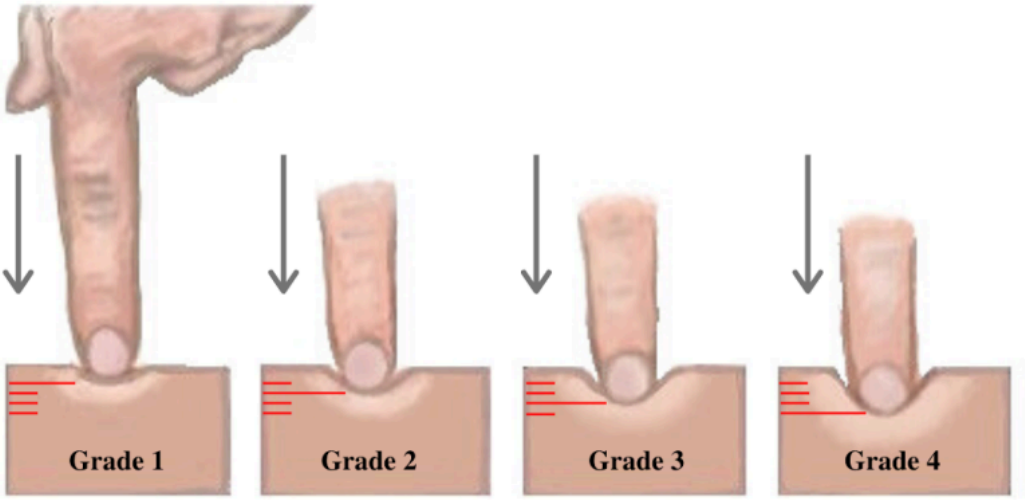


Figure 5.19 Assessing Edema

Capillary Refill

The **capillary refill test** is performed on the nail beds to monitor perfusion, the amount of blood flow to tissue. Pressure is applied to a fingernail or

21. "Grading of Edema" by Meredith Pomietlo for Chippewa Valley Technical College is licensed under CC BY 4.0

toenail until it pales, indicating that the blood has been forced from the tissue under the nail. This paleness is called blanching. Once the tissue has blanched, pressure is removed. Capillary refill time is defined as the time it takes for the color to return after pressure is removed. If there is sufficient blood flow to the area, a pink color should return within two to three seconds after the pressure is removed.

> Read additional information about performing a focused cardiovascular assessment in the "Cardiovascular Assessment" chapter in Open RN *Nursing Skills, 2e*.

Life Span Considerations

Nurses consider characteristics of the pediatric clients and older adults during assessment.[22,23]

PEDIATRIC CONSIDERATIONS

- Many profound changes occur in a newborn's cardiovascular anatomy and physiology over the first few days and weeks following birth. It is important to distinguish normal fetal to newborn cardiovascular change

22. Queensland Pediatric Emergency Care. (2022). *How children are different – Anatomical and physiological differences*. https://www.childrens.health.qld.gov.au/__data/assets/pdf_file/0031/179725/how-children-are-different-anatomical-and-physiological-differences.pdf

23. Saikia, D., & Mahanta, B. (2019). Cardiovascular and respiratory physiology in children. *Indian Journal of Anaesthesia, 63*(9), 690–697. https://doi.org/10.4103/ija.IJA_490_19.

and signs of abnormality such as congenital heart defects.
- Newborns have incomplete sympathetic innervation and experience greater vulnerability to environmental and physiological influences without the ability to compensate.
- Infants have higher heart rates and lower blood pressures than adults.
- A small volume of blood loss in small children can be significant. For example, 100 mL of blood loss in an infant weighing 5 kg is 10% of their total blood volume.
- Establishing IV access in infants and children can be challenging due to their small veins and increased subcutaneous tissue.

OLDER ADULT CONSIDERATIONS

- Cardiac valves (especially the mitral and aortic valves) often calcify in older adults, impacting their functionality and resulting in murmurs.
- Pacemaker cells decrease in number, increasing the risk of dysrhythmias.
- Increased fibrous tissue and fat in the SA node can impact the conduction of electrical impulses to the atria.
- Increased conduction time occurs (i.e., the amount of time for an electrical impulse to travel through the SA node, atria, the AV node, the bundle of His, the Purkinje fibers, and ventricles).
- The left ventricle increases in size, impacting the quantity of blood and strength of the contractions.
- Decreased sensitivity of baroreceptors and arteriosclerosis can cause orthostatic hypotension.
- Limited fluid intake (due to prescribed fluid restrictions, an attempt to manage incontinence, or decreased mobility in obtaining and drinking fluids) creates viscous blood and increases the risk for developing thrombi.
- Varicosities may develop due to the loss of elasticity of the veins, weaker leg muscles, and muscle atrophy from less exercise.

Laboratory and Diagnostic Testing

Laboratory and diagnostic testing are ordered by health care providers to identify and diagnose cardiovascular conditions.

LABORATORY STUDIES

Several key laboratory values that play a vital role in cardiovascular assessment include troponins, CK (creatine kinase), myoglobin, lipids (total cholesterol, triglycerides, HDL, and LDL), CRP (C-reactive protein), B-type natriuretic peptide, electrolytes, coagulation studies, and thyroid studies. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

- **Troponins:** Troponins are myocardial muscle proteins released into the bloodstream with injury to myocardial muscle. Elevated troponin levels indicate cardiac necrosis or an acute myocardial infarction (MI). Troponin T and I are highly specific to cardiac tissue, making them essential markers for diagnosing cardiac events.[24]
- **CK (creatine kinase) and CK-MB:** CK is an enzyme specific to cells of the brain, myocardium, and skeletal muscle. CK-MB is primarily found in myocardial muscle. CK-MB levels show a predictable rise and fall during three days, with a peak level occurring around 24 hours after the onset of chest pain. Monitoring CK and CK-MB aids in the diagnosis and assessment of MI.[25]
- **Myoglobin:** Myoglobin is a low-molecular-weight heme protein found in cardiac and skeletal muscle. It is the earliest marker detected after an MI, appearing as early as two hours after the event and declining rapidly after

24. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

25. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

seven hours. However, myoglobin is not cardiac specific, making it less reliable than troponins for MI diagnosis.[26]

- **B-type natriuretic peptide (BNP):** BNP is a protein that is released by the heart, primarily in response to increased pressure or stress on the heart muscle. This protein plays a crucial role in regulating blood volume and blood pressure. Elevated levels of BNP in the blood can be indicative of heart failure.[27]
- **Lipids:** Lipid panel laboratory tests include the examination of high-density lipoproteins (HDL), low-density lipoproteins (LDL), and triglycerides. Total cholesterol is a combined measurement of the HDL and LDL numbers. Lipid profile assessments are crucial for identifying cardiovascular risk factors. Elevated total cholesterol, triglycerides, and LDL levels are associated with atherosclerosis and an increased risk of coronary artery disease (CAD). Conversely, higher levels of HDL are considered protective against CAD.[28]
- **CRP (C-reactive protein):** CRP is the most studied marker of inflammation. Elevated CRP levels can result from any inflammatory process in the body. While not specific to cardiovascular assessment, measuring CRP is valuable for assessing cardiovascular risk, especially in middle-aged or older individuals. Higher CRP levels may indicate an increased risk of cardiovascular events.[29]
- **Electrolytes:** Many electrolyte imbalances can affect the heart's electrical

26. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

27. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

28. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

29. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

activity and muscle function[30]:

- **Sodium (Na+):** Sodium is the most common electrolyte in extracellular fluid and plays a crucial role in regulating blood pressure, maintaining fluid balance, and transmitting nerve impulses. Elevated sodium levels can cause high blood pressure and edema.
- **Potassium (K+):** Potassium is the most common electrolyte inside cells and is essential for normal muscle and nerve function, including heart rhythm. Abnormal potassium levels can result in arrhythmias and muscle weakness and can be caused by kidney disease and certain medications.
- **Calcium (Ca2+):** Calcium is essential for muscle contraction, blood clotting, and bone health. It is tightly regulated by hormones such as the parathyroid hormone and calcitonin. Abnormal calcium levels can affect muscle and nerve function and bone health.
- **Magnesium (Mg2+):** Magnesium is involved in numerous biochemical processes, including muscle and nerve function, energy metabolism, and bone health. Abnormal magnesium levels can lead to muscle cramps, irregular heart rhythms, and other issues.

- **Coagulation studies:** Coagulation studies assess the blood's ability to clot and include prothrombin time (PT), international normalized ratio (INR), and activated partial thromboplastin time (aPTT). Abnormal results can indicate a risk of clot formation or bleeding.
  - **Prothrombin time (PT):** PT measures the time it takes for blood to clot after a substance called thromboplastin is added to a blood sample. It primarily evaluates the extrinsic and common coagulation pathways. PT is often used to monitor the effect of anticoagulant medications like warfarin and to diagnose bleeding disorders.
  - **International normalized ratio (INR):** INR is a standardized measurement derived from the PT. It is used to ensure consistency in

30. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

PT results between different laboratories. INR is particularly important for individuals on anticoagulant therapy (e.g., warfarin) to monitor and maintain their blood's clotting ability within a target range.

- **Activated partial thromboplastin time (aPTT):** aPTT measures the time it takes for blood to clot after a substance that activates the intrinsic and common coagulation pathways is added to a blood sample. It is used to assess factors involved in the clotting cascade, including factors VIII, IX, XI, and XII. aPTT is used to diagnose and monitor conditions like hemophilia and to evaluate the effects of anticoagulant medications such as heparin.
- **Thrombin time (TT):** TT measures the time it takes for fibrinogen to convert into fibrin. It primarily assesses the final step of the clotting process. TT may be used to evaluate specific clotting disorders and fibrinogen abnormalities.
- **D-dimer:** D-dimer is a marker for the presence of blood clots, specifically the breakdown products of fibrin that result from the dissolution of a blood clot. Elevated levels of D-dimer may suggest the presence of an active blood clotting process in the body. D-dimer tests are often used in the diagnosis of conditions like deep vein thrombosis (DVT), pulmonary embolism (PE), and disseminated intravascular coagulation (DIC).[31]

- **Thyroid function tests:** Thyroid hormones help regulate heart rate and cardiac output. Hypothyroidism can lead to **bradycardia** (slower heart rate), increased cholesterol levels, and increased risk of atherosclerosis, which can contribute to cardiovascular disease. Conversely, hyperthyroidism can cause **tachycardia** (rapid heart rate) and increased cardiac output, potentially leading to conditions like atrial fibrillation or heart failure. Thyroid hormones also play an important role in regulating the sensitivity of the heart to adrenaline (epinephrine) and

31. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

norepinephrine, which are hormones that influence heart rate and contractility. Abnormal levels of T4 and T3 can disrupt these processes and affect heart function.[32]

DIAGNOSTIC TESTING

Providers who suspect a cardiac disorder may initially order a chest X-ray to assess the size of cardiac structures and to check for fluid in the lungs. Other common diagnostic tests related to the cardiovascular system include electrocardiograms (ECG), Holter monitors, echocardiograms, cardiac stress tests, and cardiac catheterization.

Electrocardiogram

An **electrocardiogram (EKG or ECG)** is an important diagnostic tool to help identify cardiac abnormalities. See Figure 5.20[33] for an image of a client undergoing an ECG and Figure 5.21[34] for an image of a normal ECG strip showing normal sinus rhythm. ECG records the electrical activity of the heart and allows health care professionals to assess the heart's rhythm and identify various cardiac conduction abnormalities called dysrhythmias or arrhythmias. Cardiac dysrhythmias can range from asymptomatic conditions to life-threatening events that impair the delivery of oxygenated blood to tissues and organs. See Table 5.3b for a summary of common dysrhythmias. An ECG is also a critical tool for diagnosing **myocardial ischemia** (i.e., a "heart attack"). Specific changes in an ECG tracing can reflect elevation or depression of the

32. Mayo Clinic. (2023). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357

33. "ambulance-emergency-medic-health-vehicle-rescue.jpg" by unknown author, via pxfuel.com is licensed under CC0

34. "Normal Sinus Rhythm" by Deanna Hoyord is licensed under CC BY 4.0

ST segment, allowing a provider to identify where potential ischemia or infarction of cardiac tissue may be occurring within the heart.[35]

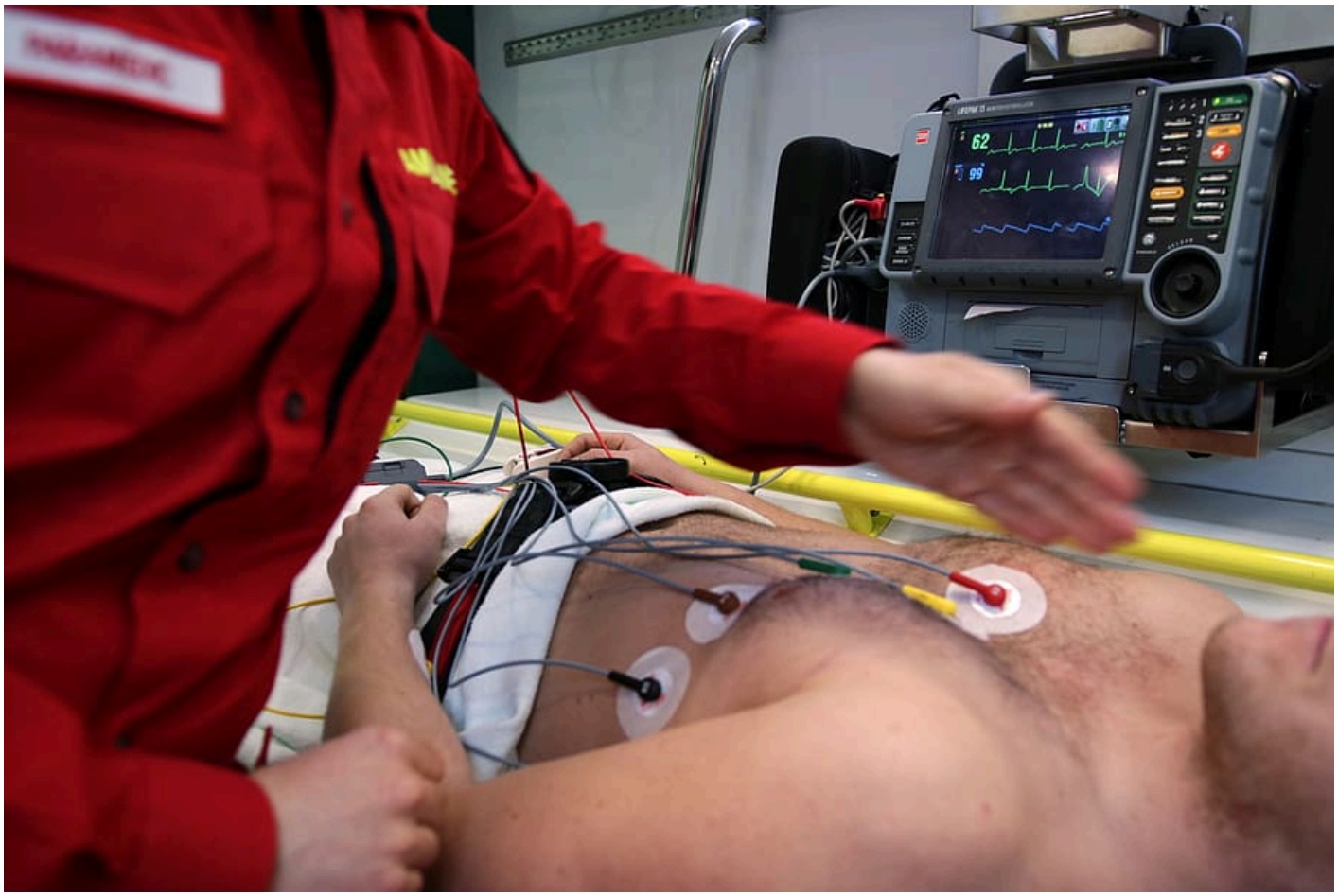


Figure 5.20 ECG

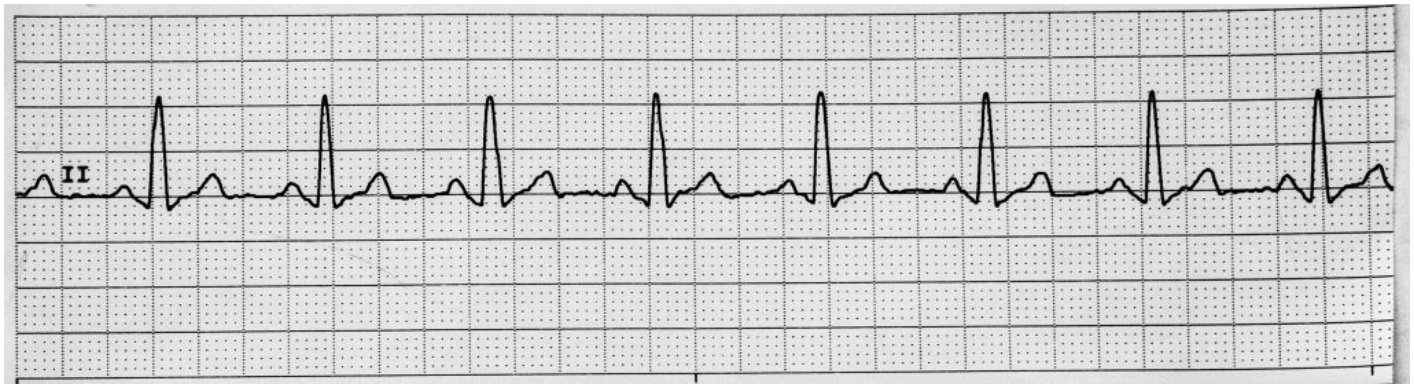


Figure 5.21 Normal ECG

35. Prutkin, J. M. (2023). ECG tutorial: Basic principles of ECG analysis. *UpToDate*. https://www.uptodate.com/

Nurses must recognize abnormal ECG rhythms requiring prompt intervention. View images of ECGs for Abnormal Rhythms in *Nursing Advanced Skills,* Chapter 7 Appendix.

Table 5.3b. Common Cardiac Arrhythmias

Cardiac Rhythm	Rate	Significance
Normal Sinus Rhythm	60-100 beats per minute (bpm)	Healthy, regular heart rhythm.
Sinus Bradycardia	Fewer than 60 bpm in adults	May be normal for well-conditioned athlete, a side effect of medications, or a symp medical conditions. May require a pacemaker if the client is symptomatic.
Sinus Tachycardia	Greater than 100 bpm in adults	May be caused by fever, stress, pain, or hypoxia or a symptom of various medical co sinus tachycardia is a normal finding during strenuous physical activity.
Atrial Fibrillation (A-Fib)	Irregularly irregular rhythm and rate	Characterized by atrial quivering that can cause decreased cardiac output because not able to fill and pump the appropriate amount of blood with each beat. A-fib inc stroke. May require a pacemaker. A-fib is a common cardiac arrhythmia with aging
Atrial Flutter	Regular rate	Atrial impulses are fast and regular, with rates between 250-300, and the ventricula same as the atrial rate. As a result, the client's cardiac output decreases.
Ventricular Tachycardia (VT or V-tach)	Greater than 100 beats per minute	The ventricular rate is often over 120 beats per minute, resulting in rapidly worsenin The client may only be able to tolerate this rapid ventricular rhythm for a short peri losing consciousness. V-tach requires emergency response.
Ventricular Fibrillation (VF)	No heart rate	Characterized by quivering ventricles with no effective contractions and no cardiac most dangerous arrhythmia because of lack of cardiac output and requires immed and emergency response.
First-Degree Heart Block	Variable	Characterized by a prolonged interval between atrial and ventricular contraction. C early sign of degeneration that can progress to more severe blocks.
Second-Degree Heart Block	Variable	Characterized by dropped ventricular beats that can result in decreased cardiac ou pacemaker if symptomatic.
Third-Degree Heart Block	Variable	Characterized by a complete electrical dissociation between the atria and ventricle pacemaker to help maintain adequate cardiac output.

Read additional information about abnormal heart rhythms and view ECG strips in the "Interpret Basic ECG" chapter in Open RN *Nursing Advanced Skills*.

Pacemakers

Pacemakers may be inserted in clients to restore normal cardiac conduction and minimize the impact of arrythmias on cardiac output. Pacemakers send electrical impulses to mimic the coordinated actions of the sinus to AV node conduction, restoring efficiency and synchronization to the contraction and relaxation of the heart tissue. Pacemakers are a relatively small battery-powered device that has leads connected to heart tissue. The device can sense the inherent electrical impulses of the heart tissue and override them when needed. The pacemaker includes a generator, a battery, and a small computer to regulate the heart impulses. The pacemaker leads include insulated wires that can be placed inside or onto the cardiac tissue. Pacemakers may be temporary or permanent, depending on the underlying cause of the cardiac arrythmia.

- **Transvenous pacemakers** are inserted through a vein and threaded into the heart. The generator is commonly placed in a small pectoral pocket in the upper chest.
- **Epicardial pacemakers** are inserted through an incision in the chest and the leads are attached to the heart. The pacemaker is inserted into a pocket in the skin of the abdomen.

A cardiac provider will determine the type of pacemaker that is required and the settings that will restore appropriate cardiac function to the client. A single chamber pacemaker sends impulses to the right ventricle, whereas a dual-chamber pacemaker can send signals to the upper and lower right heart chambers. Biventricular pacemakers stimulate both lower

ventricles of the heart and are used in situations of advanced heart failure.

People who have a permanent pacemaker will require periodic monitoring. The status of the pacemaker will be regularly checked or "interrogated" (often done remotely using a telephone or a secure web-based system) to provide information regarding the heart rhythm, the functioning of the pacemaker leads/generator, the electrical activity initiated by the pacemaker, or inherent to the heart, the battery life and the presence of any abnormal heart rhythms. Individuals with implantable pacemakers should be cautioned regarding the use of magnetic devices directly over the device and should never undergo MRI imaging.[36]

Holter Monitors

Holter monitors are portable devices that continuously record a client's heart rhythm and electrical activity over an extended period, typically 24 to 48 hours. See Figure 5.22[37] for an illustration of a Holter monitor. Its primary purpose is to detect and document irregularities in the heart's electrical patterns, such as arrhythmias, which may not be captured during brief in-office ECGs. Additionally, clients may activate a trigger on a Holter device to denote the occurrence of cardiac symptoms, such as increased shortness of breath, fatigue, or dizziness. A cardiologist can then review the symptom

36. Olshansky, B. (2022). Patient education: Pacemakers (Beyond the basics). *UpToDate*. https://www.uptodate.com/contents/pacemakers-beyond-the-basics

37. "Holter_Monitor.png" by BruceBlaus is licensed under CC BY-SA 4.0

timestamp and accompanying EGC tracing to identify if an arrhythmia occurred at that time.[38]

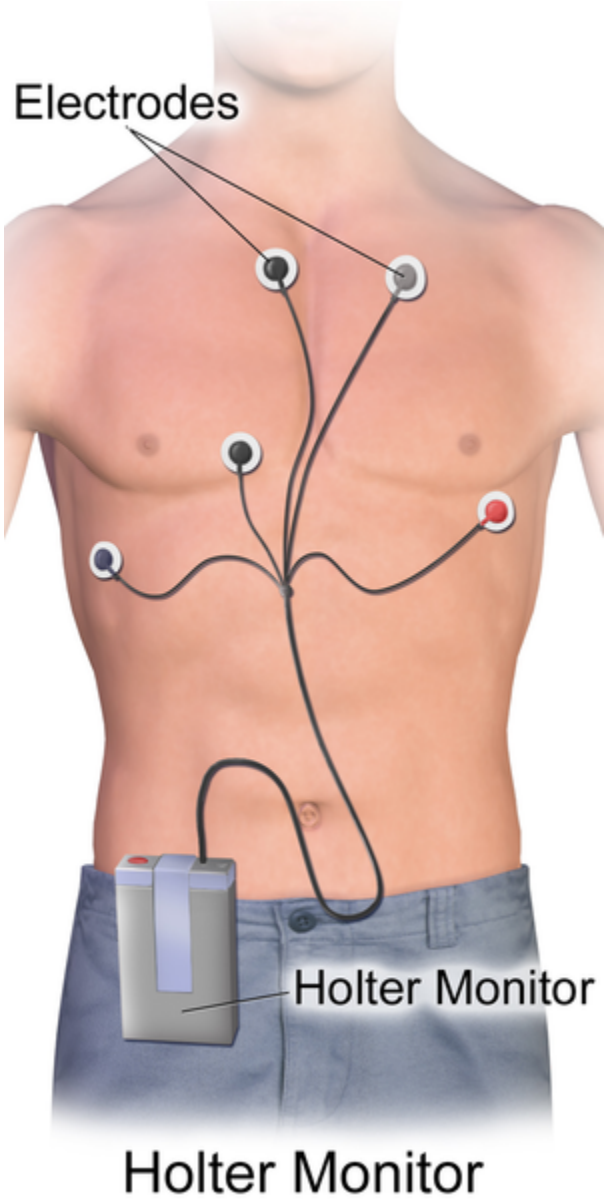


Figure 5.22 Holter Monitor

By providing a thorough real-time analysis of a client's heart rate and rhythm during their daily activities, the results of a Holter monitor help health care

38. Madias, C. (2022). Ambulatory ECG monitoring. *UpToDate*. https://www.uptodate.com/

professionals identify and diagnose a variety of cardiac conditions, including atrial fibrillation, ventricular tachycardias, bradycardias, and heart blocks.

Echocardiogram

A **transthoracic echocardiogram** is a noninvasive diagnostic test that uses sound waves (ultrasound) to create real-time images of the heart's structure and function. See Figure 5.23[39] for an image of a pediatric client undergoing a transthoracic echocardiogram. A trained sonographer or cardiologist applies a gel and a transducer to the client's chest. The transducer is moved to different areas of the chest to obtain various views of the heart, including the heart chambers, valves, walls, and blood flow patterns. Doppler ultrasound is also commonly used during **echocardiography** to determine the speed and direction of blood flow through the valves and chambers of the heart.

A **transesophageal echocardiogram (TEE)** is similar to transthoracic although it is invasive in nature. The provider may order a transesophageal echocardiogram to gain a more detailed view of the heart and aorta. To perform a transesophageal echocardiogram, a probe and ultrasound wand are guided down the esophagus and close to the position of the heart, and the ultrasound is performed. Conscious sedation is administered to enhance client comfort. Both diagnostic tools are very helpful for identifying heart failure, valvular regurgitation, and stenosis.[40,41]

39. "5619843496" by Jeremy Miles is licensed under CC BY-SA 2.0

40. Johns Hopkins Medicine. (n.d.). *Echocardiogram.* https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/echocardiogram

41. Mayo Clinic. (2024). *Echocardiogram.* https://www.mayoclinic.org/tests-procedures/echocardiogram/about/pac-20393856



Figure 5.23 Transthoracic Echocardiography

A key measurement during an echocardiogram is the client's ejection fraction. Ejection fraction measures the amount of blood the left ventricle of the heart pumps out to the body with each heartbeat. For example, an ejection fraction of 60 percent means that 60 percent of the total amount of blood in the left ventricle is pushed out with each heartbeat. A normal heart's ejection fraction is between 55 and 70 percent. The ejection fraction is used to diagnose and monitor heart failure.

Cardiac Stress Test

A **cardiac stress test** (also known as an exercise stress test or treadmill test) is a diagnostic procedure used to evaluate the performance and function of the heart during physical activity. It helps identify potential heart problems, such as coronary artery disease (CAD), arrhythmias, and heart valve issues. During a cardiac stress test procedure, a client is asked to walk on a treadmill or pedal a

stationary bicycle with the exercise requirement gradually increasing over time. See Figure 5.24[42] for an image of a cardiac stress test.



Figure 5.24 Cardiac Stress Testing

During the procedure, client symptoms are monitored for occurrence of chest pain, shortness of breath, fatigue, and dizziness. The client's ECG is also closely monitored to detect any changes in heart's electrical activity during exercise. The test is terminated when the client has achieved a target heart rate, if symptoms of discomfort occur, if the client's experiences significant ECG changes, or if the maximum duration of exercise has occurred. Cardiac stress tests may also be performed with the administration of medications such as dobutamine or adenosine for individuals who are unable to tolerate exercise-

42. "a-cardiologist-examining-a-patient-undergoing-cardiac-stress-test" by Los Muertos Crew, via Pexels.com is licensed under CC0

induced stress testing. The medications can simulate the workload that would typically occur during physical exercise.[43]

Cardiac Catheterization

Cardiac catheterization is a valuable diagnostic procedure in the evaluation and management of cardiovascular health alterations. **Cardiac catheterization**, performed in association with a **coronary angiogram**, is a diagnostic procedure used to visualize the coronary arteries, heart chambers, and great vessels. It involves the insertion of a thin, flexible tube (catheter) into the blood vessels, usually through the femoral or radial artery, to access the heart and its surrounding structures.[44,45] See Figure 5.25[46] for an image of a cardiac catheterization procedure with the image of the client's coronary arteries and heart chambers displayed on the monitor.

43. Askew, J. W., Chareonthaitawee, P., & Arruda-Olsen, A. M. (2022). Selecting the optimal cardiac stress test. *UpToDate*. https://www.uptodate.com/

44. Kern, M. J. (2022). Cardiac catheterization techniques: Normal hemodynamics. *UpToDate*. https://www.uptodate.com/

45. Velagapudi, P. (2022). Preparing patients for cardiac catheterization and possible coronary artery intervention. *UpToDate*. https://www.uptodate.com/

46. "A_cardiac_catheterization_procedure_in_the_Naval_Medical_Center_San_Diego_hospital's_cardiac_catheterization_laboratory.jpg" by Navy Medicine is licensed in the Public Domain.



Figure 5.25 Cardiac Catheterization

Providers order cardiac catheterization for many diagnostic purposes, such as the following:

- **Assessment of Coronary Artery Disease (CAD):** Identifies blocked or narrowed coronary arteries, guiding decisions about interventions such as **angioplasty** (use of a balloon to stretch open a blocked artery) or **stent** (insertion of a small mesh tube to help expand an artery) placement.
- **Evaluation of Valvular Heart Disease:** Measures pressure gradients across heart valves and assesses valve function.
- **Investigation of Congenital Heart Abnormalities:** Assesses structural abnormalities of the heart and great vessels in pediatric and adult clients.
- **Measurement of Cardiac Function:** Directly measures cardiac output, ejection fraction, and other important parameters of cardiac function.

See the following box regarding nursing interventions to prepare a client for cardiac catheterization.

Client Preparation for Cardiac Catheterization[47]

Before a cardiac catheterization procedure, thorough client preparation is needed. This involves collaboration from the nurse and health care team to ensure that all client safety procedural tasks have been addressed.

Informed Consent: The nurse ensures signed informed consent has been obtained and the client understands the procedure, its risks, and alternatives. Concerns are forwarded to the physician before the procedure begins.

Baseline Vital Signs: Baseline vital signs, including blood pressure, heart rate, respiratory rate, and temperature are documented. Monitoring trends in these parameters during the procedure is vital for detecting potential complications.

History/Allergy Assessment: A detailed history, including any known allergies, particularly iodine allergies or previous adverse reactions to contrast agents, is obtained. It is crucial to notify the health care team of a history of iodine or iodinated contrast media allergy because contrast agents are commonly used during cardiac catheterization. Allergic reactions can range from mild rashes to severe anaphylactic reactions. Clients with known allergies may require alternative contrast media or premedication to reduce the risk of an allergic response. The

47. Velagapudi, P. (2022). Preparing patients for cardiac catheterization and possible coronary artery intervention. *UpToDate*. https://www.uptodate.com/

client's renal function should also be assessed because contrast dye can impact renal function.

NPO Status: The client must remain NPO (nothing by mouth) for a specified period before the procedure (usually 6-8 hours), as dictated by agency guidelines.

Medication Management: The client's current medications should be reviewed for anticoagulants and antiplatelet agents that pose bleeding risks.

IV Access: Intravenous (IV) access is established for administering medications, contrast, and fluids during the procedure, which may be obtained via peripheral and/or central access.

Groin Prep: The groin area is prepared because the femoral artery is often used as the access point for inserting catheters. Prep involves shaving or clipping hair according to agency guidelines and cleansing the area with an antiseptic solution, such as chlorhexidine. If a radial approach is used, cleansing of the wrist and radial artery site with antiseptic is sufficient.

Health Teaching and Support: Health teaching is provided, including what to expect during and after the procedure. Emotional support is provided because many clients experience anxiety related to this invasive procedure.

During cardiac catheterization, a catheter is inserted through the access site and advanced through the blood vessels until it reaches the coronary arteries or the heart chambers. Contrast dye is injected through the catheter, and X-ray imaging is used to visualize the coronary arteries and identify areas of narrowing or blockage. Measurements of pressures and blood oxygen saturations within the heart may be taken to identify abnormalities in valve function. If areas of blockage or narrowing are noted within the coronary arteries, an angioplasty may be performed where a balloon is inflated to help open the coronary artery. After the balloon is inflated, a stent is often inserted

to help keep the coronary artery open. After the procedure has been completed, the catheter is removed, and pressure is applied to the access site until bleeding stops.[48] Clients will receive instruction to minimize movement and pressure to the catheter insertion site for a specified period. The site should be closely monitored for recurrent bleeding and pressure should be immediately applied to the insertion site if bleeding recurs. Urinary output is also closely monitored to ensure the contrast dye has not impeded renal function. Additional post-procedure education should include assessing for infection, reporting any signs of chest discomfort, knowing the guidelines for activity progression, etc.

See the following box for a case study related to a cardiac catheterization procedure.

Cardiac Catheterization Case Study

Michael is a 58-year-old man who has been experiencing recurrent episodes of chest pain and shortness of breath. His medical history includes hypertension, hyperlipidemia, and a family history of coronary artery disease (CAD). After a thorough evaluation, it has been determined that a coronary angiography (heart catheterization) is necessary to assess the extent of his coronary artery disease.

1. What are the key steps and considerations in preparing Michael for a coronary angiography procedure?

Medical history, allergies, current medications, renal function, baseline vitals/assessment, client comfort, IV access.

48. Kern, M. J. (2022). Cardiac catheterization techniques: Normal hemodynamics. *UpToDate*. https://www.uptodate.com/

2. How can health care providers ensure that Michael provides informed consent for the coronary angiography procedure?

Provide verbal instruction/written materials or brochures explaining coronary angiography, its purpose, benefits, risks, alternate procedures, and expectations before, during, and after the procedure.

3. Following the coronary angiography, what immediate post-procedure monitoring should be in place for Michael?

Vital signs monitoring, cardiac monitoring, access site monitoring, fluid balance, urine output.

5.4 Common Cardiovascular Disorders

Common cardiovascular disorders include arteriosclerosis and atherosclerosis, hypertension, coronary artery disease, heart failure, peripheral arterial disease, aneurysm, infective endocarditis, and deep vein thrombosis. Each of these conditions will be discussed in more detail in the following sections.

5.5 Hypertension

Overview

Normal blood pressure is defined as less than 120/80 mm Hg in adults. **Hypertension** refers to chronically elevated blood pressure greater than 120/80 mm Hg. Hypertension is very common, affecting millions of individuals worldwide. See Figure 5.26[1] for an image of a health care professional obtaining a blood pressure reading.



Figure 5.26 Blood Pressure Measurement

There are several classifications of blood pressure based on the systolic and

1. "Monthly check up" by Bryan Mason is licensed under CC BY 2.0

diastolic readings. See Table 5.5 for classifications of hypertension according to the American Heart Association.[2]

Table 5.5. Blood Pressure Classifications[3]

Blood Pressure Classification	Systolic (mm Hg)	Diastolic (mm Hg)
Normal	Less than 120	Less than 80
Elevated (Prehypertension)	120-129	Less than 80
Hypertension Stage 1	130-139	80-89
Hypertension Stage 2	140 or higher	90 or higher
Hypertensive Crisis	Higher than 180	Higher than 120

Causes of Hypertension

Hypertension can be due to a primary cause or as a secondary cause. **Primary hypertension** is the most common type of hypertension and has no identifiable cause. It typically develops gradually over time and is influenced by various risk factors such as genetics, age, race, diet, lifestyle, and stress.

Secondary hypertension is the result of an underlying medical condition or medication. Conditions such as kidney disease, hormonal disorders, or the use of medications such as nonsteroidal anti-inflammatory drugs (NSAIDs), pseudoephedrine or phenylephrine, and estrogen-containing birth control pills can contribute to secondary hypertension. Additionally, medical conditions like diabetes, kidney disease, and sleep apnea can increase one's risk of developing hypertension.

Risk factors for developing hypertension include age, family history, and lifestyle factors. Individuals with obesity, diets high in sodium, excessive alcohol intake, chronic stress, and limited physical activity are at higher risk

2. Basile, J., & Bloch, M. J. (2023). Overview of hypertension in adults. *UpToDate*. https://www.uptodate.com/

3. Basile, J., & Bloch, M. J. (2023). Overview of hypertension in adults. *UpToDate*. https://www.uptodate.com/

for developing hypertension.[4] For this reason, health teaching about lifestyle modifications is essential for nurses to provide to clients experiencing prehypertension or hypertension.

Assessment

Many individuals with hypertension have no symptoms and are unaware of the condition until they have an elevated blood pressure reading collected. If individuals have an elevated blood pressure reading, providers will typically repeat the reading at another appointment before making a diagnosis and beginning treatment. They may ask the individual to collect blood pressures at various dates/times at home or when out in the community and keep a tracking log. Many individuals with hypertension are asymptomatic although some develop symptoms as a result of hypertension, such as a headache, dizziness, or fainting.[5] Untreated hypertension can lead to significant health complications such as myocardial infarction (heart attack), heart failure, cerebrovascular accident (stroke), vision loss, kidney damage.

Diagnostic Testing

Diagnostic testing for hypertension involves recording blood pressures on at least two separate occasions. Blood pressure should be measured in both arms while a client is seated and relaxed. Many providers who suspect hypertension will also evaluate for signs of organ damage as a result of sustained elevated blood pressures. These evaluations may include an echocardiogram to examine for left ventricular hypertrophy (enlargement), fundoscopic examination of retinal blood vessels within the eyes, and kidney function tests to evaluate for elevated levels of serum creatinine or decreased

4. Mann, J., & Flack, J. M. (2023). Choice of drug therapy in primary hypertension. *UpToDate*. https://www.uptodate.com/

5. Basile, J., & Bloch, M. J. (2023). Overview of hypertension in adults. *UpToDate*. https://www.uptodate.com/

glomerular filtration rate (GFR).[6,7] Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

> Read additional information about how to accurately obtain a blood pressure reading in the "Blood Pressure" chapter of Open RN *Nursing Skills, 2e*.

Nursing Diagnoses

Nursing priorities for clients diagnosed with hypertension include managing blood pressure levels, promoting healthy lifestyle modifications, and providing health teaching. Common nursing diagnoses for clients with hypertension are as follows[8]:

- Risk for Decreased Cardiac Output
- Risk for Unstable Blood Pressure
- Readiness for Enhanced Health Self-Management

Outcome Identification

Outcome identification involves setting short- and long-term goals and creating expected outcome statements tailored to the client's specific needs.

6. Basile, J., & Bloch, M. J. (2023). Overview of hypertension in adults. *UpToDate*. https://www.uptodate.com/

7. Mann, J., & Flack, J. M. (2023). Choice of drug therapy in primary hypertension. *UpToDate*. https://www.uptodate.com/

8. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care*. (13th ed.).

These outcomes should be measurable and responsive to nursing interventions.

These are some sample expected outcomes for common nursing diagnoses related to hypertension:

- *The client will demonstrate improved knowledge of hypertension management by verbalizing three lifestyle modifications.*
- *The client will maintain blood pressure within the recommended target range of SBP between 100-119 mm Hg and DBP less than 80 mm Hg.*
- *The client will actively engage in self-monitoring blood pressure and maintain a record of readings to bring to the next appointment.*
- *The client will verbalize three symptoms of reduced tissue perfusion to promptly report to the health care provider.*

Interventions

Medical Interventions

Medical interventions play an important role in managing hypertension. These interventions are important for minimizing impact on other organs and potential complications like heart failure, kidney disease, and vision loss.

LIFESTYLE MODIFICATIONS

Lifestyle changes are often the first step in hypertension management and can be effective in lowering blood pressure. Recommendations may include the following:

- **Dietary Changes:** Reducing sodium intake, following a heart-healthy diet (such as the DASH or Mediterranean diets), and limiting alcohol intake.
- **Regular Physical Activity:** Engaging in regular aerobic exercise, such as brisk walking or swimming, as recommended by a health care provider.
- **Weight Management:** Achieving and maintaining a healthy weight through diet and exercise.
- **Smoking Cessation:** Encouraging smoking cessation and providing

resources when the client is ready to quit.

MEDICATION MANAGEMENT

Antihypertensive medications are prescribed to control blood pressure, especially if lifestyle modifications alone are insufficient. Classes of medications used to treat hypertension include the following[9,10]:

- **Diuretics:** Eliminate excess sodium and fluid, thus reducing blood volume and blood pressure.
- **Beta-Blockers:** Block beta-receptors, causing decreased heart rate and force of heart contractions, thus lowering blood pressure. Select beta-blockers may appear to also cause vasodilation through the alpha-1 receptor blockade.
- **Angiotensin-converting enzyme (ACE) Inhibitors:** Block the conversion of Angiotensin I to Angiotensin II in the renin-angiotensin-aldosterone system, leading to vasodilation and sodium and water excretion, thus lowering blood pressure.
- **Angiotensin II Receptor Blockers (ARBs):** Block the effects of Angiotensin II, a hormone that causes vasoconstriction, thus lowering blood pressure.
- **Calcium Channel Blockers:** Relax blood vessels by blocking calcium, thus causing vasodilation and decreased blood pressure.
- **Alpha-Agonists:** Stimulate alpha-receptors, promoting vasodilation and reducing blood pressure.
- **Direct Vasodilators:** Directly relax vascular smooth muscle, causing vasodilation and reducing blood pressure.

9. Basile, J., & Bloch, M. J. (2023). Overview of hypertension in adults. *UpToDate*. https://www.uptodate.com/

10. Mann, J., & Flack, J. M. (2023). Choice of drug therapy in primary hypertension. *UpToDate*. https://www.uptodate.com/

Read additional information about antihypertensive medications in the "Antihypertensives" section of the "Cardiovascular & Renal Systems" chapter in Open RN *Nursing Pharmacology, 2e*.

Nursing Interventions

Nursing interventions for hypertension management are essential in helping clients maintain healthy blood pressure levels and prevent complications due to damage to other organs such as the heart, kidneys, brain, and eyes.

BLOOD PRESSURE MONITORING

Nurses teach clients how to accurately measure their blood pressure at home and record blood pressure readings in a log. They encourage clients to share home blood pressure logs during follow-up appointments with their health care provider.

MEDICATION MANAGEMENT

Nurses safely administer antihypertensive medications and provide health teaching about their role in blood pressure management, potential side effects, and when to notify the provider. They teach clients about the importance of adhering to their prescribed drug treatment regimen and to consult with their provider before making any changes.

HEALTH TEACHING

Health teaching focuses on empowering clients to make healthy lifestyle changes to maintain normal blood pressure.

LIFESTYLE MODIFICATION

Nurses teach clients about the importance of blood pressure control to prevent damage to other organs. They also teach about recommended dietary changes (such as a low-sodium diet), regular exercise, and smoking cessation to promote heart health.

STRESS MANAGEMENT

Nurses teach relaxation techniques and stress management strategies, such as deep breathing exercises, progressive muscle relaxation, or guided imagery. They promote healthy coping mechanisms and encourage clients to seek counseling if needed.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Hypertension

View a brief YouTube video overview of hypertension[11]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1188#oembed-1

11. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 -Hypertension* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/NSiJp4OjLiA?si=3rwB6IBKQKwvQcy1

5.6 Arteriosclerosis & Atherosclerosis

Overview

Arteriosclerosis and atherosclerosis are interrelated cardiovascular conditions that can significantly impact cardiac health. **Arteriosclerosis** refers to the thickening and stiffening of arterial walls.[1] It is commonly associated with normal aging. The subsequent loss of elasticity of blood vessels makes them less responsive to changes in blood flow and can reduce blood flow to organs and tissues within the body. **Atherosclerosis** is a condition where cholesterol, low-density lipoprotein (LDL) deposits, and wastes build up within the lining of the arteries.[2] This buildup of substances within the vessel walls, often referred to as plaque, creates inflammation and can cause blockage of the artery. Clients who experience arteriosclerosis often will also experience atherosclerosis as plaque accumulates within blood vessels. Conditions such as diabetes often correlate with arteriosclerosis and atherosclerosis as the result of sustained inflammation within the vessels from elevated blood glucose levels. See Figure 5.27[3] for an image of an atherosclerotic plaque resulting from LDL accumulation.

1. Kaski, J. C. (2022). Pathogenesis of atherosclerosis. *UpToDate*. https://www.uptodate.com/

2. Crea, F., Kolodgie, F., Finn, A., & Virmani, R. (2022). Mechanisms of acute coronary syndromes related to atherosclerosis. *UpToDate*. https://www.uptodate.com/

3. "máu nhiễm mỡ – cholesterol" by LÊ VĂN THẢO is licensed under CC BY-SA 2.0

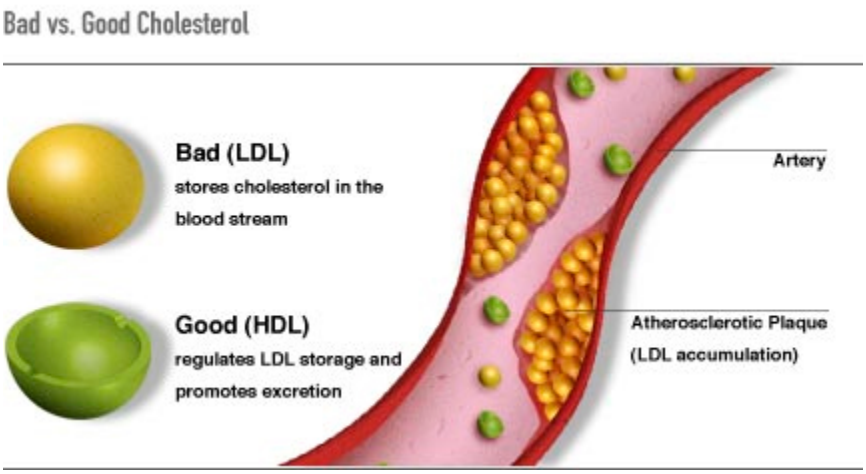


Figure 5.27 Atherosclerotic Plaque in an Artery Caused By LDL

Assessment

Signs and symptoms of arteriosclerosis and atherosclerosis often develop as a result of decreased oxygenation to tissues and organs within the body. The manifestations will vary depending on where the arterial hardening or blockage is located within the body. See Table 5.6 for potential clinical manifestations of arteriosclerosis and atherosclerosis.

Table 5.6. Clinical Manifestations of Arteriosclerosis and Atherosclerosis[4,5]

4. Kaski, J. C. (2022). Pathogenesis of atherosclerosis. *UpToDate*. https://www.uptodate.com/

5. Crea, F., Kolodgie, F., Finn, A., & Virmani, R. (2022). Mechanisms of acute coronary syndromes related to atherosclerosis. *UpToDate*. https://www.uptodate.com/

Body System	Physical Assessment Findings
Cardiovascular	– Hypertension (high blood pressure) – If atherosclerosis develops in a coronary artery, chest pain (angina) associated with coronary artery disease (CAD)
Peripheral Vascular	– Cool extremities – Pallor in extremities – Weak peripheral pulses – Capillary refill time greater than three seconds – Signs of peripheral artery disease (PAD), such as intermittent claudication (leg pain with walking)
Neurological	– Transient ischemic attacks (TIAs) or stroke symptoms if cerebral arteries are affected (e.g., weakness, speech difficulties, visual disturbances, confusion) – Neuropathy in extremities
Renal	– Decreased urine output if renal arteries are affected, causing chronic kidney disease (CKD)
Integumentary	– Cool or pale skin – Delayed wound healing
Ophthalmic	– Vision loss if retinal arteries are affected

Diagnostic Testing

Diagnostic testing for atherosclerosis involves various methods to assess the condition of arteries and determine the extent of plaque buildup and narrowing of the arterial walls. Laboratory tests, such as lipid profile and C-reactive protein are related to the buildup of cholesterol or inflammation within the arteries respectively. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges." Additional diagnostic testing that may be performed include carotid ultrasound to examine blood flow within the carotid arteries. Coronary angiography and coronary CT angiography (CTA) may be ordered to visualize strictures and buildup of plaques within the coronary arteries.[6]

Nursing Diagnoses

Nursing diagnoses for clients with atherosclerosis focus on identifying

6. Crea, F., Kolodgie, F., Finn, A., & Virmani, R. (2022). Mechanisms of acute coronary syndromes related to atherosclerosis. *UpToDate*. https://www.uptodate.com/

abnormalities and preventing complications associated with these conditions. Common nursing diagnoses include the following[7]:

- Risk for Impaired Tissue Integrity
- Readiness for Enhanced Health Self-Management

Outcome Identification

Outcome identification involves setting short- and long-term goals and creating expected outcome statements tailored to the client's specific needs. These outcomes should be measurable and responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to atherosclerosis are as follows:

- *The client will exhibit adequate tissue perfusion, as evidenced by vital signs within normal range, warm extremities, and capillary refill less than two to three seconds.*
- *The client will verbalize three lifestyle modifications to reduce the risk of plaque buildup.*
- *The client will verbalize when to notify the health care provider of new symptoms related to worsening atherosclerosis.*

Interventions

Medical Interventions

Medical interventions for arteriosclerosis and atherosclerosis aim to improve blood flow through the affected arteries and reduce the risk of complications related to insufficient arterial blood flow to other organs. Interventions include lifestyle modifications, medication therapy, and surgical procedures.

7. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.).

LIFESTYLE MODIFICATIONS

Recommended lifestyle medications include the following:

- **Dietary Changes:** Adopting a heart-healthy diet that is low in saturated fats, cholesterol, and sodium can help reduce plaque buildup and lower blood pressure.
- **Regular Physical Activity:** Engaging in regular physical activity can improve cardiovascular health, reduce cholesterol levels, and enhance overall circulation.
- **Smoking Cessation:** Quitting smoking is crucial, as smoking is a major risk factor for atherosclerosis and arterial disease.
- **Weight Management:** Achieving and maintaining a healthy weight can help improve blood pressure and reduce the workload on the heart.
- **Blood Sugar Management:** Tight control of blood sugars in clients with diabetes diminishes the progression of arteriosclerosis and atherosclerosis.

MEDICATION THERAPY

Several classes of medications may be prescribed to manage atherosclerosis and arteriosclerosis:

- **Antilipemics:** Lower LDL cholesterol levels and reduce the risk of plaque buildup.
- **Antihypertensives:** Control high blood pressure and reduce strain on the arteries; vasodilators relax blood vessels and improve blood flow.
- **Blood coagulation modifiers (Antiplatelets and anticoagulants):** Prevent blood clots from forming in narrowed arteries.

For additional information about the classes of medications used to treat arteriosclerosis and atherosclerosis, visit the

"Cardiovascular & Renal Systems" chapter in Open RN *Nursing Pharmacology, 2e*.

SURGICAL INTERVENTIONS

Several procedures or surgeries may be performed, depending on the location of the plaque buildups. An **endarterectomy** is the surgical removal of plaque from arteries. Procedures related to atherosclerosis in the coronary arteries are discussed in "Medical Interventions" in the "Coronary Artery Disease" section. In acute situations where atherosclerotic plaque becomes a thrombotic clot or **embolus** obstructing blood flow, thrombolytic medications may be administered.[8,9]

Nursing Interventions

Nursing interventions for arteriosclerosis and atherosclerosis include safely administering medications and providing health teaching about lifestyle modifications, risk factor reduction, and medication therapy.

MEDICATION MANAGEMENT

Nurses administer prescribed medications and teach about potential side effects and when to notify the provider.

8. Kaski, J. C. (2022). Pathogenesis of atherosclerosis. *UpToDate*. https://www.uptodate.com/

9. Crea, F., Kolodgie, F., Finn, A., & Virmani, R. (2022). Mechanisms of acute coronary syndromes related to atherosclerosis. *UpToDate*. https://www.uptodate.com/

HEALTH TEACHING

Nurses provide health teaching about lifestyle modifications to promote heart health, including dietary changes, smoking cessation, and regular physical activity. A heart-healthy diet is encouraged that is low in saturated fats, cholesterol, and sodium. If the client smokes and is ready to stop smoking, resources are provided for quitting. Realistic physical activity is recommended based on the client's abilities. Risk factor modification, including controlling blood pressure, cholesterol levels, and blood sugar (if applicable), is emphasized during health teaching.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Arteriosclerosis/Atherosclerosis

View a brief YouTube video overview of arteriosclerosis and atherosclerosis[10]:

10. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 –*

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1196#oembed-1

Arteriosclerosis/Atherosclerosis [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/mSpcfAiJlHs?si=ds-NElqqcMTvL-Lh

5.7 Coronary Artery Disease

Overview

Coronary artery disease (CAD) is caused by plaque buildup that causes the inside of the coronary arteries to narrow over time, which can partially or totally block the blood flow to the muscle tissue of the heart. As previously discussed in this chapter, the process of plaque buildup is referred to as atherosclerosis.

Risk Factors

There are a variety of risk factors for CAD, referred to as modifiable and nonmodifiable risk factors. Modifiable risk factors include high blood pressure; high cholesterol; smoking; obesity; physical inactivity; and diets high in saturated fats, trans fats, sodium, and refined sugars. Chronic stress and excessive alcohol consumption can also play a role in the development of coronary artery disease.[1,2] Nurses play an important role in educating clients about modifiable risk factors for CAD and healthy lifestyle choices that can reduce these risks.

There are also numerous nonmodifiable risk factors for coronary artery disease. The risk of coronary artery disease increases with age; men over the age of 45 and women over the age of 55 are at higher risk. Family history and genetics are also nonmodifiable risk factors, especially if a client has a first-degree relative who has been diagnosed with coronary artery disease or had a myocardial infarction (i.e., heart attack), especially at a young age. Specific

1. Simons, M., & Alpert, J. S. (2022). *Acute coronary syndrome: Terminology and classification*. https://www.uptodate.com/

2. Mechanic, O.J., Gavin, M., Grossman, S.A., & Ziegler, K. (2023). *Acute Myocardial Infarction (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568759/

ethnic groups, such as African Americans are also at higher risk for the development of cardiovascular disease.[3,4]

Angina

As blood flow becomes partially blocked in coronary arteries due to atherosclerosis, individuals often experience chest pain called angina. **Angina** is caused by lack of oxygenated blood flow to heart muscle tissue, referred to as **ischemia**. See Figure 5.28[5] for an image of a client experiencing angina.[6] Because angina is caused by blockage of oxygenated blood flow to the heart tissue, it is often brought on by physical activity and an increased demand for oxygenated blood. Physical activity stimulates the heart to beat faster with stronger contractions to distribute oxygenated blood flow to muscle tissue throughout the body. However, if coronary arteries are partially blocked, the heart tissue itself may not receive enough oxygenated blood flow as this workload increases, resulting in angina.

3. Simons, M., & Alpert, J. S. (2022). *Acute coronary syndrome: Terminology and classification. UpToDate*. https://www.uptodate.com/

4. Mechanic, O.J., Gavin, M., Grossman, S.A., & Ziegler, K. (2023). *Acute Myocardial Infarction (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568759/

5. "51096039583" by Marco Verch Professional Photographer's photostream is licensed under CC BY 2.0

6. Simons, M., & Alpert, J. S. (2022). *Acute coronary syndrome: Terminology and classification. UpToDate*. https://www.uptodate.com/



Figure 5.28 Angina

Angina is classified as stable or unstable. View Table 5.7 to compare the characteristics of stable versus unstable angina. Stable angina is caused by narrowing of the coronary arteries, resulting in partial blockage of blood flow. It is chronic, predictable, and relieved with rest or nitroglycerin. Clients may live with stable angina for several years and managed with medication. However, unstable angina is caused by worsening or a sudden blockage of blood flow to the heart that falls under the umbrella term of **acute coronary syndrome (ACS)**. ACS refers to conditions that cause a sudden decrease in oxygenated blood flow to the cardiac muscle, ranging from unstable angina to myocardial infarction. As previously discussed, unstable angina is characterized by chest pain that does not resolve completely with rest or nitroglycerin. **Myocardial infarction (MI)**, commonly referred to as a "heart attack," occurs when there is a sudden blockage within the coronary arteries.

Figure 5.29[7] shows a blockage in the coronary arteries of a client during a coronary angiogram that can result in a myocardial infarction without intervention.

Table 5.7. Characteristics of Stable and Acute Coronary Syndrome[8,9]

Characteristic	Stable Angina	ACS
Trigger	Typically triggered by exercise or emotional stress.	May occur at rest or with minimal exertion, sometimes with no apparent trigger.
Predictability	Generally predictable based on an individual's specific activities. For example, an individual may be aware that climbing stairs will cause angina.	Unpredictable in terms of when it occurs and its severity. It may occur suddenly without warning.
Duration of Symptoms	Short duration that typically resolves within five minutes of rest or administration of nitroglycerin.	Longer duration than five minutes. Rest and/or nitroglycerin may improve but not completely resolve the pain.
Frequency	Predictable frequency.	Episodes of angina become more frequent over time.
Severity	Often described as pressure, heaviness, tightness, or squeezing over a broad area of the chest.	Often associated with shortness of breath and may also include symptoms of nausea, vomiting, diaphoresis, dizziness, and palpitations. Women may only experience fatigue and indigestion-type symptoms.
Progression	Rarely progresses to a myocardial infarction.	A serious warning sign of an impending myocardial infarction.
Management	Managed with lifestyle modifications and medications.	Requires immediate medical attention to prevent a myocardial infarction.

7. "2016 Occluded Coronay Arteries.jpg" by OpenStax College is licensed under CC BY 3.0

8. Goyal, A., & Zeltser, R. (2022). *Unstable Angina*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK442000/

9. Gillen, C., & Goyal, A. (2022). *Stable Angina*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK559016/

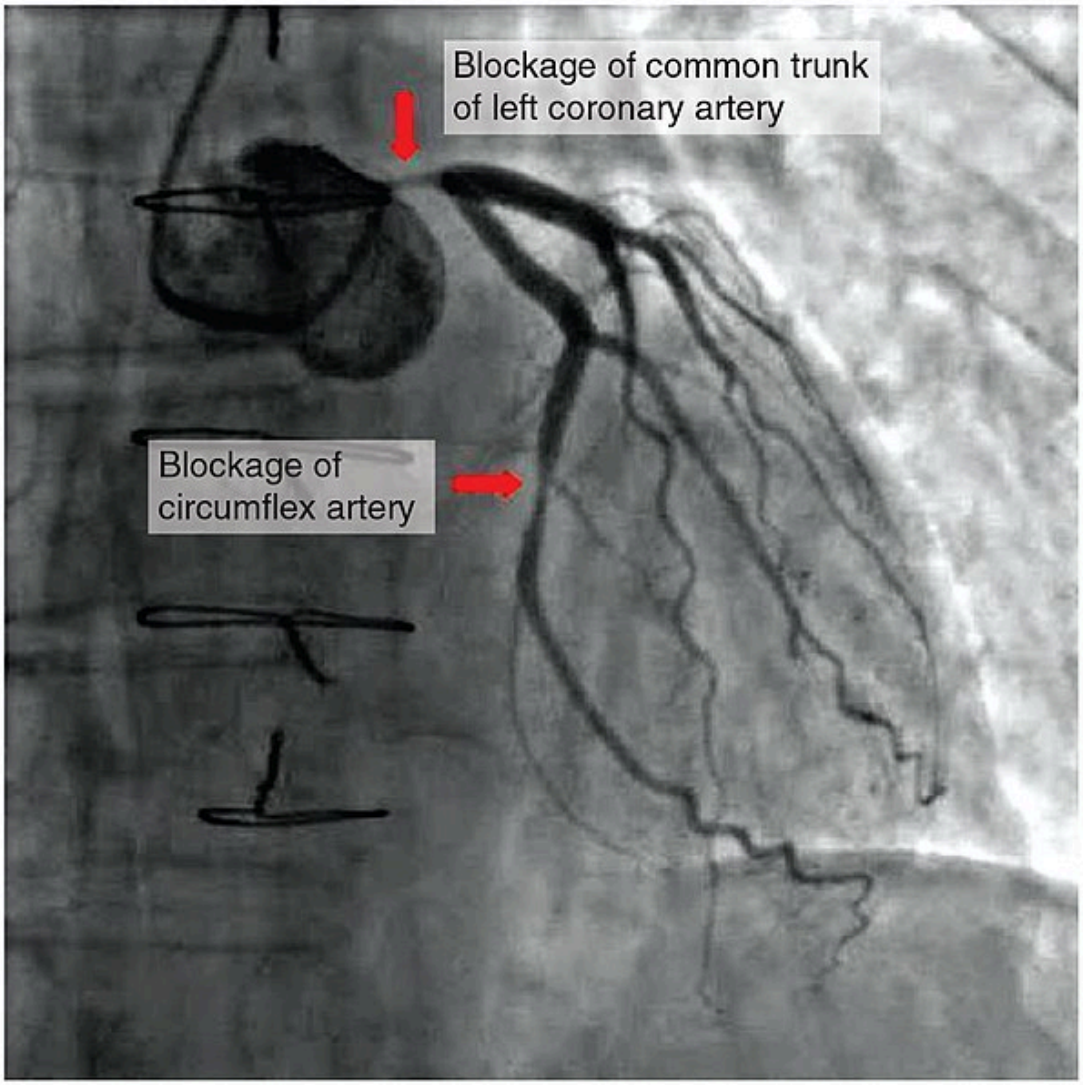


Figure 5.29 Blockages in Coronary Arteries

When a myocardial infarction occurs, there are three types of potential damage to the cardiac muscle tissue: ischemia, injury, and infarction. When ischemia occurs, the viability of the tissue may be preserved if oxygen is promptly restored, and the heart muscle can recover without permanent damage. On an ECG, ischemia to cardiac muscle tissue is indicated by ST segment depression.

Next to the area of ischemia may be tissues that were **injured**. These tissues can be viable as long as oxygen is delivered to the tissue by pathways that circumvent the blockage. For example, providing supplemental oxygen during an MI may help save injured areas from necrosis (death). Areas of injury to cardiac muscle tissues may be indicated on an ECG by ST segment

elevation. See Figure 5.30[10] for an illustration of ST elevations indicated by red arrows on an ECG strip.

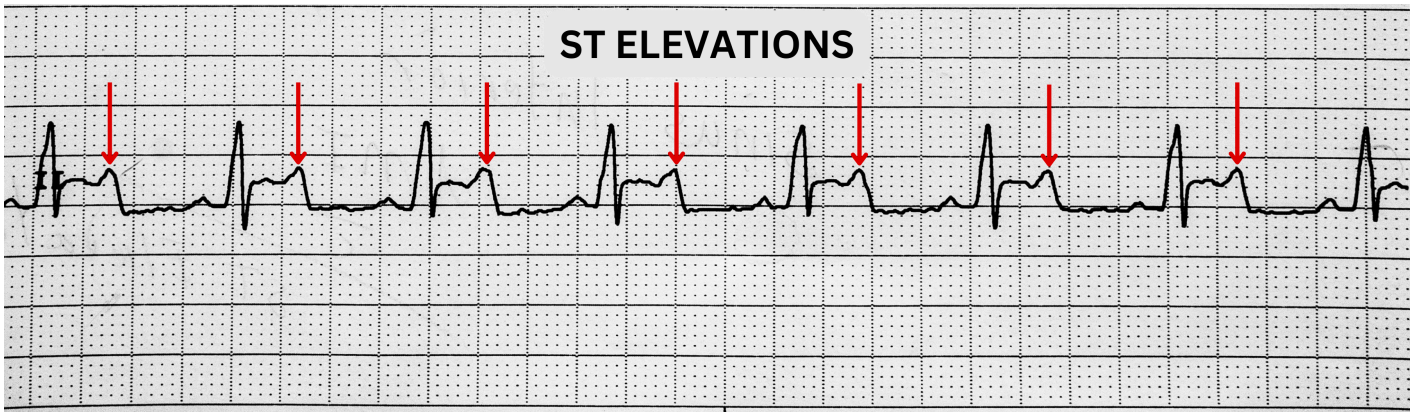


Figure 5.30 ST Elevations

The most significant area of damage during an MI is an area of **infarct**. Infarcted tissue has been deprived of oxygen for so long that the damage is irreversible, and the tissue has died. **Troponin** is a protein found in heart muscle cells that is released into the bloodstream when tissues have died and is used to help diagnose myocardial infarction. Cardiac muscle tissue that has died due to an infarct also causes a Q wave change on an ECG.[11] See Figure 5.31[12] for an illustration of a myocardial infarction.

10. "ST Elevations" by Meredith Pomietlo is licensed under CC BY 4.0

11. Mechanic, O.J., Gavin, M., Grossman, S.A., et al. (2023). *Acute Myocardial Infarction (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568759/

12. "Heart_attack-NIH.gif" by NIH: National Heart, Lung and Blood Institute is in the Public Domain.

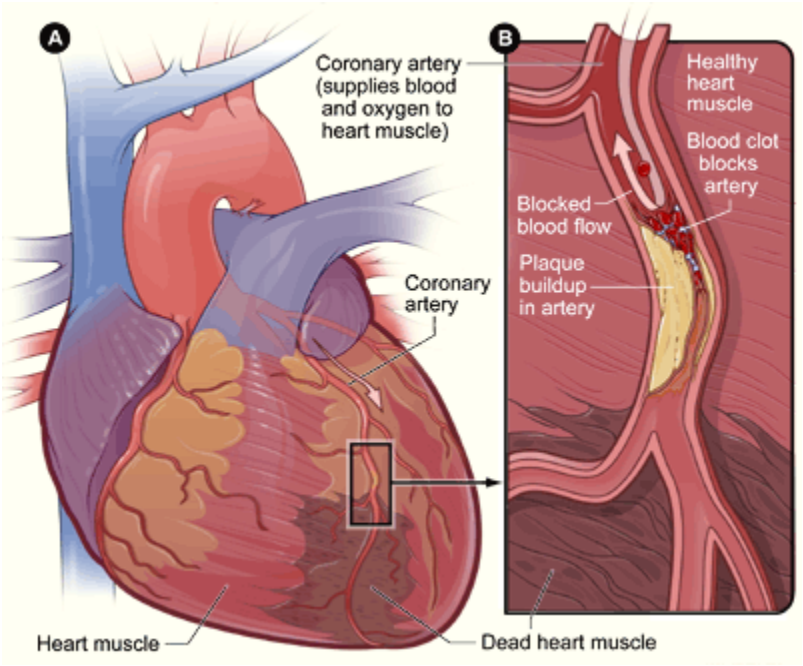


Figure 5.31 Myocardial Infarction

Additional information regarding medical treatment for MI is provided in the following box.

Medical Treatment for MI

Nurses must recognize signs of unstable angina and implement appropriate action, such as notifying the provider

and/or obtaining emergency assistance. Common interventions include the following[13,14,15]:

- Obtain stat ECG.
- Administer oxygen if SpO2 is less than 92% or per agency protocol, which helps ensure that the heart tissue receives adequate oxygen.
- Administer nitroglycerin to dilate the blood vessels and improve blood flow to the heart.
- Administer aspirin to reduce the opportunity for clot formation.
- Analgesics (such as morphine) may be prescribed to help reduce discomfort and cardiac workload, but morphine is no longer considered first-line treatment because of higher risk of death and adverse clinical outcomes.
- Mild anxiolytics may be prescribed for very anxious clients.
- Antiplatelet medications (such as clopidogrel) may be prescribed to reduce platelet aggregation and clot formation.
- Beta-blockers may be prescribed to reduce myocardial oxygen consumption by lowering heart rate, blood pressure, and myocardial contractility.

13. Goyal, A., & Zeltser, R. (2022). *Unstable Angina*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK442000/

14. Gillen, C., & Goyal, A. (2022). *Stable Angina*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK559016/

15. Ojha, N., & Dhamoon, A.S. (2023). *Myocardial Infarction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537076/

- Revascularization procedures, such as cardiac catheterization, stenting, or coronary artery bypass grafting surgery, may be required if vessel occlusion is significant.

Read additional information about MI treatment in the National Library of Medicine's StatPearl Myocardial Infarction.

View a supplementary YouTube video[16] about acute coronary syndrome: How to Treat a Heart Attack

Assessment

Nurses assess subjective and objective data on physical examination and by reviewing laboratory and diagnostic test results.

Angina is the most common symptom of CAD. However, for many people, the first sign of CAD is a myocardial infarction (MI). Symptoms of an MI include the following[17]:

- Angina (Often described as heaviness, pressure, squeezing, or the feeling of something sitting on the chest)
- Shortness of breath
- Diaphoresis (Often described as "cold sweat")
- Weakness
- Lightheadedness
- Nausea (Often described as "indigestion" or "feeling sick to your stomach")

16. 7activestudio. (2017, January 15). *How to treat a heart attack* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=QllguanpKic

17. Centers for Disease Control and Prevention. (2023). *Heart disease*. https://www.cdc.gov/heartdisease/index.htm

- Pain or discomfort in the jaw, arms, or shoulder

Over time, CAD can weaken the heart muscle. This may lead to heart failure, a serious condition where the heart can't pump blood the way it should.[18]

Diagnostic Testing

Health care providers order various tests to assess the presence and severity of blockages within the coronary arteries. Depending on the severity of symptoms, providers may also order a coronary catheterization, considered the "gold standard" for the diagnosis of CAD. Common diagnostic tests related to CAD include the following.[19,20,21,22]

- **Troponin:** A blood test used to help diagnose myocardial infarction that measures protein released into the bloodstream when heart tissue is damaged. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

18. Centers for Disease Control and Prevention. (2023). *Heart disease*. https://www.cdc.gov/heartdisease/index.htm
19. Simons, M., & Alpert, J. S. (2022). *Acute coronary syndrome: Terminology and classification. UpToDate*. https://www.uptodate.com/
20. Centers for Disease Control and Prevention. (2023). *Heart disease*. https://www.cdc.gov/heartdisease/index.htm
21. American Heart Association. (2025). *Cardiac computed tomography angiography (CCTA)*. https://www.heart.org/en/health-topics/heart-attack/diagnosing-a-heart-attack/cardiac-computed-tomography
22. American Heart Association. (2025). *Cardiac magnetic resonance imaging (MRI)*. https://www.heart.org/en/health-topics/heart-attack/diagnosing-a-heart-attack/magnetic-resonance-imaging-mri

- **Electrocardiogram (ECG or EKG):** Measures the electrical activity, rate, and rhythm of the heart.
- **Echocardiogram:** Uses ultrasound (special sound wave) to create images of the heart.
- **Exercise Stress Test:** Evaluates the heart rate and rhythm while walking on a treadmill to determine how well the heart is working when it has to pump more blood.
- **Cardiac Catheterization and Coronary Angiogram:** Examines the inside of the coronary arteries for blockage by inserting a thin, flexible tube through an artery in the groin, arm, or neck to reach the heart. During the coronary angiogram, dye is administered to view the coronary arteries. Review additional information about cardiac catheterizations under the "Diagnostic Testing" subsection in the "General Cardiovascular System Assessment" section.
- **Coronary Artery Calcium Scan:** Examines coronary arteries for calcium buildup and plaque through computed tomography (CT).
- **Cardiac Magnetic Resonance Imaging (MRI):** Uses a magnetic field and radiofrequency waves to create detailed pictures of the heart and arteries.
- **Coronary Computed Tomography (CCTA):** Uses X-rays to take images of the heart and blood vessels. A computer combines the images to create a three-dimensional (3D) image of the heart.

Nursing Diagnoses

Nursing priorities for clients with CAD involve addressing inadequate oxygenation and managing pain, fatigue, activity intolerance, impaired cardiac output, and anxiety. Nursing diagnoses for clients with CAD are formulated based on the client's assessment data, medical history, and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions. Recall that symptoms of CAD are related to decreased oxygenated blood flow in the coronary arteries and can range from stable, chronic angina to acute coronary syndrome (ACS).[23]

23. Mechanic, O.J., Gavin, M., Grossman, S.A., & Ziegler, K. (2023). *Acute Myocardial*

Common nursing diagnoses for stable CAD include the following[24]:

- Acute Pain
- Risk for Decreased Cardiac Tissue Perfusion
- Risk for Decreased Cardiac Output
- Readiness for Enhanced Health Self-Management

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to CAD are as follows:

- *The client will maintain adequate cardiac tissue perfusion as evidenced by the following vital sign ranges: SBP between 90 mm Hg – 120 mm Hg, HR 60-99 bpm, and O2 saturation greater than 92%.*
- *The client will report relief of angina within 5-10 minutes of rest and/or administration of nitroglycerin.*
- *The client will verbalize a decreased level of anxiety and demonstrate the use of relaxation techniques (e.g., deep breathing exercises) to effectively manage anxiety.*
- *The client will be able to participate in activities of daily living (ADLs) and physical activity.*

Infarction (Nursing). StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568759/

24. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.).

Interventions

Medical Interventions

Medical interventions for CAD are aimed at managing symptoms, slowing disease progression, and improving quality of life. These interventions are typically prescribed by health care providers based on the severity of CAD, the client's risk factors, and individualized needs and goals. Common medical interventions used to address CAD include medication therapy and lifestyle modifications. For severe CAD, surgical treatment may be performed.[25,26]

MEDICATION THERAPY

Several classes of medications are used to treat CAD:

- **Antiplatelet Medications:** Help reduce the buildup of thrombotic plaque in the coronary arteries. Common medications include aspirin and clopidogrel.
- **Cholesterol-Lowering Medications:** Reduce the risk of atherosclerosis and plaque buildup. Common medications include statins like atorvastatin and simvastatin to lower LDL blood levels.
- **Antihypertensive Medications:** Control blood pressure and reduce strain on the heart. Common medications include beta-blockers, ACE inhibitors, and calcium channel blockers.
- **Nitroglycerin:** Relaxes and dilates coronary blood vessels to increase blood flow to cardiac muscle tissue and resolve angina.
- **Antianginal Medications:** Reduce the frequency and severity of angina.

25. Simons, M., & Alpert, J. S. (2022). *Acute coronary syndrome: Terminology and classification. UpToDate*. https://www.uptodate.com/

26. Mechanic, O.J., Gavin, M., Grossman, S.A., & Ziegler, K. (2023). *Acute Myocardial Infarction (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568759/

Examples include isosorbide, beta-blockers, and calcium channel blockers.

- **Antiarrhythmic Medications:** Used to manage abnormal rhythms. Because abnormal heart rhythms are associated with CAD, medications like beta-blockers or calcium channel blockers may be prescribed.
- **Thrombolytic Therapy:** Used to dissolve blood clots that are blocking coronary arteries during an acute myocardial infarction.

> Read more information about these medication classes in "Cardiovascular & Renal System Medications" in Open RN *Nursing Pharmacology, 2e*.

View supplementary YouTube videos[27,28,29,30] on common cardiac medications:

- Calcium channel blockers: CCBs for Hypertension (high blood pressure) or Arrhythmias (irregular heartbeat)
- ACE inhibitors: How do ACE inhibitors work?
- Nitrates: A Patient Guide: Nitroglycerin Jennifer Riccobono 252 subscribers Subscribe

27. 7activestudio. (2017, January 15). *How to treat a heart Attack* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=QllguanpKic

28. Drugs in Motion. (2018, December 10). *CCBs for hypertension (high blood pressure) or arrhythmias (irregular heartbeat)* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=QeVIGjJbE6g

29. British Heart Foundation. (2018, October 2). *How do ACE inhibitors work?* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=xIlaQuRaZmk

30. Riccobono, J. (2012, September 11). *A patient guide: Nitroglycerin* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=pII49Kn14Q8

LIFESTYLE MODIFICATIONS

Several evidence-based lifestyle modifications are recommended by health care providers, including the following[31]:

- **Healthy Weight:** Carrying extra weight can put extra stress on the heart and blood vessels. Clients are encouraged to follow a healthy diet and incorporate regular physical activity to maintain a healthy weight.
- **Heart Healthy Diet:** A heart-healthy diet low in saturated fats, trans fats, cholesterol, and sodium is encouraged. Emphasis is placed on consuming fruits, vegetables, whole grains, and lean proteins while also considering cultural and religious diet preferences.
- **Moderate Alcohol Consumption:** Alcohol consumption can elevate blood pressure and should be consumed in moderation. Men should have no more than two drinks per day, and women no more than one drink per day.
- **Regular Physical Activity:** Physical activity is recommended to maintain a healthy weight and lower blood pressure, blood cholesterol, and blood sugar levels. For adults, the Surgeon General recommends 2 hours and 30 minutes of moderate-intensity exercise, like brisk walking or bicycling, every week. Children and adolescents should get 1 hour of physical activity every day.[32]
- **Smoking Cessation**: Smoking is a significant risk factor for CAD. If clients smoke, they are encouraged to consider quitting at every health care visit through counseling and nicotine replacement therapy.
- **Mental Health:** Various studies have shown the impact of trauma, depression, anxiety, and stress on the body, including stress on the heart. Clients are encouraged to talk to their health care providers about their

31. Centers for Disease Control and Prevention. (2025). *Heart disease*. https://www.cdc.gov/heartdisease/index.htm

32. Centers for Disease Control and Prevention. (2025). *Heart disease*. https://www.cdc.gov/heartdisease/index.htm

mental health.

SURGICAL INTERVENTIONS

In severe cases of CAD, these surgical procedures may be performed by cardiologists:

- **Cardiac Catheterization With Angioplasty:** A catheter is inserted into a narrowed coronary artery during cardiac catheterization. During the procedure, a balloon at the end of the catheter is inflated to widen the artery and improve blood flow. A small mesh device, known as a stent, may also be inserted to help keep the coronary artery open after the procedure is completed. Review information about cardiac catheterization under the "Diagnostic Testing" subsection in the "General Cardiovascular System Assessment" section.
- **Coronary Artery Bypass Grafting (CABG):** Blocked coronary arteries are bypassed using grafts (i.e., veins or arteries obtained from elsewhere in the body) to create new pathways for blood to flow to the heart muscle.

CARDIAC REHABILITATION

Cardiac rehabilitation is a supervised program that includes physical activity, education about healthy lifestyle choices, and counseling to find ways to relieve stress and improve mental health. It is typically prescribed for clients who have had cardiac surgery, a myocardial infarction, or have been diagnosed with heart failure. Cardiac rehabilitation can help prevent another, perhaps more serious, heart attack and helps clients build heart-healthy habits.[33]

33. Centers for Disease Control and Prevention. (2025). *Heart disease*. https://www.cdc.gov/heartdisease/index.htm

Read more information about How Cardiac Rehabilitation Can Help Heal Your Heart by the CDC.

Nursing Interventions

Nursing interventions for CAD focus on medication management, health teaching, safety promotion, and psychosocial support to facilitate overall cardiovascular health.

MEDICATION MANAGEMENT

Prescribed medications are safely administered, and monitoring is provided for therapeutic effect and potential side effects. Teaching is provided about the role of medications, potential side effects, and when to notify the provider.

HEALTH TEACHING

Health teaching is provided about CAD, its risk factors, and the role of prescribed treatments and medications.

Guidance is provided for tracking blood pressure and monitoring cholesterol levels with lab work. Lifestyle modifications, as outlined under the "Medical Interventions" subsection, are taught and reinforced. Client understanding is evaluated, and follow-up teaching and/or cardiac rehabilitation is recommended as indicated.

SAFETY PROMOTION

Clients experiencing angina are taught how to properly use and store nitroglycerin.

Nitroglycerin Safety

Client teaching for nitroglycerin is crucial as it helps individuals understand how to use this medication safely and effectively.

- Instruct the client on the correct method of administration based on the prescribed form (sublingual tablets, transdermal patch, or spray).
- If using sublingual tablets, advise client to be in a seated position and then place the tablet under the tongue and allow it to dissolve.
- Clearly explain the prescribed dosage and the frequency with which nitroglycerin should be taken. Clients should be instructed to self-administer one tablet every five minutes for a total of three doses.
- Pain relief should start within one to two minutes of administration.
- Nitroglycerin tablets should be stored in their original container and protected from light.
- Inform clients about potential side effects of nitroglycerin, such as hypotension, headache, dizziness, or flushing. These effects are usually temporary but should be reported to the health care provider if persistent.

Clients and their family members are taught to recognize symptoms of an unstable angina and/or myocardial infarction and when to call 911.

PSYCHOSOCIAL SUPPORT

Nurses address the emotional and psychological impact of CAD by providing emotional support and making referrals to mental health professionals as

indicated. Clients are also encouraged to participate in support groups and cardiac rehabilitation programs to maintain heart-healthy lifestyles.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Coronary Artery Disease

View a brief YouTube video overview of CAD[34]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1205#oembed-1

34. Open RN Project. (2024, April 4). *Health Alterations – Chapter 5 Cardiovascular – Coronary artery disease* [Video]. YouTube. CC BY-NC 4.0 https://www.youtube.com/watch?v=5KaFXLcRKNQ

5.8 Heart Failure

Overview

The heart is a hard-working muscle that pumps about 1.5 gallons of blood per minute and over 2,000 gallons of blood per day. **Heart failure (HF)** occurs when the heart loses its effectiveness in pumping blood and is referred to as decreased cardiac output. When the heart is not pumping effectively, classic symptoms of fatigue, shortness of breath, edema, or lung congestion can occur.

Chronic HF is a progressive disorder that can be represented on a continuum. The continuum ranges from individuals who are at risk for HF but are asymptomatic, to individuals who have end-stage heart failure and require hospice care. Therapeutic goals and medical treatment are based on where the individual falls on this continuum.[1]

Causes of Heart Failure

There are many common causes of HF, including CAD, myocardial infarction (MI), hypertension, valve disorders, and cardiomyopathy.[2] CAD that causes ischemia weakens the cardiac muscle tissue. If an MI occurs, depending on the location of the infarct, muscle tissue dies. If the infarct affects the left ventricle, the heart's ability to pump is severely affected.

Hypertension is another common cause of HF. Hypertension causes vascular resistance that the heart must overcome to pump blood throughout

1. Heidenreich, P. A., Bozkurt, B., Aguilar, D., et. al. (2022). 2022 AHA/ACC/HFSA guideline for the management of heart failure: A report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation, 145(*18), e895–e1032. https://doi.org/10.1161/CIR.0000000000001063

2. Colucci, W. S., & Borlaug, B. A. (2022). Heart failure: Clinical manifestations and diagnosis in adults. *UpToDate*. https://www.uptodate.com/

the body. This increased force causes the ventricles to become thickened and lose their pumping effectiveness.

Heart valve conditions and cardiomyopathy are also common causes of heart failure. Cardiomyopathy has many causes, either acquired or hereditary, that weaken the heart's muscle tissue. Valve conditions cause narrowing and/or backflow of blood through the valves. Ineffective value function may be identified through the presence of a heart murmur. Both conditions impair the heart's ability to pump blood.

In addition to these disease processes, various risk factors impacting cardiac health can also lead to the emergence of HF. Smoking, obesity, alcohol, and substance misuse can weaken heart tissue and increase the risk of heart failure. As individuals age, the heart experiences age-related strain on the valves and muscle tissues. Finally, family history of heart disease and ethnicity may can also contribute to increased risk for HF.[3] Non-hispanic Black individuals have the highest death rate per capita.[4]

Signs and Symptoms of Chronic Heart Failure

HF is characterized by symptoms of fatigue, fluid retention, and shortness of breath, depending on which side of the heart is not pumping effectively. Left-sided and right-sided heart failure are two distinct but interrelated conditions that affect the heart's ability to pump blood effectively. Some clients develop symptoms of both left- and right-sided heart failure. Causes, symptoms, and potential complications of right- and left-sided heart failure differ, but treatment is often similar and often includes diuretics, ACE inhibitors, beta-

3. Colucci, W. S., & Borlaug, B. A. (2022). Heart failure: Clinical manifestations and diagnosis in adults. *UpToDate*. https://www.uptodate.com/

4. Heidenreich, P. A., Bozkurt, B., Aguilar, D., et. al. (2022). 2022 AHA/ACC/HFSA guideline for the management of heart failure: A report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation, 145*(18), e895–e1032. https://doi.org/10.1161/CIR.0000000000001063

blockers, vasodilators, and oxygen therapy. See Table 5.8 for a comparison of the signs, symptoms, and potential complications of left- and right-sided heart failure.

Table 5.8. Left- and Right-Sided Heart Failure[5,6]

Characteristic	Left-Sided Heart Failure (LHF)	Right-Sided Heart Failure (RHF)
Primary Ventricle Affected	– Left ventricle (LV)	– Right ventricle (RV)
Causes	– Hypertension – Coronary artery disease (CAD) – Myocardial Infarction (MI) – Valvular heart disease	– Pulmonary hypertension – Left-sided heart failure – Pulmonary valve disease
Signs/Symptoms	– **Dyspnea** (especially on exertion) – **Orthopnea** (shortness of breath when lying flat) – Paroxysmal nocturnal dyspnea (PND) – S3 gallop (ventricular gallop) – Crackles in lungs – **Venous stasis** (slow blood flow in the veins, usually in the legs) – Decreased ejection fraction on echocardiogram – Decreased pulses, pale/cool extremities	– Peripheral edema (legs, ankles) – **Ascites** (abdominal edema) – Anorexia – Hepatomegaly (enlarged liver) – Jugular venous distension
Complications	– Pulmonary edema – Left atrial enlargement – Cardiogenic shock from decreased cardiac output – Kidney failure	– Liver failure – Kidney failure – Venous stasis ulcers

Functional Classifications of Heart Failure

Because HF is a progressive disease, clients are classified into four categories based on their limitations of physical activity based on the New York Heart Association (NYHA) Functional Classification. The NYHA Functional Classification categories include the following[7]:

5. Colucci, W. S., & Borlaug, B. A. (2022). Heart failure: Clinical manifestations and diagnosis in adults. *UpToDate*. https://www.uptodate.com/

6. Colucci, W. S., & Dunlay, S. M. (2022). Clinical manifestations and diagnosis of advanced heart failure. *UpToDate*. https://www.uptodate.com/

7. American Heart Association. (2023). *Classes and stages of heart failure*.

- **Class I:** No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, or shortness of breath.
- **Class II:** Slight limitation of physical activity. Comfortable at rest. Ordinary physical activity results in fatigue, palpitation, shortness of breath, or chest pain.
- **Class III:** Marked limitation of physical activity. Comfortable at rest. Less than ordinary activity causes fatigue, palpitation, shortness of breath, or chest pain. Palliative care may be prescribed to enhance the client's quality of life.
- **Class IV:** Symptoms of heart failure at rest. Any physical activity causes further discomfort. This stage is also commonly referred to as "end-stage heart failure" that qualifies for hospice care.

As clients undergo treatment, the care team can evaluate the effectiveness of treatment based on the client's current category of NYHA Functional Classification. It is helpful for nurses to know a client's baseline NYHA Functional Classification to know what assessment findings to expect and what findings indicate worsening clinical status.

Acute Decompensated Heart Failure

Acute decompensated heart failure (ADHF) is the sudden or gradual onset of worsening signs or symptoms of heart failure requiring unplanned office visits, emergency room visits, or hospitalization. It occurs when the heart's ability to pump a sufficient amount of oxygenated blood to the body's tissue is no longer sufficient.

Up to 50% of cases of ADHF have no known cause. Potential causes include nonadherence to medications or salt restrictions, side effects of medications, uncontrolled hypertension, arrhythmias, and exacerbation of chronic obstructive pulmonary disease. Other contributing factors include noncardiac conditions such as kidney disease, diabetes mellitus, and anemia.

https://www.heart.org/en/health-topics/heart-failure/what-is-heart-failure/classes-of-heart-failure

Signs and symptoms of ADHF include worsening dyspnea, edema, lung sounds, and mental status. The client may also have decreased urine output (oliguria). Nurses must rapidly recognize these unexpected findings in clients with heart failure and promptly report them to the health care provider. Clients with ADHF often require hospitalization and treatment with intravenous diuretics, oxygen therapy, and other medications to maintain adequate cardiac output and perfusion of the kidneys, brain, and heart tissue.

Assessment

When assessing a client with chronic heart failure, it is important to understand the differences between expected findings for that client and signs of an acute exacerbation. Expected findings are based on New York Heart Association Functional Classification, as well as recently documented and communicated status from other members of the health care team. In order to recognize potential clinical deterioration, the nurse caring for a client who has been diagnosed with heart failure must know their baseline status in terms of edema, lung sounds, mental status, and kidney function.

Diagnostic Testing

Common tests used to diagnose heart failure, as well as acute decompensated heart failure, include brain natriuretic peptide (BNP), chest X-ray (CXR), echocardiogram, and electrocardiogram (ECG)[8,9]:

- Brain natriuretic peptide (BNP) is a laboratory test that measures protein created by the heart and blood vessels. Elevated levels commonly indicate heart failure.

8. Colucci, W. S., & Borlaug, B. A. (2022). Heart failure: Clinical manifestations and diagnosis in adults. *UpToDate*. https://www.uptodate.com/

9. Colucci, W. S., & Dunlay, S. M. (2022). Clinical manifestations and diagnosis of advanced heart failure. *UpToDate*. https://www.uptodate.com/

- A chest X-ray examines the size and shape of the heart and identifies fluid accumulation in the lungs.
- An echocardiogram evaluates the structure and function of the heart chambers and valves, as well as blood flow throughout the heart. The ejection fraction measures the amount of blood the left ventricle of the heart pumps out to the body with each heartbeat. A normal heart's ejection fraction is between 55 and 70 percent. Clients with left-sided heart failure have ejection fraction measurements less than 55 percent. Clients with right-sided heart failure often have a normal ejection fraction.
- An ECG identifies irregular cardiac rhythms that could be contributing to decreased cardiac output associated with HF.

Nursing Diagnoses

Nursing priorities for clients with heart failure include addressing respiratory status, fluid retention, fatigue, activity intolerance, and self-management of chronic disease to promote quality of life. Common nursing diagnoses include the following[10]:

- Decreased Cardiac Output
- Decreased Activity Intolerance
- Fatigue
- Impaired Gas Exchange
- Excess Fluid Volume
- Readiness for Enhanced Health Management

Outcome Identification

Outcome identification involves setting short and long-term goals and creating expected outcome statements tailored to the client's specific needs.

10. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.).

These outcomes should be measurable and responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to HF are as follows:

- *The client will maintain oxygenation saturation readings above 92%.*
- *The client will demonstrate a reduction of pitting edema in the lower extremities within one week.*
- *The client will exhibit improved exercise tolerance by walking on a flat surface for at least ten minutes without chest pain or excessive shortness of breath within two weeks.*
- *The client will demonstrate the use of relaxation techniques to manage anxiety before discharge, such as deep breathing exercises.*
- *The client will verbalize an understanding of the importance of a low-sodium diet and will list three specific dietary changes they plan to make at home.*

Interventions

Medical Interventions

Medical interventions play an important role in managing the signs and symptoms of heart failure (HF), preventing acute exacerbations, and improving quality of life for individuals with HF. Common medical interventions used to treat HF include medication therapy, lifestyle modifications, cardiac rehabilitation, and surgical interventions.

MEDICATION THERAPY

Several classes of medications are used to treat heart failure:

- **Diuretics:** Reduce fluid retention and edema by increasing urine production. However, diuretics can cause hypokalemia and other electrolyte imbalances, so electrolytes must be monitored carefully. Potassium supplementation may be required.

- **ACE Inhibitors and Angiotensin II Receptor Blockers (ARBs):** Relax systemic blood vessels, thus reducing systemic resistance and increasing cardiac output.
- **Beta-Blockers:** Slow the heart rate and allow for increased ventricular filling before each contraction. However, beta-blockers can worsen HF, so they must be monitored carefully.
- **Aldosterone Antagonists:** Reduce fluid retention.
- **Inotropes:** Strengthen the heart's contractions.

> Read more information about these classes of medications in "Cardiovascular & Renal System Medications" in Open RN *Nursing Pharmacology, 2e*.

LIFESTYLE MODIFICATIONS

Lifestyle modifications focus on reducing fluid retention and fatigue, while maximizing heart function:

- **Dietary Changes:** Reducing sodium intake is crucial for managing fluid retention. Recommended sodium intake is less than two to three grams daily.[11]
- **Fluid Restriction:** In advanced stages of HF or in acute exacerbations with pulmonary edema, fluid intake is often restricted to less than 1.5 to 2 liters/day.
- **Exercise:** A structured exercise program can improve heart function and reduce fatigue.

11. American College of Cardiology. (2023). *Too little sodium can be harmful to heart failure patients*. https://www.acc.org/About-ACC/Press-Releases/2023/02/22/20/42/Too-Little-Sodium-Can-be-Harmful-to-Heart-Failure-Patients

- **Weight Management:** Maintaining a healthy weight reduces strain on the heart.
- **Smoking Cessation:** If the client smokes, quitting smoking improves overall cardiovascular health.

CARDIAC REHABILITATION

Cardiac rehabilitation programs offer supervised exercise, health teaching, and counseling to help clients with HF regain strength, manage their conditions effectively at home, and reduce hospitalizations.

SURGICAL INTERVENTIONS

Clients with advanced heart failure may have surgical interventions and/or devices implanted to assist with cardiac output[12,13]:

- **Left Ventricular Assist Device (LVAD):** A mechanical pump is implanted to assist the heart's pumping function. LVADs are commonly used when a client is awaiting heart transplantation.
- **Heart Transplantation:** For clients with end-stage HF, a heart transplant may be considered, based on the client's overall health and other chronic conditions.
- **Heart Valve Surgery:** If a client is experiencing heart failure due to damaged heart valves, repair or replacement of valves be performed to alleviate symptoms.
- **Coronary Artery Bypass Grafting (CABG):** For clients where coronary artery disease is a contributing factor, CABG surgery may be necessary to improve blood flow to the heart muscle.

12. Colucci, W. S., & Borlaug, B. A. (2022). Heart failure: Clinical manifestations and diagnosis in adults. *UpToDate*. https://www.uptodate.com/

13. Colucci, W. S., & Dunlay, S. M. (2022). Clinical manifestations and diagnosis of advanced heart failure. *UpToDate*. https://www.uptodate.com/

Nursing Interventions

Nursing interventions for heart failure (HF) focus on medication management, health teaching, and psychosocial support to promote quality of life while the client copes with a chronic disease.

MEDICATION MANAGEMENT

Prescribed medications are safely administered, and teaching is provided about medications and their role in improving heart function. In hospitalized clients, therapeutic effects of medications are evaluated, and monitoring is performed for common side effects, such as electrolyte imbalances.

HEALTH TEACHING

Nurses provide health teaching to clients about self-management of HF to avoid acute exacerbations and hospitalization. Clients are taught to promptly report the following symptoms to their health care provider[14]:

- Increased shortness of breath or fatigue during their regular daily routine.
- Feelings like their heart rate is racing or throbbing.
- Weight gain of more than two or three pounds in a 24-hour period or more than five pounds in a week, indicating worsening fluid retention. Clients are encouraged to track daily weights in a journal and bring the journal to follow-up appointments.
- Worsening edema in the ankles, feet, and lower legs.
- Increased home blood pressure readings. Clients are taught to track blood pressure readings in a journal and bring the journal to follow-up appointments.
- Confusion or impaired thinking. These symptoms might be first noticed

14. American Heart Association. (2023). *Managing heart failure symptoms.* https://www.heart.org/en/health-topics/heart-failure/warning-signs-of-heart-failure/managing-heart-failure-symptoms

by family members.
- Trouble sleeping due to dyspnea.
- Decreased appetite or swelling in the abdomen making their waistband feel tight.

View or download a PDF Self-Check Plan for Heart Failure Management by the American Heart Association.[15]

Health teaching is also provided about heart-healthy food choices and sodium restrictions to prevent fluid retention. Smoking cessation is encouraged, and information about relaxation techniques to manage anxiety is provided.

Clients with orthopnea are instructed to sleep with their head elevated on pillows or in a recliner to promote lung expansion. Clients experiencing fatigue are encouraged to balance periods of activity with periods of rest to conserve energy.

PSYCHOSOCIAL SUPPORT

Nurses address the emotional and psychological impact of HF by providing emotional support and encouraging positive coping strategies. Referrals to mental health professionals are provided for additional support, if needed. Clients are encouraged to participate in support groups and cardiac rehabilitation programs.

15. American Heart Association. (2023). *Managing heart failure symptoms*. https://www.heart.org/en/health-topics/heart-failure/warning-signs-of-heart-failure/managing-heart-failure-symptoms

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Heart Failure

View a brief YouTube video overview of HF[16]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1218#oembed-1

16. Open RN Project. (2024, April 4). *Health Alterations – Chapter 5 Cardiovascular – Heart failure* [Video]. YouTube. CC BY-NC 4.0 https://www.youtube.com/watch?v=unEnPZAlpk0

5.9 Peripheral Arterial Disease

Overview

Peripheral artery disease (PAD) is caused by atherosclerosis, with narrowed or blocked arteries, causing reduced oxygenated blood flow to the lower extremities. Risk factors for PAD are similar to atherosclerosis and include smoking, hypertension, high cholesterol, and inflammation. Additional risk factors include age and a history of diabetes or previous injuries or trauma to arterial vessels.[1]

See Figure 5.32[2] for an illustration of PAD.

1. Neschis, D. G., & Golden, M. A. (2022). Clinical features and diagnosis of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

2. "Peripheral_Arterial_Disease.gif" by National Heart Lung and Blood Institute is in the Public Domain.

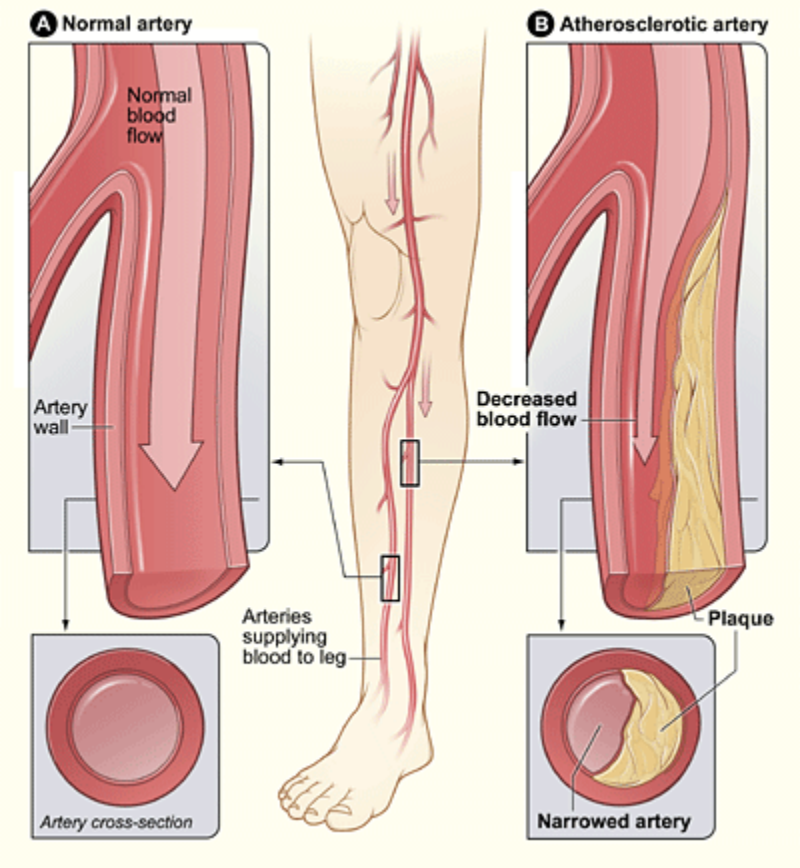


Figure 5.32 Peripheral Arterial Disease

PAD can cause nonhealing wounds in the lower extremities that can become infected and lead to foot or leg amputation. PAD also increases a client's risk for myocardial infarction and stroke.

The most common symptom of PAD is painful muscle cramping in the hips, thighs, or calves when walking, climbing stairs, or exercising called intermittent claudication. This pain typically resolves when the activity is stopped, although it may take a few minutes. The reason for this pain is working muscles need more oxygenated blood flow, and vessels occluded with atherosclerosis are unable to provide sufficient blood flow. This results in tissue ischemia and pain.

Assessment

Diminished blood flow to the extremities that occurs during chronic PAD is often asymptomatic until it becomes severe. Sudden or severe decreased

perfusion of oxygenated blood to an affected limb may result in manifestations known as the 6P's[3]:

- Pain
- Paralysis
- Paresthesia
- Pulselessness
- Pallor
- **Poikilothermia**

See Table 5.9 for common clinical manifestations of PAD across body systems.

Table 5.9. Clinical Manifestations of Peripheral Artery Disease[4,5]

Body System	Description
Musculoskeletal	– **Intermittent claudication**: Predictable muscle pain, cramping, or fatigue during physical activity (e.g., walking) that resolves with rest and recurs with activity. – Muscle wasting or atrophy in the affected limb(s) due to chronic reduced blood flow.
Cardiovascular	– Reduced or absent peripheral pulses (e.g., dorsalis pedis, posterior tibial) in the affected limb(s) due to reduced blood flow. – Prolonged capillary refill time greater than three seconds.
Integumentary	– Skin may appear pale or blanched when elevated and dusky or red when lowered. It often feels cool to the touch. – Hair loss on the lower limbs and thickened or brittle nails. – Development of nonhealing ulcers on the toes or feet.
Neurological	– Numbness, tingling, or weakness in the extremities due to reduced blood supply to the peripheral nerves.

3. Natarajan, B., Patel, P., & Mukherjee, A. (2020). Acute lower limb ischemia-etiology, pathology, and management. *International Journal Angiology, 29*(3). 168-174. https;//doi.org/10.1055/s-0040-1713769

4. Harris, L., & Dryjski, M. (2023). Epidemiology, risk factors, and natural history of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

5. Neschis, D. G., & Golden, M. A. (2022). Clinical features and diagnosis of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

Diagnostic Testing

Health care providers may use a combination of noninvasive and invasive tests to evaluate blood flow and identify blockages in the arteries of the limbs, such as the following:

- **Doppler Ultrasound:** Identifies areas of arterial narrowing or blockage causing reduced blood flow in the extremity.
- **Segmental Pressure Measurements:** Identifies specific locations of arterial narrowing or blockage resulting in altered blood pressure using blood pressure readings at multiple levels along the leg (i.e., thigh, calf, ankle).
- **Ankle-Brachial Index (ABI):** Compares blood pressure in the arms (i.e., brachial artery) to the ankles (i.e., dorsalis pedis or posterior tibial arteries). A lower ABI indicates reduced blood flow to the lower extremities and suggests PAD.[6,7]

Nursing Diagnoses

Nursing diagnoses for peripheral artery disease (PAD) focus on managing symptoms and reducing the risk of complications. Common nursing diagnoses for clients with peripheral arterial disease include the following[8]:

- Risk for Impaired Tissue Integrity

6. Harris, L., & Dryjski, M. (2023). Epidemiology, risk factors, and natural history of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

7. Neschis, D. G., & Golden, M. A. (2022). Clinical features and diagnosis of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

8. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.).

- Chronic Pain
- Readiness for Enhanced Health Self-Management

Outcome Identification

Outcome identification involves setting short- and long-term goals and creating expected outcome statements tailored to the client's specific needs. These outcomes should be measurable and responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to peripheral arterial disease are as follows:

- *The client will exhibit improved peripheral perfusion, as evidenced by decreased intermittent claudication, after completing a prescribed walking therapy program.*
- *The client will demonstrate intact skin with no new ulcers in the lower extremities.*
- *The client will accurately verbalize how to gradually improve collateral circulation by walking to the point of pain, resting, and then walking again for a prescribed length of time.*

Interventions

Medical Interventions

Medical interventions for PAD aim to manage the conditions, reduce the risk of complications, and improve blood flow through the affected arteries.

Interventions include lifestyle modifications, medication therapy, and surgical management.[9,10]

LIFESTYLE MODIFICATIONS

Lifestyle modifications for PAD include the following:

- **Dietary Changes:** A heart-healthy diet low in saturated fats, cholesterol, and sodium can help reduce plaque buildup.
- **Regular Exercise:** Regular physical activity can improve cardiovascular health. Prescribed walking therapy can promote the development of collateral circulation that reduces or resolves intermittent claudication.
- **Smoking Cessation:** Quitting smoking is crucial because smoking is a major risk factor for atherosclerosis and arterial injury.
- **Weight Management:** Achieving and maintaining a healthy weight can help improve blood pressure and reduce the workload on the heart.
- **Blood Glucose Management:** Tightly controlling blood glucose levels in clients with diabetes diminishes the progression of atherosclerosis.

MEDICATION THERAPY

Several medication classes may be prescribed to manage PAD:

- **Statins:** Lower LDL cholesterol levels and can reduce the risk of plaque buildup.
- **Antiplatelet Drugs:** Reduce the risk of thrombosis formation in plaques.
- **Antihypertensive Medications:** Control high blood pressure and reduce

9. Harris, L., & Dryjski, M. (2023). Epidemiology, risk factors, and natural history of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

10. Neschis, D. G., & Golden, M. A. (2022). Clinical features and diagnosis of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

strain on the arteries.

- **Anticoagulants:** Prevent blood clots from forming in narrowed arteries.
- **Vasodilators:** Relax blood vessels and improve blood flow.
- **Cholesterol Absorption Inhibitors:** Reduce cholesterol absorption in the intestines.
- **Thrombolytic Therapy:** Eliminate blood clots in acute situations when blood flow is obstructed.

> Read more information about these medication classes in "Cardiovascular & Renal System Medications" in Open RN *Nursing Pharmacology, 2e*.

SURGICAL INTERVENTIONS[11]

- **Angioplasty and Stent Placement: Percutaneous Transluminal Angioplasty (PTA)** is a minimally invasive procedure in which a catheter is inserted into a narrowed artery and a balloon is inflated to compress the plaque and widen the artery. A stent may be inserted to help keep the artery open.
- **Peripheral Bypass Grafting:** In cases of severe arterial disease, surgical intervention may be recommended. This procedure involves bypassing blocked or narrowed arteries using grafts (usually veins or arteries from elsewhere in the body) to create new pathways for blood to flow to the skeletal muscle.
- **Revascularization Procedures:** Aortoiliac or femoropopliteal bypass may be performed to restore blood flow in specific arteries.
- **Embolectomy:** In cases of acute limb ischemia due to a clot or emboli, the

11. Neschis, D. G., & Golden, M. A. (2022). Clinical features and diagnosis of lower extremity peripheral artery disease. *UpToDate*. https://www.uptodate.com/

clot is removed to restore blood flow.

Nursing Interventions

Nursing interventions for clients with chronic PAD focus on medication management and health teaching to promote quality of life and reduce the risk of complications.

MEDICATION MANAGEMENT

Nurses safely administer prescribed medications and monitor for side effects. The effectiveness of medications is evaluated, and concerns are communicated with the health care provider.

HEALTH TEACHING

Nurses provide health teaching about lifestyle modifications, including walking therapy, dietary changes, and smoking cessation. Walking therapy, as prescribed based on the client's abilities and limitations, is vital for developing collateral circulation. Clients are encouraged to walk to the point of pain, rest, and then resume walking for a specified period of time. A heart-healthy diet is encouraged that is low in saturated fats, cholesterol, and sodium. If the client smokes, resources for quitting smoking are provided. Risk factor modification is encouraged, including controlling blood pressure, cholesterol levels, and blood glucose.

Clients are instructed on limb positioning techniques that can improve blood flow, such as dangling when sitting unless edema is also present, in which case legs may be elevated but not above the level of the heart. Constrictive clothing and crossing the legs are discouraged. Clients are encouraged to closely examine their feet daily and to promptly report injuries or areas of skin breakdown to their health care provider.

POSTOPERATIVE MANAGEMENT

When caring for postoperative clients on a medical-surgical unit who have

undergone vascular surgery for PAD, nurses closely monitor the surgical site and distal pulses for perfusion. Any signs of decreased perfusion or bypass rupture should be immediately reported to the surgeon.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

View a supplementary YouTube video[12] explaining the differences between peripheral arterial and venous disease: Arterial insufficiency VS Venous insufficiency | William C. Fox Texas Endovascular.

12. Texas Endovascular. (2016, November 20). *Arterial insufficiency VS Venous insufficiency | WIlliam C. Fox Texas Endovascular* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=29-7zpOYWiM



RN Recap: Peripheral Arterial Disease

View a brief YouTube video overview of peripheral arterial disease[13]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1230#oembed-1

13. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 – Peripheral arterial disease* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/esDoxdI_amg?si=FqUuw9WwTjrlpZIS

5.10 Venous Insufficiency

Overview

Venous insufficiency is a condition that occurs when the veins in the legs have difficulty returning blood back to the heart. Veins have one-way valves that help blood flow in the right direction. When the valves are weakened or damaged, blood can pool in the veins. Various conditions can cause venous insufficiency, including deep vein thrombosis, varicose veins, age, obesity, and pregnancy. Occupations that require individuals to sit for longer periods of time may also predispose clients to venous insufficiency.[1]

Assessment

Signs of venous insufficiency may vary based upon the severity of the venous involvement. Clients may experience swelling, especially noted in the ankles and lower legs. Swelling typically worsens throughout the day. Many clients may also report aching or pain in the affected extremity. The pain is often described as throbbing or cramping. Many clients with venous insufficiency may also report fatigue or feelings of heaviness in the legs. Some individuals may experience itching or tingling in the legs, and skin color in the affected area may appear dark or discolored. The skin texture may also change and appear dry or rough, taking on a scaly appearance. The veins of the impacted extremities may also appear enlarged and tortuous, visible near the surface of the skin. For individuals with severe cases of venous insufficiency, open sores or ulcers may develop.[2]

1. Patel, S. K., & Surowiec, S. M. (2023). Venous insufficiency. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430975/

2. Henke, P. (2024). *Chronic venous insufficiency*. https://vascular.org/patients-and-referring-physicians/conditions/chronic-venous-insufficiency

Diagnostic Testing

Diagnostic testing for venous insufficiency includes methods to assess the functionality of the venous system. Providers may order ultrasound or Doppler flow studies to examine the direction and flow patterns of the blood. If more definitive identification of restricted vessel areas is needed, a venography may be performed. In this procedure, contrast dye is injected into the large veins of the leg, and X-ray images are collected to provide more comprehensive images of the venous system.[3]

Nursing Diagnoses

Nursing diagnoses for venous insufficiency focus on managing symptoms and reducing the risk of complications. Common nursing diagnoses include the following:

- Impaired Skin Integrity
- Chronic Pain
- Activity Intolerance

Outcome Identification

Outcome identification involves setting short- and long-term goals and creating expected outcome statements tailored to the client's specific needs. These outcomes should be measurable and responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to venous insufficiency are as follows:

- *The client will exhibit improved skin integrity with the absence of new ulcerations or wounds within two weeks.*

3. Henke, P. (2024). *Chronic venous insufficiency*. https://vascular.org/patients-and-referring-physicians/conditions/chronic-venous-insufficiency

- *The client will experience a reduction in chronic pain levels, achieving a pain rating of 2-3 or below within three days.*
- *The client will demonstrate improved tolerance to physical activity, achieving the ability to perform walk 300 feet without undue fatigue within one week.*

Interventions

Medical Interventions

Medical interventions for venous insufficiency aim to manage symptoms, improve venous circulation, and prevent complications.

Common interventions include the following:

- **Compression Therapy:** Graduated compression stockings help improve blood flow by applying pressure to the legs. They reduce swelling, prevent blood from pooling, and assist in maintaining proper venous function.
- **Elevated Leg Positioning:** Encouraging clients to elevate their legs regularly helps reduce swelling and improve venous return. Elevating the legs above heart level can be particularly beneficial.
- **Lifestyle Modifications:**
    - **Regular Exercise:** Physical activity, especially exercises that involve the calf muscles, promotes blood circulation. Walking and calf muscle exercises are often recommended.
    - **Weight Management:** Maintaining a healthy weight reduces pressure on the veins and can improve circulation.
- **Sclerotherapy:** Sclerotherapy involves injecting a solution into small- and medium-sized varicose veins, causing them to collapse and be reabsorbed by the body.
- **Vascular Surgery:** In severe cases or when other interventions are ineffective, surgical procedures such as vein ligation or vein stripping may be considered.[4]

Nursing Interventions

Nursing interventions for venous insufficiency focus on health teaching about managing symptoms, promoting venous circulation, and preventing complications.

HEALTH TEACHING

Nurses teach the importance of regular exercise, particularly activities that engage the calf muscles. They provide information on weight management and discuss lifestyle modifications, such as avoiding prolonged sitting or standing. Nurses teach the purpose of compression stockings and assist with proper fitting. They instruct the client on techniques for applying and removing compression stockings and to monitor for signs of skin breakdown. Clients are encouraged to elevate their legs above their heart level when sitting to reduce edema and promote venous return.[5]

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client,

4. Scovell, S. (2023). *Patient education: Lower extremity chronic venous disease (Beyond the basics). UpToDate*. https://www.uptodate.com/contents/lower-extremity-chronic-venous-disease-beyond-the-basics

5. Scovell, S. (2023). *Patient education: Lower extremity chronic venous disease (Beyond the basics). UpToDate*. https://www.uptodate.com/contents/lower-extremity-chronic-venous-disease-beyond-the-basics

reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Venous Insufficiency

View a brief YouTube video overview of venous insufficiency[6]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1239#oembed-1

6. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 – Venous insufficiency* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/DBwU_RVOMZ4?si=248pOh4-ThuXs3WP

5.11 Deep Vein Thrombosis

Overview

Deep vein thrombosis (DVT) is a clot that forms in a deep, peripheral vein. DVTs usually develop in the lower leg, thigh, or pelvis, but they can also occur in the arm.[1] See Figure 5.33[2] for an image of a DVT in the client's right leg, indicated by unilateral redness and edema as compared to the left leg.

1. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

2. "Deep vein thrombosis of the right leg.jpg" by James Heilman, MD is licensed under CC BY-SA 3.0



Figure 5.33 Signs of a DVT

Three main pathophysiological mechanisms involved in the development of a DVT (often referred to as Virchow's triad) are venous stasis, hypercoagulability, and injury to a vein.[3] **Venous stasis** refers to slow blood flow, often caused by immobility, medication therapies, and heart failure. Hypercoagulability may occur due to deficient fluid volume, pregnancy, oral contraceptive use, or

3. Waheed, S.M., Kudaravalli, P., & Hotwagner, D.T. (2023). *Deep Vein Thrombosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507708/

smoking. Injury to a vein is often caused by major surgery (particularly the abdomen, pelvis, hips, or legs), fracture, or severe muscle injury. Venous wall damage may occur due to venipuncture, certain medications, trauma, and surgery. Chronic disease like cancer, heart disease, and lung disease can also increase the risk for developing DVTs, as well as other factors such as obesity, central venous access devices, inherited clotting disorders, and a previous history or family history of DVTs.[4,5]

Assessment

The lower extremities of clients at risk for developing DVTs should be routinely assessed for unilateral extremity edema, redness, warmth, and calf pain. The bilateral extremities should be examined simultaneously because DVTs can initially cause minor signs that are easily missed. Although Homan's sign was a traditional procedure used to assess for DVT, current research indicates it is not sensitive or specific for diagnosing DVT and is no longer considered a criterion for DVT.[6] Any signs or symptoms suspicious for DVT should be immediately communicated to the health care provider for urgent diagnostic testing.

Pulmonary emboli (PE) are a potential complication of a DVT and can develop quickly, even without noticeable symptoms of a DVT. A pulmonary embolism can occur when a clot from elsewhere in the body travels through venous circulation and gets lodged in the blood vessels of the lungs. This impedes blood flow, and impacted lung tissue dies. PEs are medical

4. Martin, P. (2024). *9 Deep vein thrombosis care plans*. NursesLabs. https://nurseslabs.com/deep-vein-thrombosis-nursing-care-plans/

5. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

6. Ambesh, P., Obiagwu, C., & Shetty, V. (2017). Homan's sign for deep vein thrombosis: A grain of salt? *Indian Heart Journal, 69*(3), 418–419. https://doi.org/10.1016/j.ihj.2017.01.013

emergencies that require emergent treatment. Signs and symptoms of a PE include the following[7]:

- Sudden difficulty breathing
- Tachycardia and/or irregular heart rhythm
- Chest pain or discomfort, which usually worsens with a deep breath or coughing
- **Hemoptysis** (Coughing up blood)
- Very low blood pressure, lightheadedness, change in level of consciousness, or fainting
- Sudden anxiety

Diagnostic Testing

Diagnostic testing for a suspected DVT includes a D-dimer and a duplex ultrasound, with the results available within four hours if possible.[8]

- **D-dimer** is a blood test that is a marker for the presence of blood clots, specifically the breakdown products of fibrin that result from the dissolution of a blood clot. Elevated levels of D-dimer may suggest the presence of an active blood clotting process in the body. If the D-dimer test is negative, it means that the client probably does not have a DVT.[9,10]

7. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/
8. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/
9. Mayo Clinic. (2022). *Blood tests for heart disease*. https://www.mayoclinic.org/diseases-conditions/heart-disease/in-depth/heart-disease/art-20049357
10. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

- **Duplex ultrasonography** is an imaging test that uses sound waves to look at the flow of blood in the veins. It can detect blockages or blood clots in the deep veins.[11]

If a PE is suspected, additional diagnostic testing is performed, such as a computed tomographic pulmonary angiography (CTPA), a special type of X-ray test that includes injection of contrast material into a vein to provide images of the blood vessels in the lungs.

Nursing Diagnosis

Nursing diagnoses for clients with a DVT that can form life-threatening emboli are based on the client's assessment data, medical history, and specific needs. Nursing priorities of care include preventing pulmonary embolism, managing pain, administering anticoagulant therapy, and providing health teaching.

Nursing diagnoses guide the development of individualized care plans and interventions. Examples of nursing diagnoses related to DVT include the following[12]:

- Acute Pain
- Readiness for Enhanced Knowledge
- Risk for Impaired Tissue Perfusion
- Risk for Bleeding

Outcome Identification

Examples of outcome criteria for clients at risk for developing a DVT or PE are as follows:

11. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

12. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.).

- *The client will not experience a DVT during hospitalization for other medical or surgical conditions.*
- *The client will not experience a pulmonary embolism, as evidenced by absence of dyspnea and chest pain.*

Interventions

Medical Interventions

Medical interventions for DVTs typically include administration of anticoagulants. In severe or chronic cases, thrombolytic therapy, inferior vena cava filter, or surgery may be performed.

MEDICATION THERAPY

Anticoagulants

Anticoagulants reduce the ability of the blood to clot, preventing the clot from becoming larger while the body slowly reabsorbs it and reducing the risk of further clots developing. The most frequently used injectable anticoagulants are unfractionated heparin (administered intravenously), low-molecular weight heparin (LMWH), and fondaparinux (injected subcutaneously). Anticoagulants administered orally include warfarin, dabigatran, rivaroxaban, apixaban, and edoxaban.[13] All anticoagulants can cause excessive bleeding, so nurses must closely monitor for unusual bleeding and implement bleeding precautions to clients receiving anticoagulants. Nurses and providers monitor laboratory results to help ensure therapeutic levels of anticoagulation medication is administered. Clients are typically started on heparin injections and transitioned to coumadin to ensure that therapeutic impact is achieved more quickly.

13. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

Thrombolytics

Thrombolytics (commonly referred to as "clot busters") work by dissolving the clot. They have a high risk of excessive bleeding compared to the anticoagulants, so they are prescribed for severe cases.[14] Tissue Plasminogen Activator (tPA), also known by the generic name alteplase, is administered intravenously to dissolve severe clots blocking tissue perfusion but are most commonly used to dissolve clots or emboli causing myocardial infarction, strokes, or pulmonary embolism.

> Read more information about anticoagulants in the "Blood Coagulation Modifiers" section of the "Cardiovascular & Renal Systems" chapter in Open RN *Nursing Pharmacology, 2e*.

SURGICAL INTERVENTIONS

Inferior Vena Cava Filter

When anticoagulants cannot be used or clients develop chronic cases of DVTs, a filter can be inserted inside the inferior vena cava to trap an embolus before it reaches the lungs.[15]

14. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

15. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/

Thrombectomy/Embolectomy

In rare cases, a surgical procedure to remove the clot may be necessary for preservation of life or limb. Thrombectomy involves removal of the clot in a client with DVT, and embolectomy refers to removal of an embolus.[16]

Nursing Interventions

Nursing interventions primarily focus on preventing DVTs and PEs for clients who are at risk. If a DVT is diagnosed, nurses administer anticoagulants and analgesics, implement bleeding precautions, and monitor for excessive bleeding.

NURSING INTERVENTIONS TO PREVENT DVTS

For hospitalized clients at risk, the following interventions are commonly implemented to prevent the development of a DVT[17]:

- Encourage early ambulation or frequent leg exercises in postoperative clients or those who are bed-bound.
- Apply mechanical measures to prevent venous stasis, as prescribed, such as sequential compression devices (SCDs) or compression stockings.
- Administer LMWH as prescribed to prevent the development of clots.

16. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/dvt/facts.html

17. National Blood Clot Alliance. (n.d.). *Stop the clot, spread the word.* https://www.stoptheclot.org/spreadtheword/

HEALTH TEACHING TO PREVENT DVTS

Nurses teach the following information to clients who are at risk for developing DVTs[18]:

- Move around as soon as possible after having been confined to bed, such as after surgery, illness, or injury.
- When sitting for long periods of time, such as when traveling for more than four hours, get up and walk around every one to two hours.
- Exercise your legs while you're sitting by raising and lowering your heels while keeping your toes on the floor and tightening and releasing your leg muscles.
- Wear loose-fitting clothes.
- Reduce your risk by stopping smoking, maintaining a healthy weight, and avoiding a sedentary lifestyle.

If a DVT is diagnosed, nurses administer prescribed anticoagulants and manage discomfort by administering analgesics as needed, while continuing to monitor for signs and symptoms of a PE. Bleeding precautions are implemented for clients receiving anticoagulants with routine monitoring for signs and symptoms of excessive bleeding.

> Review NIC interventions of bleeding precautions in the "Thrombocytopenia" section of the "Hematological Alterations" chapter.

18. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/dvt/facts.html

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Deep Vein Thrombosis

View a brief YouTube video overview of deep vein thrombosis[19]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1251#oembed-1

19. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 – Deep vein thrombosis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/tDAGmwFDFfg?si=EgdLSHVyjJtoRcAF

5.12 Aneurysm

Overview

An **aneurysm** is a dilation or bulging of a blood vessel caused by weakened vessel walls. This vascular condition poses a significant threat to client health due to its potential for rupture or dissection. An aneurysm rupture is a bursting of the aneurysm that can lead to life-threatening hemorrhage. An aneurysm dissection happens when there is a tear in the inner wall of the vessel, creating a false lumen. This leads to bleeding occurring inside the wall of the artery and can also be life-threatening. Aneurysms can occur in several vessels throughout the body but are more commonly found in arteries due to the increased pressure in these vessels. Aneurysms can be caused by a variety of factors, including fatty plaque buildup in a vessel, hypertension, trauma, or infection within a vessel, which subsequently weakens the vessel tissue. Risk factors for aneurysm development include the presence of hypertension, atherosclerosis, smoking, and age.[1,2] See Figure 5.34[3] for an illustration of aortic and abdominal aneurysms.

1. Dalman, R. L., & Mell, M. (2023). Overview of abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

2. Dalman, R. L., & Mell, M. (2023). Management of asymptomatic abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

3. "Aortic_aneurysm.jpg" by en:National Institutes of Health is in the Public Domain.

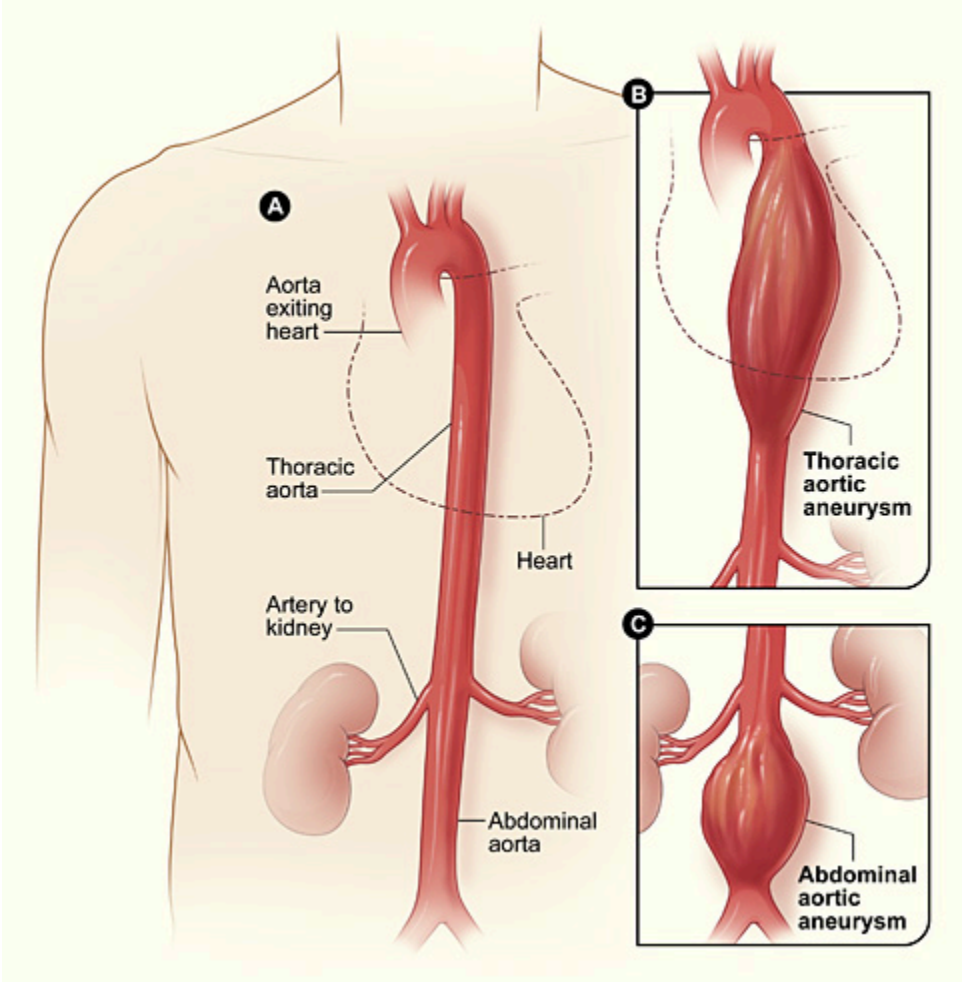


Figure 5.34 Aortic and Abdominal Aneurysms

Assessment

Physical assessment findings for an aneurysm can be challenging to identify because most manifestations of an aneurysm do not occur until they reach a significant size or rupture. Many aneurysms are found incidentally when diagnostic tests are performed for other conditions. See Table 5.12 for potential clinical manifestations of an aneurysm, based on its size and location.

Table 5.12. Potential Clinical Manifestations of an Aneurysm[4,5]

4. Dalman, R. L., & Mell, M. (2023). Overview of abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

5. Dalman, R. L., & Mell, M. (2023). Management of asymptomatic abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

Body System	Description

Cardiovascular	– Pulsatile mass located over the affected artery
	– Murmurs over affected artery
	  – Hypotension
	  – Syncope

Neurological	– Severe headache – Visual disturbances – Weakness, numbness, paralysis, or slurred speech
Respiratory	– Dyspnea – Cough

Gastrointestinal	– Abdominal tenderness
	– Abdominal pain: deep, tearing, constant
	  – Abdominal bruit or pulsatile bruit
	  – Hematemesis (vomiting blood) or melena (dark, tarry stools)
	  – Abdominal distension
	  – Palpable mass

Musculoskeletal	– Back pain (dull, aching back pain in the lumbar region for abdominal aneurysms) – Flank pain (pain in the flank or lower back for thoracic aneurysms)

Integumentary	– Cool, pale extremities – Cyanosis – Pallor – Diaphoresis

Diagnostic Testing

Diagnosis of an aneurysm may include these diagnostic imaging studies[6,7]:

- Ultrasound often is an initial helpful screening tool used to provide information about the size, shape, and location of an aneurysm.
- Computed Tomography Angiography (CTA) utilizes radiological cross-section images to provide a more detailed image of an affected vessel.
- Magnetic Resonance Angiography (MRA) may also be used to visualize aneurysms by employing a magnetic field and radio waves to create images.
- Angiography may be utilized to identify the extent of the vascular compromise.

Nursing Diagnoses

Nursing diagnoses for aneurysm focus on minimizing the risk of complications. Common nursing diagnoses for clients with an aneurysm include the following:

6. Dalman, R. L., & Mell, M. (2023). Overview of abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

7. Dalman, R. L., & Mell, M. (2023). Management of asymptomatic abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

- Risk for Deficient Fluid Volume
- Anxiety
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification involves setting short- and long-term goals and creating expected outcome statements tailored to the client's specific needs. These outcomes should be measurable and responsive to nursing interventions. Sample outcomes are as follows:

- *The client will verbalize three symptoms of a worsening aneurysm requiring notification of the health care provider.*
- *The client will verbalize three methods to decrease aneurysm progression, such as stopping smoking, reducing stress, and taking medications as prescribed.*

Interventions

Medical Interventions

Medical interventions for an aneurysm aim to manage the size and location of the aneurysm and may include watchful waiting and monitoring, medication therapy, and surgical management.

WATCHFUL WAITING AND MONITORING

Clients with small aneurysms may be regularly monitored with imaging studies (e.g., ultrasounds or CT scans) to track the aneurysm's size and growth rate. Lifestyle modifications to control risk factors, such as blood pressure and smoking cessation, are often recommended.

MEDICATION THERAPY

Medications such as beta-blockers and ACE inhibitors are commonly used to

control blood pressure and reduce force on the vessels that can worsen the aneurysm.

SURGICAL INTERVENTIONS

Several types of surgeries may be performed on an aneurysm, based on its size, symptoms, and the client's hemodynamic status.

- **Endovascular Aneurysm Repair (EVAR)** is a minimally invasive procedure where a stent graft is inserted into the aneurysm through small incisions in the groin or other access points. The graft reinforces the weakened artery wall and redirects blood flow, reducing pressure on the aneurysm and minimizing the risk of rupture.
- **Open surgical repair** occurs through an operation where the aneurysm is directly accessed, and a graft is sewn into place to replace the weakened section of the artery.
- **Coiling** is a minimally invasive procedure involving the insertion of tiny coils into the aneurysm through a catheter to promote clotting within the aneurysm and prevent blood flow.
- **Clipping** is a surgical procedure involving the placement of a small metal clip at the base of the aneurysm to block blood flow into it and prevent rupture.[8,9]

Nursing Interventions

Nursing interventions for clients with aneurysms focus on blood pressure

8. Dalman, R. L., & Mell, M. (2023). Overview of abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

9. Dalman, R. L., & Mell, M. (2023). Management of asymptomatic abdominal aortic aneurysm. *UpToDate*. https://www.uptodate.com/

control with medications and lifestyle modifications, health teaching, and psychosocial support.

BLOOD PRESSURE CONTROL

Nurses safely administer prescribed antihypertensive medications and teach clients about their purpose in reducing the risk of aneurysm enlargement. Lifestyle modifications are also encouraged for blood pressure control.

HEALTH TEACHING AND EMOTIONAL SUPPORT

Nurses actively listen to the client's concerns about an aneurysm, encourage open communication with the health care provider, and promote psychosocial support. Clear and comprehensive information about aneurysms, risk factor modification, follow-up care, and signs of complications is provided.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Aneurysm

View a brief YouTube video overview of aneurysm[10]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1267#oembed-1

10. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 – Aneurysm* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/dgdz5imF4CM?si=NrQu53H74NUstfUA

5.13 Infective Endocarditis

Overview

Infective endocarditis (IE) is an infection of the inner lining of the heart chambers and valves caused by bacteria or fungi. IE can lead to the formation of vegetations (clumps of infected material) on heart valves, causing damage to the valves that can impair cardiac function. Risk factors for IE include congenital heart disease, prosthetic heart valves, intravenous drug use, and dental procedures that result in transmission of bacteria into the bloodstream.[1] See Figure 5.35[2] for an illustration of IE.

1. Wang, A., & Holland, T. L. (2023). Overview of management of infective endocarditis in adults. *UpToDate*. https://www.uptodate.com/

2. "Endocarditis.png" by BruceBlaus is licensed under CC BY-SA 4.0

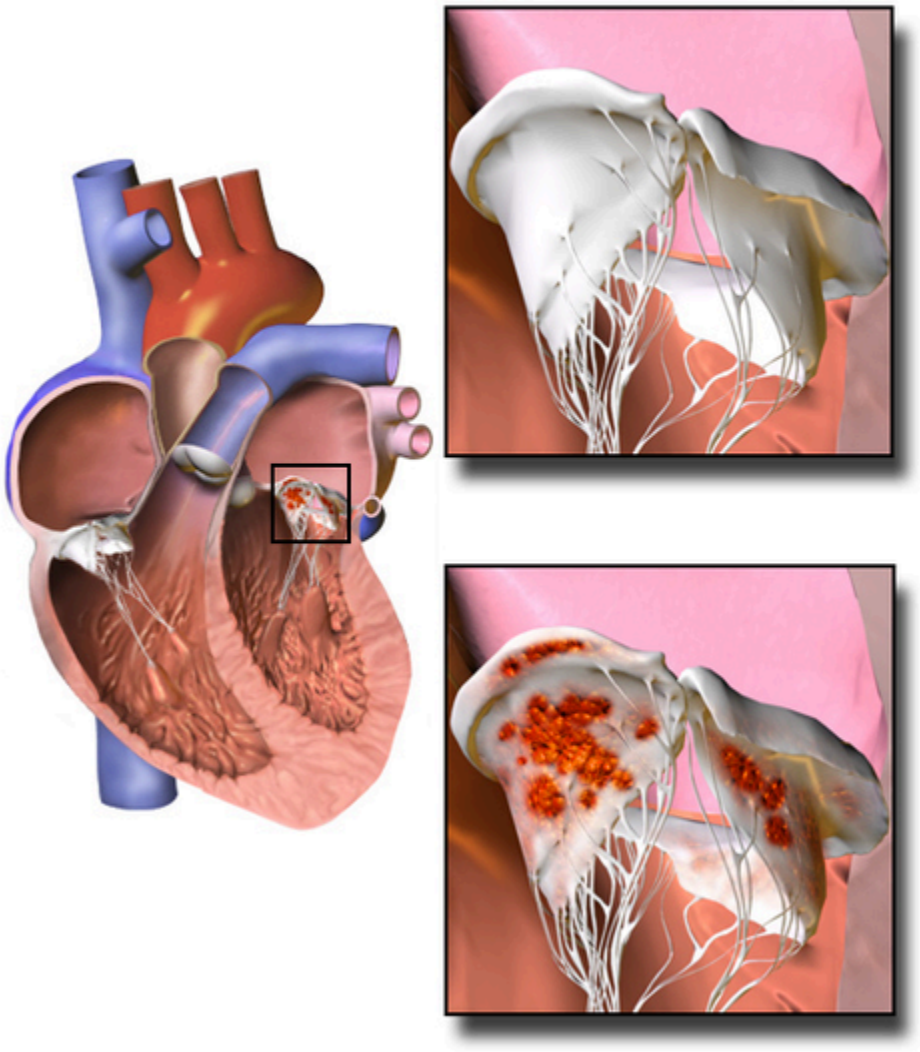


Figure 5.35 Infective Endocarditis

Assessment

Physical assessment findings for infective endocarditis (IE) can vary depending on the stage of the infection, causative microorganism, and the presence of complications. See Table 5.13 for potential clinical manifestations of IE.

Table 5.13. Potential Clinical Manifestations of Infective Endocarditis[3,4]

Body System	Description
Cardiovascular	– New or changing heart murmurs (indicating valve involvement) – Tachycardia (elevated heart rate) – Irregular heart rhythms (arrhythmias) – New signs of heart failure
Neurological	– Altered mental status – Weakness, numbness, paralysis, or slurred speech
Respiratory	– Dyspnea – Cough, fever, or respiratory distress
Integumentary	– Petechiae (small, red or purple spots) – **Splinter hemorrhages** (linear hemorrhages under nails) – **Osler's nodes** (tender subcutaneous nodules, often on fingertips) – **Janeway lesions** (nontender, red or hemorrhagic macules, often on palms or soles) – **Roth spots** (retinal hemorrhages; visible on fundoscopy)
General	– Fever, chills, night sweats, fatigue, joint pain

Diagnostic Testing`

The diagnosis of infective endocarditis (IE) typically involves a combination of clinical evaluation, laboratory tests, and imaging studies. These tests help confirm the presence of IE, identify the causative microorganism, and guide treatment.[5,6]

3. Wang, A., & Holland, T. L. (2023). Overview of management of infective endocarditis in adults. *UpToDate*. https://www.uptodate.com/
4. Spelman, D. (2022). Complications and outcome of infective endocarditis. *UpToDate*. https://www.uptodate.com/
5. Wang, A., & Holland, T. L. (2023). Overview of management of infective endocarditis in adults. *UpToDate*. https://www.uptodate.com/
6. Spelman, D. (2022). Complications and outcome of infective endocarditis. *UpToDate*. https://www.uptodate.com/

- Blood cultures are collected from individuals suspected of having IE to identify the causative microorganism.
- Echocardiography is also used to examine cardiac structures and look for the presence of vegetation on heart values.
- Complete blood cell count and C-reactive protein blood tests may be used to detect systemic infection and inflammation.

Nursing Diagnoses

Nursing diagnoses for clients with infective endocarditis guide nursing care. Examples of common nursing diagnoses are the following:

- Risk for Decreased Cardiac Output
- Risk for Infection
- Risk for Decreased Tissue Perfusion

Outcome Identification

Outcome identification involves setting short- and long-term goals and creating expected outcome statements tailored to the client's specific needs. These outcomes should be measurable and responsive to nursing interventions.

- *The client will maintain cardiac output within normal limits as evidenced by systolic blood pressure in normal range.*
- *The client will remain free from sepsis.*
- *The client will maintain effective tissue perfusion as evidenced by capillary refill less than three seconds.*

Interventions

Medical Interventions

Medical interventions for infective endocarditis aim to effectively resolve the infection and kill the causative microorganism.

MEDICATION THERAPY

Antibiotics are the cornerstone of treatment for IE. They are typically administered intravenously for several weeks to eradicate the infecting microorganism.

SURGICAL INTERVENTION

Surgeries (such as valve repair, valve replacement, or debridement of the lesion) address complications of IE and remove infected tissue.[7,8]

Nursing Interventions

Nursing interventions focus on safely administering prescribed medications, monitoring for complications, and managing pain. Nurses closely monitor for complications such as embolic events caused by vegetation, acute heart failure, and sepsis. Prescribed analgesics are safely administered if IE causes pain in locations such as the chest and joints. Nurses provide health teaching regarding the purpose of prescribed medications and signs of complications to promptly report to the health care provider.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client,

7. Wang, A., & Holland, T. L. (2023). Overview of management of infective endocarditis in adults. *UpToDate*. https://www.uptodate.com/

8. Spelman, D. (2022). Complications and outcome of infective endocarditis. *UpToDate*. https://www.uptodate.com/

reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Infective Endocarditis

View a brief YouTube video overview of infective endocarditis[9]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1293#oembed-1

9. Open RN Project. (2024, June 23). *Health Alterations – Chapter 5 – Infective endocarditis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/uOYsbEc_Wgk?si=aN9MuN30wMtmYi7q

5.14 Learning Activities

Learning Activities

Chest Pain Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Mrs. Fatima Khan is a 58-year-old female who presents to the emergency department complaining of severe chest pain that started approximately 30 minutes ago. She describes the pain as a crushing sensation located in the center of her chest, radiating to her left arm. She rates the pain as 9/10 on the pain scale and reports associated symptoms of diaphoresis, nausea, and shortness of breath. She has a medical history of hypertension, hyperlipidemia, and type 2 diabetes mellitus and no known allergies. Current medications include lisinopril 10 mg daily, metformin 1000 mg twice daily, and atorvastatin 40 mg daily.

Vital Signs: BP 180/100mmHg, HR 110 bpm, RR 24 bpm, O2 sat 92% on room air, Temperature 37.0 C (98.6 F).

Physical Examination: Client is diaphoretic with a S3 gallop, shallow respirations, and audible crackles bilaterally. Skin is cool, clammy, and pale.

Laboratory and Diagnostic Results:

- Troponin: Elevated (> 0.04 ng/mL)

1. "Chest Pain Case Study" by Open RN is licensed by CC BY-NC 4.0

- CK-MB: Elevated
- Blood Glucose: 220 mg/dL
- Total Cholesterol: 240 mg/dL
- ECG: ST-segment elevation in leads II, III, aVF, and V1-V6
- Echocardiogram: Left ventricular dysfunction with decreased ejection fraction (EF 30%)

Questions:

1. What is the significance of elevated troponin levels in a client with suspected MI?
2. How do elevated CK-MB levels contribute to the diagnosis of MI, and how do they differ from troponin levels in timing and specificity?
3. Why is it important to monitor blood glucose levels in a client with acute MI, and what impact can elevated levels have on the client's prognosis?
4. Describe the role of total cholesterol levels in the assessment of cardiovascular risk and their relevance in the management of MI.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=1300#h5p-19

"Cardiology Glossary Cards" by Open RN is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=1300#h5p-20

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An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=1300#h5p-21

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An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=1300#h5p-56

2

2. "Case Study: Peripheral Arterial Disease" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

- Test your knowledge on pediatric cardiovascular conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[3]

- Test your knowledge on heart failure using this NCLEX Next Generation-style multiple response question. You may reset and resubmit your answers to this question an unlimited number of times.[4]

- Test your knowledge on heart failure using this NCLEX Next Generation-style case

3. "Pediatric Cardiovascular Bowtie" by Jennifer Hinz and OpenRN is licensed under CC BY-NC 4.0

4. "Heart Failure Multiple Response" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

study. You may reset and resubmit your answers to this question an unlimited number of times.[5]

- Test your knowledge using this NCLEX Next Generation-style question. You may reset and resubmit your answers to this question an unlimited number of times.[6]

- Test your knowledge on peripheral arterial disease using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[7]

5. "Heart Failure – Level 2" by Angela Landry for OpenRN is licensed under CC BY-NC 4.0

6. "PAD" by Kellea Ewen for OpenRN is licensed under CC BY-NC 4.0

7. "Peripheral Arterial Disease" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on venous insufficiency using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[8]

- Test your knowledge on myocardial infarction using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[9]

Telehealth Scenarios

Telehealth is an innovative technology that can bridge the gap between health care professionals and clients, especially for clients who live in remote areas. Telehealth makes health care not only more accessible but can also provide continuity of care and prevent unnecessary hospitalizations. Nurses who provide telehealth services become digital communicators and

8. "Venous Insufficiency" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

9. "Cardiac Case Study" by Travis Christman for OpenRN is licensed under CC BY-NC 4.0

educators, clinical expertise with empathy and effective online communication.

Practice using effective telehealth communication in the following three scenarios with an 80-year-old Hispanic male who has chronic heart failure and is self-managing his condition at home[10]

- Alejandro Hernandez, Telehealth Visit 1: Post-hospitalization Follow-Up
- Alejandro Hernandez, Telehealth Visit 2: Identifying Learning Needs
- Alejandro Hernandez, Telehealth Visit 3: Evaluating Effectiveness of Health Teaching

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V Glossary

Acute coronary syndrome: A group of conditions that involves a sudden compromise in blood flow to the myocardium. (Chapter 5.7)

Afterload: The force the ventricles must generate to pump blood against the resistance in the vessels. (Chapter 5.2)

Aneurysm: Dilation or bulging of a blood vessel caused by weakened vessel walls. (Chapter 5.12)

Angina: Chest pain or discomfort that is unpredictable and occurs at rest or with minimal exertion. (Chapter 5.7)

Angioplasty: Use of a balloon to stretch open a blocked artery. (Chapter 5.3)

Ankle-brachial index (ABI): An assessment comparing the blood pressure in the arms (brachial artery) to that in the ankles (dorsalis pedis or posterior tibial arteries). (Chapter 5.9)

Arteriosclerosis: The thickening and stiffening of arterial walls. (Chapter 5.6)

Artery: A blood vessel that carries blood away from the heart. (Chapter 5.2)

Ascites: Abnormal fluid accumulation in the abdomen. (Chapter 5.3, Chapter 5.8)

Atherosclerosis: Buildup of cholesterol, fatty deposits, and wastes within the lining of the arteries. (Chapter 5.6)

Blood pressure: The force exerted by blood on the walls of the blood vessels. (Chapter 5.2)

Bradycardia: The condition in which resting rate drops below 60 bpm. (Chapter 5.2, Chapter 5.3)

Capillary: A microscopic channel that supplies blood to the tissue cells where nutrients and wastes are exchanged at the cellular level. (Chapter 5.2)

Capillary refill test: Test performed on the nail beds to monitor perfusion. (Chapter 5.3)

Cardiac catheterization: A diagnostic procedure used to visualize the coronary arteries, heart chambers, and great vessels; also known as coronary angiography or angiogram. (Chapter 5.3)

Cardiac output (CO): Measurement of the amount of blood pumped by each ventricle in one minute. (Chapter 5.2)

Cardiac stress test: A diagnostic procedure used to evaluate the

performance and function of the heart during physical activity; also known as an exercise stress test or treadmill test. (Chapter 5.3)

Cardiovascular disease (CVD): Disease that affects the heart and blood vessels. (Chapter 5.1)

Clipping: A surgical procedure involving the placement of a small metal clip at the base of the aneurysm to block blood flow into it and prevent rupture. (Chapter 5.12)

Coiling: A minimally invasive procedure involving the insertion of tiny coils into the aneurysm through a catheter to promote clotting within the aneurysm and prevent blood flow into it. (Chapter 5.12)

Compliance: The ability of any compartment to expand to accommodate increased content. (Chapter 5.2)

Contractility: The force or strength of the contraction itself. (Chapter 5.2)

Coronary angiogram: A procedure that uses a special dye (contrast material) and X-rays to see how blood flows through the arteries in the heart. (Chapter 5.3)

Coronary artery disease (CAD): Plaque buildup that causes the inside of the coronary arteries to narrow over time, which can partially or totally block the blood flow to the muscle tissue of the heart. (Chapter 5.7)

D-dimer: A blood test that is a marker for the presence of blood clots, specifically the breakdown products of fibrin that result from the dissolution of a blood clot. (Chapter 5.11)

Deep vein thrombosis: A blood clot in a peripheral deep vein. (Chapter 5.11)

Diastole: Period of relaxation that occurs as the chambers fill with blood. (Chapter 5.2)

Duplex ultrasonography: An imaging test that uses sound waves to look at the flow of blood in the veins. (Chapter 5.11)

Dyspnea: Shortness of breath. (Chapter 5.3, Chapter 5.8)

Dysrhythmia: An altered conduction of the electrical signal through the heart, resulting in an abnormal rate or rhythm.

Echocardiography: A noninvasive diagnostic test that uses sound waves (ultrasound) to create real-time images of the heart's structure and function. (Chapter 5.3)

Edema: Excess fluid around the cells. (Chapter 5.2)

Electrocardiogram (EKG or ECG): A recording of the electrical activity of the heart that allows health care professionals to assess the heart's rhythm and identify various cardiac conditions. (Chapter 5.3)

Embolus: A portion of a thrombus that breaks free from the vessel wall and enters the circulation. (Chapter 5.6)

Endarterectomy: Surgical removal of plaque from the arteries. (Chapter 5.6)

Endovascular aneurysm repair (EVAR): A minimally invasive procedure where a stent graft is inserted into the aneurysm through small incisions in the groin or other access points. (Chapter 5.12)

Epicardial pacemakers: Pacemakers inserted through an incision in the chest, and the leads are attached to the heart. (Chapter 5.3)

Heart failure (HF): Occurs when the heart loses its effectiveness in pumping blood and is referred to as decreased cardiac output. (Chapter 5.8)

Heart rate (HR): The number of times the heart beats per minute. (Chapter 5.2)

Hematemesis: Vomiting of blood. (Chapter 5.12)

Hemoptysis: Coughing up blood. (Chapter 5.11)

Holter monitor: A portable device designed to continuously record a client's heart rhythm and electrical activity over an extended period, typically 24 to 48 hours. (Chapter 5.3)

Hypertension: Chronically elevated blood pressure greater than 120/80 mm Hg. (Chapter 5.5)

Hypervolemia: Excessive fluid volume. (Chapter 5.2)

Hypovolemia: Low blood volume. (Chapter 5.2)

Infarct: The most significant area of damage during an MI. (Chapter 5.7)

Infective endocarditis: A potentially life-threatening infection of the inner lining of the heart chambers and valves. (Chapter 5.13)

Injured: Tissues located next to ischemic area that can remain viable as long as oxygen is delivered to the tissue by pathways that circumvent the blockage. (Chapter 5.7)

Intermittent claudication: Muscle pain, cramping, or fatigue during physical activity (e.g., walking) that resolves with rest and recurs with activity. (Chapter 5.9)

Ischemia: Condition in which oxygenated blood flow to tissue is reduced. (Chapter 5.7)

Janeway lesions: Nontender, red, or hemorrhagic macules often found on the palms of the hands or soles of the feet. (Chapter 5.13)

Jugular venous distention (JVD): Distended jugular vein when client is positioned at 45 degrees. (Chapter 5.3)

Melena: Dark, tarry stools. (Chapter 5.12)

Metabolic syndrome: A group of conditions that increase the risk of coronary heart disease, diabetes, and stroke. The conditions include elevated blood pressure, blood glucose, and triglyceride levels, as well as increased waist circumference. (Chapter 5.3)

Modifiable risk factors: Risk factors that an individual can control through their actions, behavior, or lifestyle choices. (Chapter 5.3)

Murmurs: Abnormal heart sounds that may indicate valvular or structural heart abnormalities. (Chapter 5.3)

Myocardial infarction (MI): Commonly referred to as a "heart attack"; occurs when there is a sudden blockage within the coronary arteries that occludes oxygenated blood flow to the heart tissue. (Chapter 5.7)

Myocardial ischemia: Also known as "heart attack." Myocardial ischemia occurs when there is decreased blood flow through the coronary arteries. (Chapter 5.3)

Negative inotropic factors: Factors that increase contractility. (Chapter 5.2)

Nonmodifiable risk factors: Risk factors are those that cannot be changed. (Chapter 5.3)

Open surgical repair: An operation where the aneurysm is directly accessed, and a graft is sewn into place to replace the weakened section of the artery. (Chapter 5.12)

Orthopnea: Shortness of breath when lying flat. (Chapter 5.3, Chapter 5.8)

Osler's nodes: Tender subcutaneous nodules often found on the fingertips. (Chapter 5.13)

Paroxysmal nocturnal dyspnea: Sudden nighttime breathlessness. (Chapter 5.3)

Pectus carinatum: Protrusion of the chest. (Chapter 5.3)

Pectus excavatum: Depression of the chest. (Chapter 5.3)

Percutaneous transluminal angioplasty (PTA): A minimally invasive procedure in which a catheter is inserted into a narrowed artery and a balloon is inflated to compress the plaque and widen the artery. (Chapter 5.9)

Perfusion: The passage of blood through the blood vessels. (Chapter 5.2)

Pericardial friction rub: A high-pitched, scratchy sound that occurs when the inflamed pericardial layers rub against each other. (Chapter 5.3)

Peripheral artery disease (PAD): A type of atherosclerosis in which narrowed or blocked arteries reduce blood flow to the limbs, usually the legs; also known as peripheral vascular disease (PVD). (Chapter 5.9)

Poikilothermia: Coolness in an affected limb. (Chapter 5.9)

Point of maximum impulse (PMI): The location where the apex of the heart touches the chest wall. (Chapter 5.3)

Positive inotropic factors: Factors that increase contractility. (Chapter 5.2)

Precordium: Area over the heart. (Chapter 5.3)

Preload: End diastolic volume. (Chapter 5.2)

Primary hypertension: The most common type of hypertension that typically has no identifiable cause. It tends to develop gradually over time and is influenced by various risk factors such as genetics, age, race, diet, lifestyle, and stress. (Chapter 5.5)

Pulse: Expansion and recoiling of the arterial wall. (Chapter 5.2)

Roth spots: Retinal hemorrhages that are visible on fundoscopy. (Chapter 5.13)

S1: The first heart sound, often described as “lub,” that corresponds to the closure of the atrioventricular valves (i.e., the mitral and tricuspid valves). (Chapter 5.3)

S2: The second heart sound, described as “dub,” that corresponds to the closure of the semilunar valves (aortic and pulmonic valves). (Chapter 5.3)

S3: A low frequency heart sound, known as a ventricular gallop, that is heard shortly after the S2 and precedes S1. (Chapter 5.3)

S4: A sound heard late in the cardiac cycle, just before S1; known as an atrial gallop. (Chapter 5.3)

Secondary hypertension: Hypertension that occurs as the result of an underlying medical condition or medication. (Chapter 5.5)

Segmental pressure measurements: Blood pressure readings at multiple

levels along the limbs (e.g., thigh, calf, ankle) to help identify specific locations of arterial narrowing or blockage. (Chapter 5.9)

Sinoatrial (SA) node: Establishes normal cardiac rhythm within the heart. (Chapter 5.2)

Sinus rhythm: Normal electrical pattern of the heart. (Chapter 5.2)

Splinter hemorrhages: Linear hemorrhages under the nails. (Chapter 5.13)

Stent: Insertion of a small mesh tube to help expand an artery. (Chapter 5.3)

Stroke volume (SV): The quantity of blood pumped out of the left ventricle with contraction of the heart muscle. (Chapter 5.2)

Systole: Period of contraction that the heart undergoes while it pumps blood into circulation. (Chapter 5.2)

Tachycardia: Heart rate over 100 beats per minute. (Chapter 5.2, Chapter 5.3)

Thrills: Vibratory sensations over the precordium, particularly in areas where murmurs are suspected. (Chapter 5.3)

Transesophageal echocardiogram: A invasive procedure that involves the insertion of an ultrasound probe via the esophagus to produce a more detailed ultrasound image of heart. (Chapter 5.3)

Transthoracic echocardiogram: A noninvasive diagnostic test that uses sound waves (ultrasound) to create real-time images of the heart's structure and function. (Chapter 5.3)

Transvenous pacemakers: Pacemakers inserted through a vein and threaded into the heart. (Chapter 5.3)

Troponin: A blood test used to help diagnose myocardial infarction that measures protein released into the bloodstream when heart tissue is damaged. (Chapter 5.7)

Veins: Blood vessels that return blood to the heart. (Chapter 5.2)

Venous insufficiency: A condition that occurs when the veins in the legs have difficulty returning blood back to the heart. (Chapter 5.10)

Venous reserve: Volume of venous blood located in venous networks within the liver, bone marrow, and integument. (Chapter 5.2)

Venous stasis: Slow blood flow in the veins, usually in the legs. (Chapter 5.8, Chapter 5.11)

Venules: Small veins. (Chapter 5.2)

PART VI

CHAPTER 6 RESPIRATORY ALTERATIONS

6.1 Respiratory Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with respiratory disorders
- Explain the pathophysiology of respiratory disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in caring for the client with respiratory disorders
- Integrate common pharmacological and nonpharmacological measures for the client with respiratory disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=85#h5p-40

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The respiratory system is a complex and intricate network of organs and tissues that play a pivotal role in the overall health and well-being of an individual. Its primary function is gas exchange with the intake of oxygen and the elimination of carbon dioxide from the body.

The respiratory system works in conjunction with the cardiovascular system, enabling the delivery of oxygen throughout the body and the removal of carbon dioxide at the cellular level.

Health alterations in the respiratory system can have profound consequences on an individual's physical and emotional well-being. When the respiratory system falters, it can lead to numerous health issues, ranging from coughing and shortness of breath to more severe conditions that impact the ability to sustain life.

The emotional and psychological impact of respiratory disorders should also not be underestimated. Individuals dealing with chronic respiratory disease often experience anxiety, depression, and reduced quality of life due to their limited ability to engage in activities of daily living, enjoy hobbies, or even socialize with others. **Dyspnea** is a hallmark symptom of many respiratory disorders and is defined as a feeling of difficulty breathing or air hunger. Dyspnea can be particularly distressing, not only because of the feeling of anxiety that it provokes, but also because it impairs one's sense of control and autonomy, leading to increased stress and emotional strain. In addition to administering medications and providing health teaching related to respiratory health alterations, nurses also provide psychosocial support to help clients manage their feelings of dyspnea and anxiety and enhance their quality of life.

This chapter will review the anatomy and physiology of the respiratory system; provide an overview of general respiratory system assessments, diagnostic tests, and interventions; and then discuss common respiratory alterations of asthma, chronic obstructive pulmonary disease, pneumonia, lung cancer, tuberculosis, and miscellaneous respiratory disorders.

6.2 Review of Anatomy and Physiology of the Respiratory System

This section will review the anatomy and physiology of the respiratory system. Common disorders affecting these anatomic structures are also introduced. See Figure 6.1[1] for an illustration of the major structures of the respiratory system.

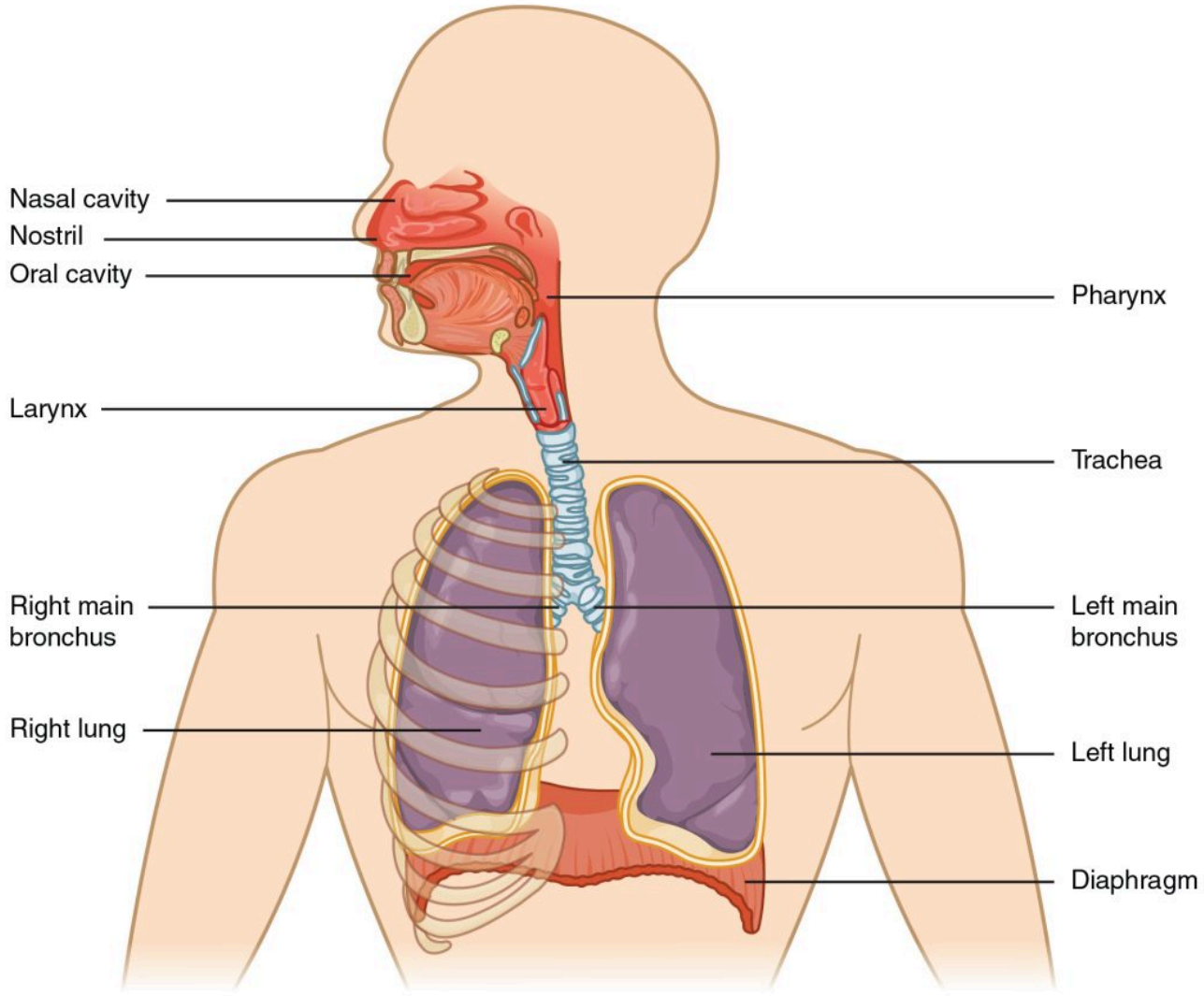


Figure 6.1 Major Structures of the Respiratory System

1. "2301_Major_Respiratory_Organs.jpg" by OpenStax College is licensed under CC BY 3.0

Nose, Nasal Cavity, and Sinuses

The upper respiratory system refers to the nose, nasal cavities, sinuses, pharynx, and larynx. See Figure 6.2[2] for an illustration of anatomic structures of the upper respiratory system. An **upper respiratory infection (URI)** refers to a viral infection of one or more of these structures.

The entrance and exit for the respiratory system are through the nose. The nostrils are the opening to the nose, also referred to as nares. The nares and nasal cavities are lined with mucous membranes, containing sebaceous glands and hair follicles that serve to prevent the passage of large debris, such as dirt, through the nasal cavity. **Rhinorrhagia** refers to bleeding from the nose, also called **epistaxis**. **Rhinitis** refers to inflammation of the nasal mucosa.

The nares open into the nasal cavity, which is separated into left and right sections by the **nasal septum**. The floor of the nasal cavity is composed of the hard palate and the soft palate. The nasal cavities are lined with mucous membranes that produce mucus, a substance created for lubrication and protection. **Rhinorrhea**, commonly referred to as a "runny nose," is a medical term for excess mucus production by the nasal cavities.

Adjacent to the nasal cavity are the sinuses that serve to warm and humidify incoming air. There are four sinuses named for their adjacent bones: frontal sinus, maxillary sinus, sphenoidal sinus, and ethmoidal sinus. Air moves from the nasal cavities and sinuses into the pharynx. **Sinusitis** refers to inflammation of the sinus cavities.[3]

2. "Blausen_0872_UpperRespiratorySystem.png" by Blausen.com staff (2014). Medical gallery of Blausen Medical 2014 is licensed under CC BY 3.0

3. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

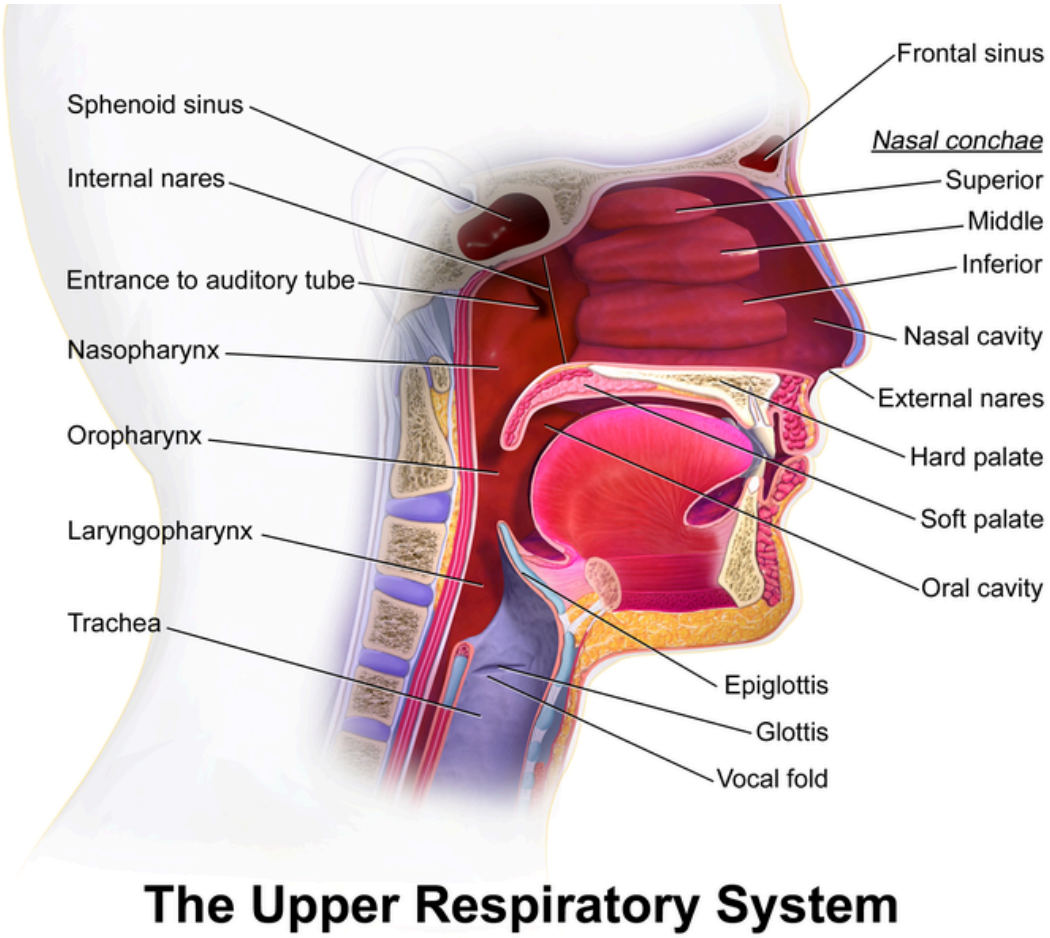


Figure 6.2 Upper Respiratory System

Pharynx

The **pharynx**, commonly known as the throat, is divided into three major regions: the nasopharynx, the oropharynx, and the laryngopharynx. See Figure 6.3[4] for an illustration of the regions of the pharynx.[5]

4. "2305_Divisions_of_the_Pharynx.jpg" by OpenStax College is licensed under CC BY 3.0

5. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

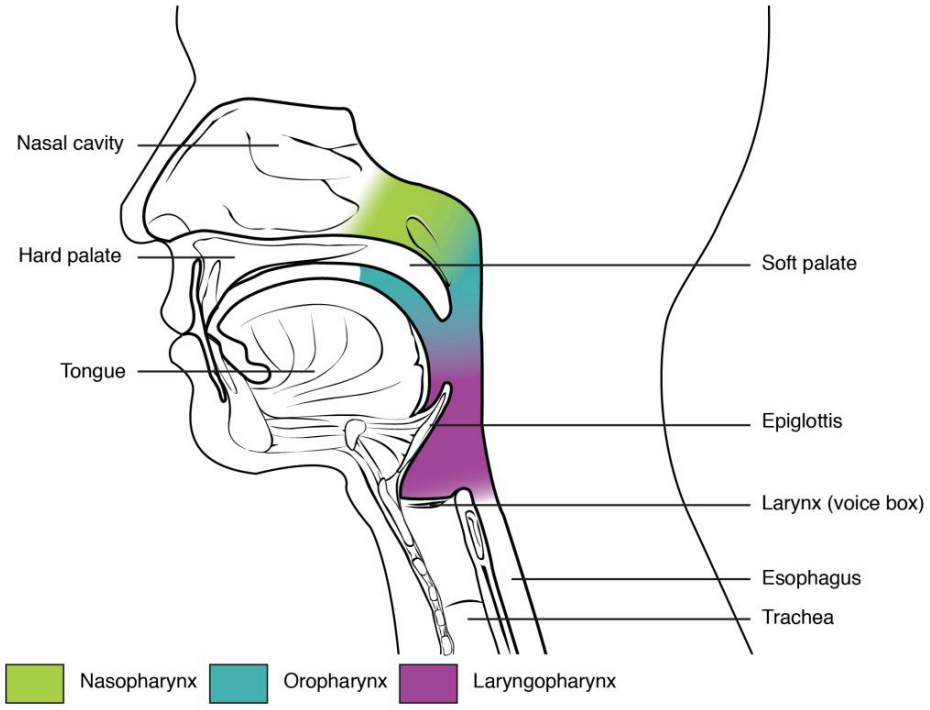


Figure 6.3 Regions of the Pharynx

At the top of the nasopharynx is the pharyngeal tonsil, also called adenoid. The function of the pharyngeal tonsil is to trap and destroy invading pathogens that enter the airway during inhalation. **Pharyngitis** is inflammation of the pharynx, and tonsillitis is inflammation of the tonsils.[6]

The soft palate and a bulbous structure called the uvula swing upward during swallowing to close off the nasopharynx to prevent ingested materials from entering the nasal cavity. Eustachian tubes connect the middle ear cavities with the nasopharynx. This connection is why upper respiratory infections often lead to ear infections.[7]

The oropharynx is bordered superiorly by the nasopharynx and anteriorly by the oral cavity. The oropharynx contains two distinct sets of tonsils called the

6. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

7. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

palatine tonsils and lingual tonsils that also trap and destroy pathogens entering the body through the oral or nasal cavities. **Adenoids** are lymphatic tissue between the back of the nasal cavity and the pharynx. **Adenoiditis** refers to inflammation of the adenoids, a common medical condition in young children that can hinder speaking and breathing.[8]

The laryngopharynx is just below the oropharynx. It is part of the pharynx (throat) located behind the larynx. The laryngopharynx separates into the trachea (the tube going into the larynx) and the esophagus (the tube going into the stomach). The epiglottis prevents food and fluid from entering the trachea while swallowing.[9]

Larynx

The structure of the **larynx** is formed by several pieces of cartilage, as shown in Figure 6.4.[10] Three large cartilage pieces form the major structure of the larynx called the thyroid cartilage (the larger piece of cartilage on the anterior side), epiglottis (at the top of the larynx), and cricoid cartilage (just inferior to the thyroid cartilage). **Laryngitis** refers to inflammation of the larynx, specifically the vocal cords, typically resulting in huskiness or loss of one's voice and a cough.[11]

8. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

9. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

10. "2306_The_Larynx.jpg" by OpenStax College is licensed under CC BY 3.0

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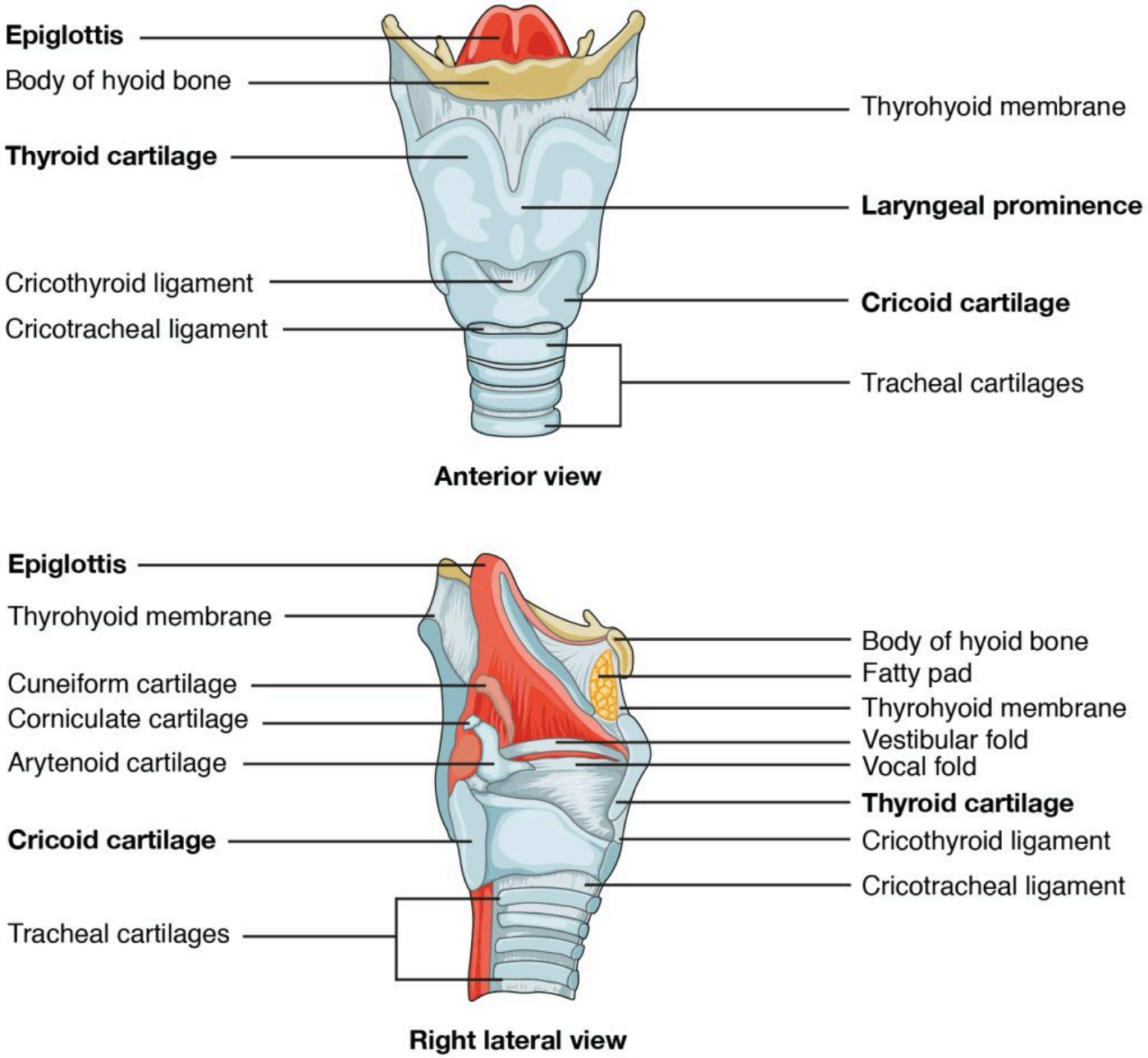


Figure 6.4 Larynx

The **epiglottis** is a flap of tissue that covers the trachea during swallowing to prevent **aspiration**, the inhalation of food or fluids into the trachea and lower respiratory tract. The act of swallowing causes the pharynx and larynx to lift

upward, allowing the pharynx to expand and the epiglottis of the larynx to swing downward, closing the opening to the trachea.[12]

Vocal cords are white, membranous folds attached by muscle to the cartilages of the larynx on their outer edges. The inner edges of the vocal cords are free, allowing oscillation as air passes through to produce sound for speaking.[13]

The lower respiratory tract consists of the trachea, bronchi, alveoli, and lungs.[14]

Trachea

The **trachea** is formed by stacked, C-shaped pieces of cartilage that are connected by dense connective tissue. See Figure 6.5[15] for an illustration of the trachea. The trachea stretches and expands slightly during inhalation and exhalation, whereas the rings of cartilage provide structural support and prevent the trachea from collapsing. The trachea is lined with cilia and mucus-secreting cells to trap debris and move it towards the pharynx to be swallowed or spit out.[16]

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15. "Trachea" by Meredith Pomietlo is a derivative of "File:2308a_The Trachea" by OpenStax Anatomy and Physiology and is licensed under CC BY 4.0

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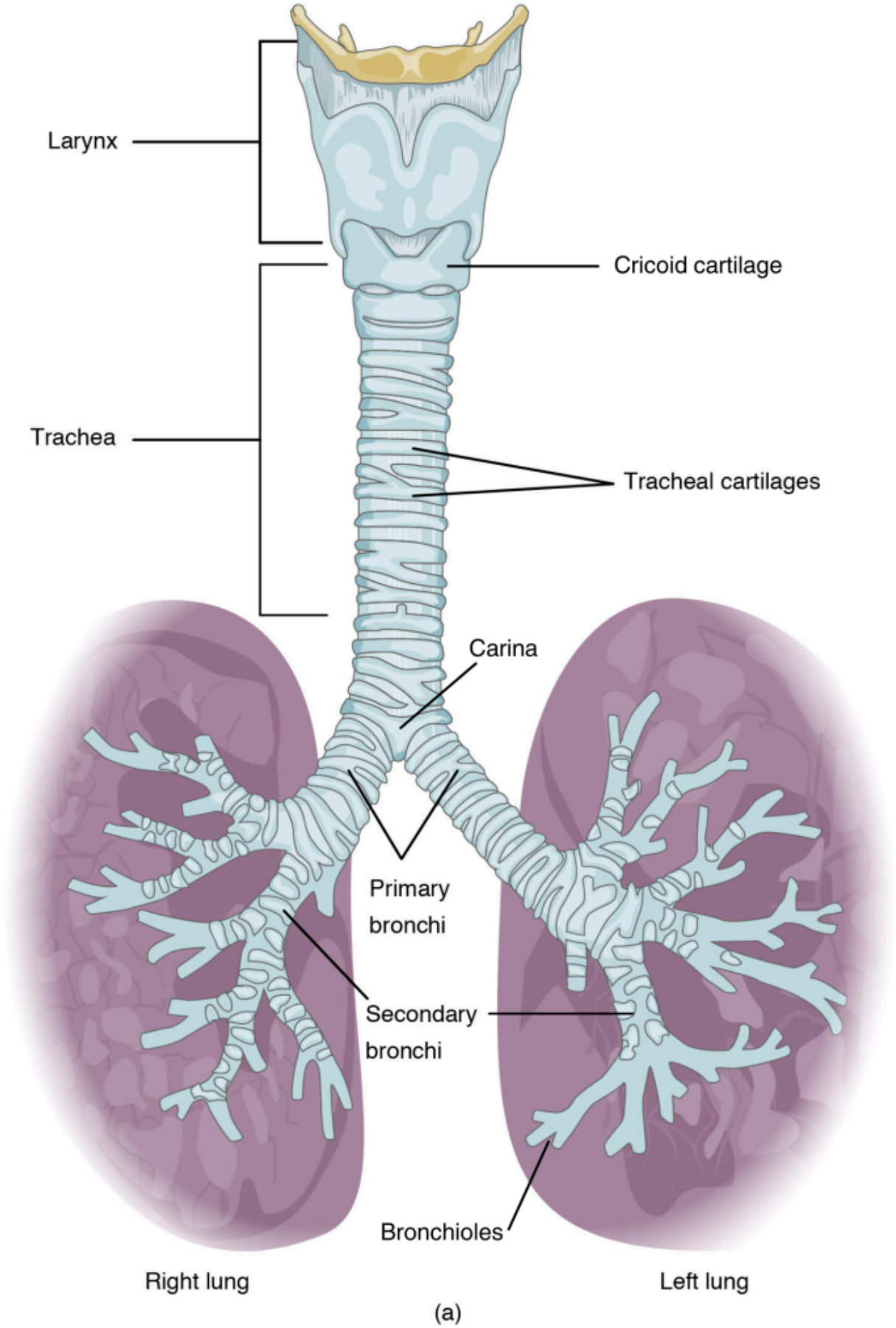


Figure 6.5 Trachea

If the upper respiratory tract becomes blocked with mucus, inflammation, or a foreign object, no air can pass to the lungs, causing a life-threatening emergency requiring a tracheostomy. A **tracheostomy** is an incision created in the trachea to create an artificial opening to allow breathing when an obstruction is present.[17]

Bronchi and Bronchioles

Bronchi are the main air passageways of the lungs. The trachea branches into the right and left primary bronchi at the carina. The **carina** is a raised structure that contains specialized nervous system tissue that induces violent coughing if a foreign body, such as food, is present. Rings of cartilage, similar to those of the trachea, support the structure of the bronchi and prevent their collapse. The bronchi of each lung continue to branch up to 26 times creating the bronchial tree, which looks similar to the branching of an actual tree. The main function of the bronchi is to provide a passageway for air to move into and out of each lung.[18]

Bronchioles are the smallest branches of the bronchi that lead to the alveolar sacs. The muscular walls of these tiny bronchioles do not contain cartilage like those of the bronchi, so the muscular wall can change the size of the bronchioles to increase or decrease airflow to the alveoli. **Bronchospasm** is a symptom of many respiratory conditions that refers to a sudden constriction of the muscles in the walls of the bronchioles. **Bronchitis** refers to inflammation of the bronchi.[19]

The trachea, bronchi, and bronchioles are lined with mucous membranes

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that create mucus secretions that can be expelled through the mouth, also referred to as **sputum**.[20]

Alveoli

Alveoli are small, grape-like sacs where gas exchange occurs. See Figure 6.6[21] for an illustration of one alveolus surrounded by capillaries. The blue capillaries refer to deoxygenated blood transported to the lungs from the pulmonary artery, and the red capillaries refer to oxygenated blood that is being transported back to the heart via the pulmonary vein. Note in this case that a vein is carrying oxygenated blood. Veins always carry blood back to the heart, but most of the time, it is deoxygenated. However, in this case, the pulmonary vein is transporting blood that is oxygenated back to the heart because it is being transported from the lungs.[22]

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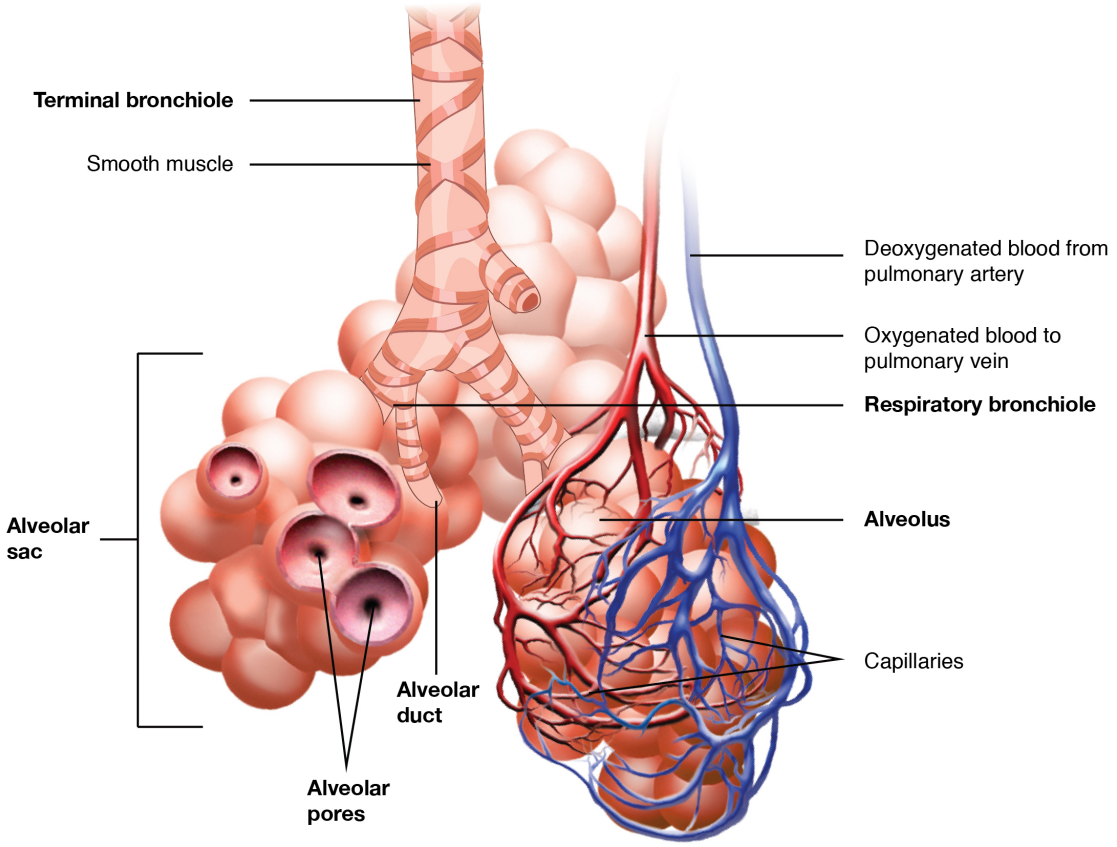


Figure 6.6 Alveolus

Alveoli have elastic walls that allow the alveolus to stretch during air intake, which greatly increases the surface area available for gas exchange. Alveoli secrete **surfactant**, a slippery substance that keeps the lungs from collapsing. **Atelectasis** is a medical term that refers to the collapse of alveoli and/or small passageways of the lungs that can result in a partially or completely collapsed lung.[23]

Lungs

The **lungs** are connected to the trachea by the main (primary) bronchi that

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branches into the right and left bronchi. See Figure 6.7[24] for an illustration of the lungs. On the inferior surface, the lungs are bordered by the diaphragm. The cardiac notch, a medial indentation found only on the left lung, allows space for the heart. The apex of the lung is the superior region, whereas the base is the distal region near the diaphragm.[25]

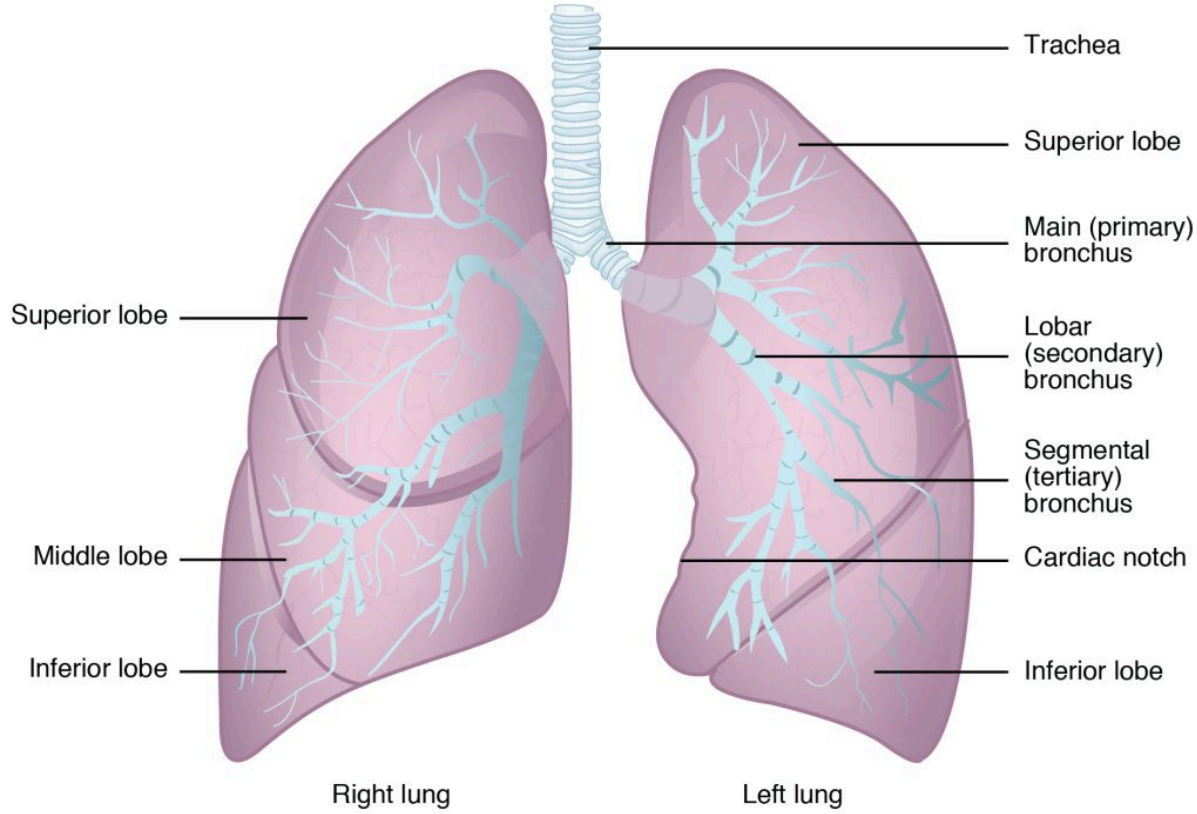


Figure 6.7 Lungs

Each lung is composed of smaller units called **lobes**. The right lung consists of three lobes: the superior, middle, and inferior lobes. The left lung is smaller and only contains two lobes, superior and inferior, as it shares space with the

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heart. Each lobe receives its own large bronchus that has multiple branches. A **lobectomy** refers to surgical removal of a lobe of the lung.[26]

There are two pleural membranes in the lungs. The visceral pleura is a thin membrane on the outer surface of the lungs. The parietal pleura lines the inside of the thoracic cavity. Between these two membranes is the **pleural cavity** that contains pleural fluid to reduce friction and also sticks to the lungs to help keep them inflated. See Figure 6.8[27] for an illustration of the pleural membranes and the pleural cavity. **Pleural effusion** refers to excessive fluid between the pleural membranes that is commonly caused by disease or trauma.[28]

26. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

27. "2313_The_Lung_Pleurea.jpg" by OpenStax College is licensed under CC BY 3.0.

28. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

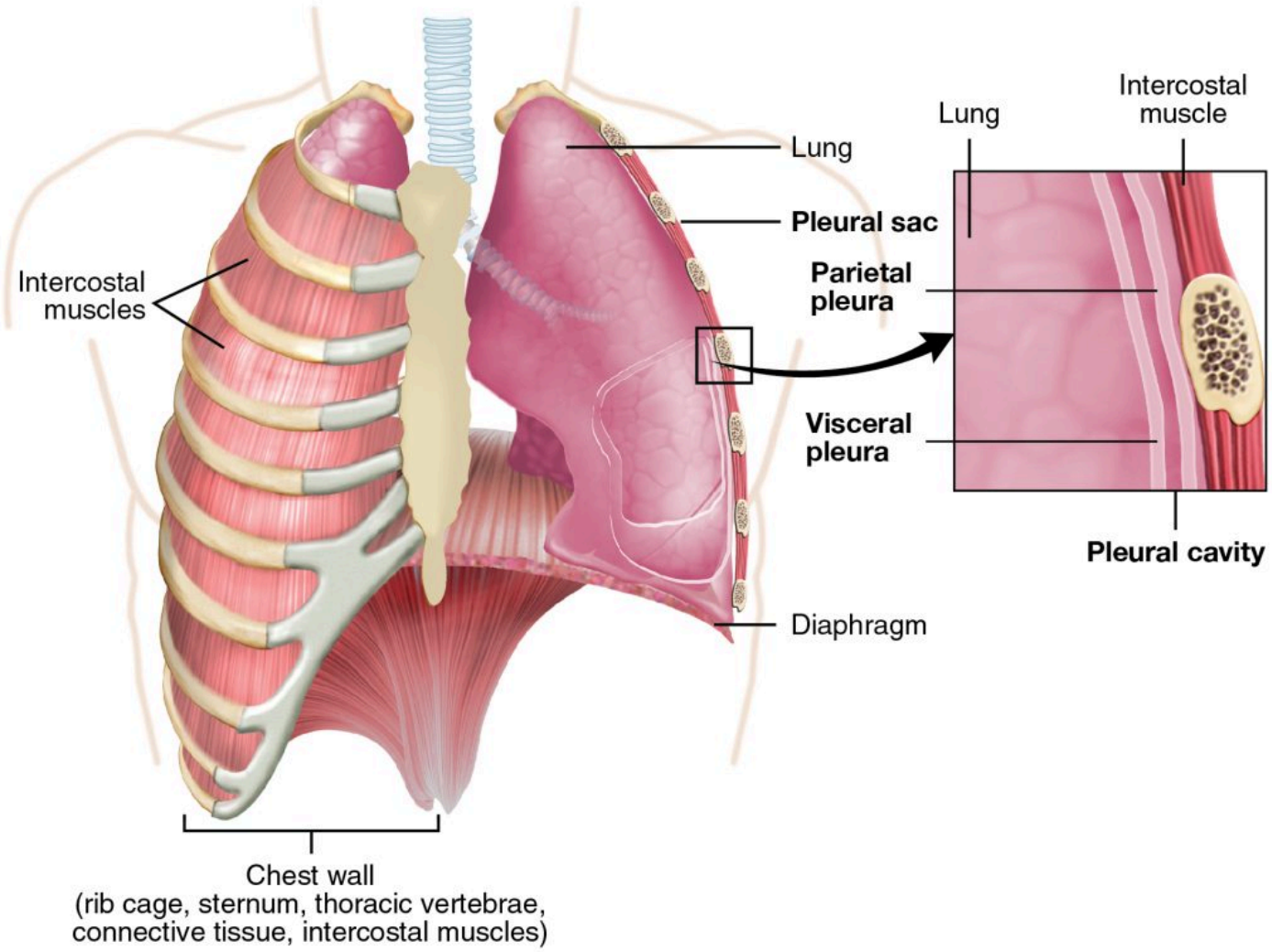


Figure 6.8 Pleural Cavity

The main function of the respiratory system is **gas exchange**, meaning providing the body with a constant supply of oxygen to the body and removing carbon dioxide. To achieve gas exchange, the structures of the respiratory system create the mechanical movement of air into and out of the lungs called **ventilation**.[29]

29. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

Ventilation and the Mechanics of Breathing

The lungs bring oxygen to the cells of our body through inhalation and exhalation. **Inhalation**, also called inspiration, is the act of breathing air inward. During inhalation, the diaphragm contracts and flattens, creating a larger lung cavity, which decreases the pressure inside the lungs. At the same time, the intercostal muscles (the muscles between the ribs) pull downward, also causing the thoracic cavity to expand. The **thoracic cavity** is the space inside the chest that contains the heart, lungs, and other organs. As the thoracic cavity expands, a negative pressure (i.e., vacuum) is created inside the chest cavity, causing air to rush into the lungs (because air always moves from high pressure to low pressure).[30]

During **exhalation**, also called expiration or the act of breathing out, the diaphragm relaxes and the thoracic cavity springs back to its original position. This causes the volume of the thoracic cavity to decrease and pressure to increase, causing air to leave the lungs.

Lung sounds are caused by the movement of air from the trachea to the bronchioles to the alveoli and can be impacted by the presence of sputum, bronchoconstriction, or fluid in the alveoli. These sounds are referred to as rhonchi (coarse crackles), rales (fine crackles), wheezes, stridor, and pleural rub[31]:

- **Rhonchi**, also referred to as coarse crackles, are low-pitched, continuous sounds heard on expiration that are a sign of turbulent airflow through mucus in the large airways.
- **Rales**, also called fine crackles, are popping or crackling sounds heard on inspiration. They are associated with medical conditions that cause fluid accumulation within the alveolar and interstitial spaces, such as heart

30. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

31. Ernstmeyer, K., & Christman, E. (Eds.). (2023). Nursing skills 2e. Open RN. https://wtcs.pressbooks.pub/nursingskills/

failure or pneumonia. The sound is similar to that produced by rubbing strands of hair together close to your ear.

- **Wheezes** are whistling noises produced when air is forced through airways narrowed by bronchoconstriction or mucosal edema. For example, clients with asthma commonly have wheezing.
- **Stridor** is heard only on inspiration. It is associated with obstruction of the trachea/upper airway.
- **Pleural rub** sounds like the rubbing together of leather and can be heard on inspiration and expiration. It is caused by inflammation of the pleura membranes that results in friction as the surfaces rub against each other.

> Listen to lungs sounds in the "Respiratory Assessment" section of the "Respiratory Assessment" chapter of Open RN *Nursing Skills, 2e*.

Forced breathing is a type of breathing that can occur during exercise, singing, or playing a musical instrument. During forced breathing, inspiration and expiration both occur due to muscle contractions. In addition to the contraction of the diaphragm and intercostal muscles, other accessory muscles must also contract. Muscles of the neck contract and lift the thoracic wall, increasing lung volume, and accessory muscles of the abdomen contract, forcing abdominal organs upward against the diaphragm. This helps to push the diaphragm farther into the thorax, pushing out more air. In addition, accessory muscles help to compress the rib cage, which also reduces the volume of the thoracic cavity. These additional muscle contractions during inspiration also occur during **labored breathing**, a symptom of many respiratory disorders.[32]

32. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

Control of Breathing

Respiratory rate is the number of breaths taken per minute. The normal respiratory rate for adults is 12-20 breaths per minute. A child under 1 year of age has a normal respiratory rate between 30 and 60 breaths per minute. By the time a child is about eleven years old, the normal rate is closer to 14 to 22.

Respiratory rate may increase or decrease during illness or disease. Medical terms related to breathing include **tachypnea** (rapid breathing), **bradypnea** (slow breathing), and **apnea** (episodes of the absence of breathing). **Dyspnea** is a common symptom of respiratory disorders and refers to shortness of breath or a feeling of breathlessness.[33]

The respiratory rate is controlled by the respiratory center located within the medulla oblongata and pons in the brain stem, which responds primarily to changes in carbon dioxide, oxygen, and pH levels in the blood. These changes are sensed by central chemoreceptors, which are located in the brain, and peripheral chemoreceptors, which are located in the aortic arch and carotid arteries.

The major factor that drives breathing is not **hypoxemia** (a decreased amount of dissolved oxygen in the blood), but rather the concentration of carbon dioxide. Carbon dioxide is a waste product of cellular respiration and is toxic at high levels in the blood. Elevated levels of carbon dioxide are called **hypercapnia**. As carbon dioxide levels increase, the central chemoreceptors stimulate the contraction of the diaphragm and intercostal muscles, increasing the rate and depth of respirations to help rid the body of carbon dioxide. **Hyperventilation** refers to rapid and deep breathing. It can occur for many reasons such as anxiety and pain, but it can also be a sign the body is trying to compensate for acidosis and increasing the pH level by eliminating excess carbon dioxide.

In contrast, low levels of carbon dioxide in the blood stimulate shallow, slow breathing to help the body retain carbon dioxide. **Hypoventilation** refers to

33. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

slow and shallow breathing.[34] Hypoventilation can occur for several reasons, such as oversedation by opioids and exhaustion from hyperventilation. It can also be a sign the body is trying to compensate for alkalosis by retaining carbon dioxide and decreasing the pH level.

Gas Exchange

Ventilation (i.e., the mechanics of breathing) provides air to the alveoli for gas exchange. Respiration refers to the exchange of gases in the lungs between the alveoli and the pulmonary capillaries or in the tissues between the systemic capillaries and cells/tissues.

Gas exchange refers to the exchange of oxygen and carbon dioxide through capillary walls of the alveoli and the pulmonary capillaries, called external respiration. During external respiration, oxygen from the air we breathe diffuses into the blood. Carbon dioxide (waste) diffuses out of the blood and into the alveoli where it can be exhaled. Throughout the rest of the body, gas exchange also occurs between the systemic capillaries and body cells/tissues, called internal respiration. During internal respiration, oxygen diffuses out of the systemic capillaries and body cells/tissues, and carbon dioxide diffuses from the cells/tissues into the systemic capillaries where it is carried to the lungs. It is through this process that cells in the body are oxygenated and carbon dioxide, the waste product of cellular respiration, is removed from the body.[35]

Perfusion

In addition to adequate ventilation, the second important aspect of gas exchange is perfusion. **Perfusion** refers to the flow of blood. In the lungs,

34. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

35. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

perfusion occurs in the **pulmonary circulation** as it moves from the heart into the lungs and then back to the heart for distribution to the body. The pulmonary arteries carry deoxygenated blood from the heart into the lungs, where they branch and eventually become the capillary network composed of pulmonary capillaries. These pulmonary capillaries create the respiratory membrane with the alveoli. As the blood is pumped through this capillary network, gas exchange occurs.[36]

Although a small amount of the oxygen is able to dissolve directly into the blood from the alveoli, most of the oxygen binds to hemoglobin within the red blood cells. The more oxygen the hemoglobin in the red blood cells carry, the brighter red the color of the blood. Oxygenated blood returns to the heart through the pulmonary veins to the left atrium and ventricle, where it is pumped out to the body via the aorta. The hemoglobin on the red blood cells transports the oxygen to the tissues throughout the body.[37]

Hypoxia and Hypoxemia

Diseases and disorders affecting the respiratory system can cause **hypoxia**, defined as reduced tissue oxygenation. Hypoxia can occur due to inadequate ventilation or impaired perfusion, also referred to as **V-Q mismatch,** where the ratio of air ventilating the lungs' alveoli (V) to blood perfusing through the surrounding capillaries (Q) is not properly matched.

Pulmonary edema is an example of hypoxia caused by inadequate ventilation due to fluid accumulation in alveoli, often caused by heart failure or kidney failure. As a result of the fluid accumulation, oxygen cannot move across the alveolar membrane into the blood, and carbon dioxide cannot be removed from the blood. As a result, hypoxia and **hypercapnia** (high levels of

36. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

37. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

carbon dioxide) may occur, requiring urgent medical interventions to sustain life by decreasing carbon dioxide levels and increasing oxygen levels.[38]

Another example of hypoxia caused by impaired perfusion is a pulmonary embolism. Let's take a closer look at pulmonary embolism in the box below.

Pulmonary Embolism

A pulmonary embolism (PE) can occur when a clot from elsewhere in the body travels through venous circulation and gets lodged in the blood vessels of the lungs. This impedes blood flow, and impacted lung tissue dies. PEs are medical emergencies that require emergent treatment. Diagnosis of pulmonary embolism involves various tests:

- CT pulmonary angiography (CTPA): Visualizes blood flow in the pulmonary arteries.
- D-dimer test: Detects the presence of a substance that may indicate the presence of a blood clot.
- Ultrasound: Checks for DVT in the legs.
- Ventilation-perfusion (V/Q) scan: Detects blood flow and air movement in the lungs.

Signs and symptoms of PE include sudden shortness of breath, sudden anxiety or feeling of "impending doom," chest pain, rapid heart rate, coughing up blood, sweating, feeling lightheaded or dizzy, or leg swelling or pain if a DVT is present. Read more about DVT in the "Cardiovascular Alterations" chapter. Complications of PE include death of lung tissue, increased pulmonary pressure in the arteries of the lungs, and cardiac arrest. Rapid intervention is

38. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

required if PE is suspected. Treatment includes blood thinners to prevent additional clotting, thrombolytic therapy to dissolve clots, inferior vena cava (IVC) filter to prevent clots traveling to the lungs, oxygen therapy, and supportive measures such as pain management and breathing exercises.[39]

The term hypoxia and hypoxemia are not synonymous. Whereas hypoxia refers to reduced tissue oxygenation, hypoxemia is defined as a decrease in the partial pressure of oxygen in the blood (PaO2). Hypoxemia can be caused by impaired delivery of oxygen to the tissues or defective utilization of oxygen by tissues. Additionally, hypoxemia and hypoxia do not always coexist. For example, clients can develop hypoxemia without hypoxia if there is a compensatory increase in their hemoglobin levels and/or cardiac output (CO).[40]

39. Centers for Disease Control and Prevention. (2023). *Venous thromboembolism*. https://www.cdc.gov/blood-clots/about/?CDC_AAref_Val=https://www.cdc.gov/ncbddd/dvt/facts.html

40. Sarkar, M., Niranjan, N., & Banyal, P. K. (2017). Mechanisms of hypoxemia. *Lung India, 34*(1), 47–60. https://doi.org/10.4103/0970-2113.197116

6.3 General Respiratory System Assessment and Interventions

When assessing a client with respiratory system alterations, the nurse must consider risk factors, cultural, and socioeconomic factors that may impact health. Health history, physical examination findings, and diagnostic test results will also play an important role in respiratory system assessment. This section will discuss common assessments, diagnostic tests, and interventions that apply to a variety of respiratory alterations.

Risk Factors and Social Determinants of Health Related to the Respiratory System

A comprehensive assessment of risk factors allows nurses to identify individuals at risk for respiratory disease and implement prevention interventions. Nurses also consider modifiable and nonmodifiable risk factors that may influence a client's health.[1]

Respiratory risk factors include the following:

- **Tobacco Use:** One of the most significant modifiable risk factors for respiratory health is tobacco use. Smoking tobacco and exposure to secondhand smoke are linked to a myriad of respiratory conditions, including chronic obstructive pulmonary disease (COPD) and lung cancer. An individual's smoking history, including duration and number of packs smoked daily, is used to assess their risk for developing respiratory disease. To calculate an individual's pack years of smoking, multiply the number of packs smoked per day by the number of years the individual has smoked. The pack years of smoking measurement assists providers in understanding cumulative exposure and potential for lung damage and

1. World Health Organization. (n.d.). *Chronic respiratory diseases*. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1

implementing effective preventive interventions.[2,3]

- **Environmental Exposures:** Individuals may be exposed to a range of environmental factors that can impact their respiratory health. Occupational hazards (such as exposure to smoke or dust), indoor air pollution, and outdoor air quality can all contribute to the development or exacerbation of respiratory conditions.[4,5]
- **Allergies and Sensitivities:** Allergies and sensitivities to airborne allergens, such as pollen, dust mites, pet dander, and mold, can trigger respiratory alterations like asthma.[6,7,8]

2. American Lung Association. (2025). *COPD causes and risk factors*. https://www.lung.org/lung-health-diseases/lung-disease-lookup/copd/what-causes-copd

3. Centers for Disease Control and Prevention. (n.d.). *Lung cancer basics*. https://www.cdc.gov/lung-cancer/about/

4. United States Environmental Protection Agency. (2024). *Particle pollution and respiratory effects*. https://www.epa.gov/pmcourse/particle-pollution-and-respiratory-effects

5. American Lung Association. (2023). *Disparities in the impact of air pollution*. https://www.lung.org/clean-air/outdoors/who-is-at-risk/disparities

6. World Health Organization. (n.d.). *Chronic respiratory diseases*. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1

7. National Heart, Lung, and Blood Institute. (2022). *Respiratory failure: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/respiratory-failure/causes

8. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

- **Chronic Medical Conditions:** Chronic medical conditions, such as obesity and gastroesophageal reflux disease (GERD), can have a direct impact on respiratory health. Obesity can lead to reduced lung function and increased risk of sleep apnea, while GERD can contribute to conditions like chronic cough, asthma, and aspiration pneumonia.[9,10,11]
- **Family History:** A family history of respiratory conditions, such as asthma, cystic fibrosis, or lung cancer, can provide valuable insights into an individual's genetic predisposition to respiratory issues. Family history is used to assess genetic risk factors and plan appropriate screenings and interventions.[12,13,14]

9. World Health Organization. (n.d.). *Chronic respiratory diseases*. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1

10. National Heart, Lung, and Blood Institute. (2022). *Respiratory failure: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/respiratory-failure/causes

11. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

12. World Health Organization. (n.d.). *Chronic respiratory diseases*. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1

13. National Heart, Lung, and Blood Institute. (2022). *Respiratory failure: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/respiratory-failure/causes

14. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

- **Lifestyle Factors:** Lifestyle factors, including diet, physical activity, stress management, and sleep patterns, can also impact respiratory health. Unhealthy dietary choices, sedentary behavior, and chronic stress can contribute to inflammation and compromise immune function, increasing susceptibility to respiratory infections.[15,16,17]

Cultural Factors

Cultural factors encompass a wide range of social, behavioral, and environmental elements that are shaped by cultural norms, beliefs, and practices. These factors can impact an individual's risk of developing respiratory health alterations. For example, in some cultures, smoking is deeply ingrained as a social or ceremonial practice, while in other cultures, it may be discouraged or even considered taboo. Understanding these cultural attitudes is crucial when assessing an individual's risk of smoking-related conditions and planning interventions to promote smoking cessation.

Cultural dietary practices can also influence respiratory health, especially in relation to allergies and asthma. Some cultural dietary preferences include foods that may exacerbate allergies or contribute to inflammation, whereas other cultures emphasize dietary patterns that promote lung health. Cultural practices related to cooking methods, fuel sources, and housing construction

15. World Health Organization. (n.d.). *Chronic respiratory diseases*. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1

16. National Heart, Lung, and Blood Institute. (2022). *Respiratory failure: Causes and risk factors*. National Institutes of Health. https://www.nhlbi.nih.gov/health/respiratory-failure/causes

17. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

can also contribute to indoor air pollution, which can increase the risk of respiratory conditions.[18,19,20]

Socioeconomic Factors

Socioeconomic factors encompass a range of economic and social determinants that influence living conditions, access to health care, and lifestyle choices. Lower income levels are associated with an increased risk of developing respiratory health alterations. Individuals with limited financial resources may face challenges in accessing health care services, have decreased ability to purchase prescribed medications, or may live in environments with increased pollution that triggers health conditions like asthma or COPD. Individuals with limited financial resources may also delay seeking medical attention due to its cost, leading to advanced disease before it is diagnosed. Lower educational achievement can also impact an

18. World Health Organization. (n.d.). *Chronic respiratory diseases*. https://www.who.int/health-topics/chronic-respiratory-diseases#tab=tab_1

19. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

20. Li, X., Cao, X., Guo, M., Xie, M., & Liu, X. (2020). Trends and risk factors of mortality and disability adjusted life years for chronic respiratory diseases from 1990 to 2017: Systematic analysis for the Global Burden of Disease Study. *The British Medical Journal, 368*, m234. https://doi.org/10.1136/bmj.m234

individual's ability to navigate the complex health care system or understand potential treatment options without assistance.[21,22]

Environmental work hazards can also impact respiratory health. Some occupations, such as construction, agriculture, or manufacturing, may expose workers to environmental hazards like dust, chemicals, or airborne pollutants, increasing their risk of respiratory alterations.[23,24]

Case Study on Risk Factor Identification

John Spector, a 55-year-old man, visits his primary care physician for a routine check-up. He has a family history of respiratory conditions, with his mother diagnosed with chronic

21. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

22. Li, X., Cao, X., Guo, M., Xie, M., & Liu, X. (2020). Trends and risk factors of mortality and disability adjusted life years for chronic respiratory diseases from 1990 to 2017: Systematic analysis for the Global Burden of Disease Study. *The British Medical Journal, 368*, m234. https://doi.org/10.1136/bmj.m234

23. Gaffney, A. W., Himmelstein, D. U., Christiani, D. C., & Woolhandler, S. (2021). Socioeconomic inequality in respiratory health in the US from 1959 to 2018. *JAMA Internal Medicine, 181*(7), 968–976. https://doi.org/10.1001/jamainternmed.2021.2441

24. Cheatham, D., & Marechal, I. (2018). *Respiratory health disparities in the United States and their economic repercussions*. Equitable Growth. https://equitablegrowth.org/respiratory-health-disparities-in-the-united-states-and-their-economic-repercussions/

obstructive pulmonary disease (COPD) in her 60s. John is a lifelong smoker, having started smoking in his late teens and continuing to smoke a pack of cigarettes daily. He works in a dusty, industrial environment and is frequently exposed to airborne pollutants. He states that he is so tired after work, so he usually gets dinner at a fast-food restaurant on the way home and rarely has energy to exercise.

Based on the information provided, assess John for any respiratory health risk factors.

Smoking History: *John's long-term smoking habit is a significant modifiable risk factor for respiratory health alterations. Smoking is a leading cause of conditions like COPD, lung cancer, and exacerbations of asthma. Encouraging smoking cessation should be a primary focus in addressing this risk factor.*

Occupational Exposure: *John's workplace exposure to dust and airborne pollutants represents another modifiable risk factor. Long-term exposure to occupational hazards can lead to respiratory conditions, such as occupational asthma or pneumoconiosis. Implementing respiratory protection like masks may help mitigate this risk.*

Family History of COPD: *John's family history of COPD is a nonmodifiable risk factor, indicating a genetic predisposition to respiratory issues. While nonmodifiable, it should be considered when assessing his overall respiratory risk.*

Age: *John's age of 55 is a nonmodifiable risk factor. Age is a critical consideration in assessing respiratory health risk, as the risk of certain conditions, such as COPD, tends to increase with age.*

Lifestyle Factors: *In addition to smoking, poor dietary habits and physical inactivity can contribute to obesity, which is*

associated with respiratory conditions like sleep apnea. Assessing for modifiable risk factors and encouraging lifestyle modifications are also important.

General Assessment of the Respiratory System

A comprehensive assessment of an individual's overall health is essential because the respiratory system plays a critical role in maintaining the body's overall functioning. Respiratory alterations can have significant consequences that not only impact respiratory health but also can affect other body systems.

Health History

Nurses gather a detailed health history, paying close attention to personal or family history of respiratory disorders. Questions should include inquiries about asthma, chronic obstructive pulmonary disease (COPD), pneumonia, bronchitis, or other respiratory conditions.[25]

Family history plays a pivotal role in the emergence of respiratory health alterations. A family history of respiratory diseases in first-degree relatives, such as parents, siblings, or children, can indicate an increased genetic risk for respiratory issues. A close family or significant other's history of smoking should also be considered because secondhand smoke can impact an individual's respiratory health.[26]

25. Dezube, R. (2023). *Medical history and physical examination for lung disorders.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/medical-history-and-physical-examination-for-lung-disorders

26. Dezube, R. (2023). *Medical history and physical examination for lung disorders.* Merck Manual Consumer Version. https://www.merckmanuals.com/

Nurses assess risk factors known to impact respiratory health. These may include a history of smoking or exposure to environmental pollutants. Detailed information about smoking habits, including pack years, is essential to assess the level of risk. The presence of allergies can also influence respiratory health and should be documented during the assessment.[27]

Travel history and geographical area of residence can also play a role in risk of respiratory health alterations. For example, international travel history can reveal exposure to endemic respiratory infections (e.g., tuberculosis or respiratory viruses). Geographic areas of residence can also pose respiratory risks. Urban areas often have higher levels of air pollution and industrial emissions, increasing the risk of respiratory conditions like asthma and COPD. In contrast, rural areas may pose risks related to agricultural exposures or limited access to health care resources.[28,29]

Physical Examination

Conducting a thorough examination of body systems provides the nurse with

home/lung-and-airway-disorders/diagnosis-of-lung-disorders/medical-history-and-physical-examination-for-lung-disorders

27. Dezube, R. (2023). *Medical history and physical examination for lung disorders*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/medical-history-and-physical-examination-for-lung-disorders

28. Teall, A. M., Pittman, O. A., & Pandian, V. (2020). Evidence-based assessment of the lungs and respiratory system. In Gawlik, K. S., Melnyk, B. M., & Teall, A. M. (Eds.). *Evidence-based physical examination: Best practices for health & well-being assessment*. Springer Publishing Company. https://doi.org/10.1891/9780826164544.0007

29. Reyes, F.M., Modi, P., & Le, J.K. (2024) *Lung Exam*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459253/

cues regarding potential respiratory disorders. Early identification of abnormal findings and notification of the health care provider can lead to prompt intervention and management and improve client outcomes. Table 6.3a summarizes assessments for each body system related to manifestations of respiratory alterations.

Table 6.3a. Manifestations of Respiratory Alterations by Body System[30,31,32]

Body System	Clinical Manifestations
Respiratory	Dyspnea, tachypnea, bradypnea, decreased pulse oximetry reading, use of accessory muscles, nasal flaring, adventitious or decreased lung sounds, coughing, sputum production, **pleuritic chest pain** (worse on deep breathing or coughing), barrel chest (increased anterior-posterior diameter), intercostal retractions, or cyanosis. See Figure 6.9[33] for an image of increased anterior-posterior diameter of the chest.
Cardiovascular	Tachycardia (in response to hypoxia) or signs of right-sided heart failure (i.e., jugular vein distention, peripheral edema).
Neurological	Altered mental status, confusion, disorientation, dizziness, syncope (fainting), or headaches (due to hypoxia).
Musculoskeletal	Decreased activity tolerance, fatigue, and weakness (related to hypoxia). Decreased muscle mass or poor growth in children (due to chronic illness).
Integumentary	Clubbing of the nailbeds due to chronic hypoxia. See Figure 6.10[34] for an image of clubbing.

30. Teall, A. M., Pittman, O. A., & Pandian, V. (2020). Evidence-based assessment of the lungs and respiratory system. In Gawlik, K. S., Melnyk, B. M., & Teall, A. M. (Eds.). *Evidence-based physical examination: Best practices for health & well-being assessment*. Springer Publishing Company. https://doi.org/10.1891/9780826164544.0007

31. Reyes, F.M., Modi, P., & Le, J.K. (2024) *Lung Exam*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459253/

32. Dezube, R. (2023). *Medical history and physical examination for lung disorders.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/medical-history-and-physical-examination-for-lung-disorders

33. "Normal A-P Chest Image.jpg" and "Barrel Chest.jpg" by Meredith Pomietlo for Chippewa Valley Technical College are licensed under CC BY 4.0



Figure 6.9 Increased Anterior-Posterior (A-P) Diameter of the Chest. Left image is a normal chest compared to a chest with increased A-P diameter on the right.



Figure 6.10 Clubbing of the Nailbeds Due to Chronic Hypoxia

34. "Clubbing of fingers in IPF.jpg" by IPFeditor is licensed under CC BY-SA 3.0

Focused Respiratory System Assessment

Respiratory assessment involves a systematic examination of various components, including the nose and sinuses, pharynx, trachea, larynx, lungs, thorax, skin, mucous membranes, general appearance, and activity tolerance.[35]

Nose & Sinuses

- Visually examine the external nose for any deformities, asymmetry, or lesions. Ask the client about nasal congestion, discharge, or frequent nosebleeds, which can indicate sinus or nasal issues.

Pharynx, Trachea, and Larynx

- Use a tongue depressor and a light source to examine the pharynx, looking for any redness, swelling, tonsillar enlargement, or lesions. Ask the client to say "Ah" to assess the movement of the soft palate and uvula and assess the presence of a gag reflex. Assess the trachea for midline positioning. Inspect and palpate the neck for any enlarged lymph nodes or masses. Listen for a husky voice or other voice changes.

Lungs & Thorax

- Observe the client's chest for shape, symmetry, and any visible abnormalities such as deformities or masses. Use your hands to assess chest expansion, tenderness, crepitus (crackling), or masses. Listen to breath sounds with a stethoscope and note any areas of decreased breath sounds or adventitious sounds such as wheezing, rhonchi (coarse crackles), or rales (fine crackles).

Skin and Mucous Membranes

35. Reyes, F.M., Modi, P., & Le, J.K. (2024) *Lung Exam*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459253/

- Examine the skin for pallor, cyanosis (bluish or grayish discoloration), or clubbing of the fingernails. Check mucous membranes (e.g., lips and gums) for color, moisture, and any signs of dehydration.

General Appearance

- Observe the client's general appearance for signs of distress, such as increased work of breathing, use of accessory muscles, or restlessness. Assess the respiratory rate and pattern of breathing. Check for increased anterior-posterior ratio of the chest. If the client is experiencing shortness of breath, assess their ability to speak in sentences or their limitation to speaking in phrases or words.

Endurance

- Evaluate the client's ability to engage in activity without experiencing shortness of breath. Inquire about any limitations in physical activity or recent changes in endurance.

> Review comprehensive respiratory assessment in Open RN *Nursing Skills, 2e*.

Life Span Considerations

PEDIATRIC CONSIDERATIONS

There are differences in the pediatric respiratory system compared to an

adult. Key differences in the pediatric respiratory system include the following[36,37]:

- Newborns may have insufficient surfactant, especially if preterm, that can severely impact gas exchange due to alveoli collapse.
- Periods of apnea are common in newborns.
- Infants have significantly fewer alveoli and higher metabolic needs than adults, resulting in faster respiratory rates. For example, the normal respiratory rate for a newborn is 30-60 breaths per minute.
- Infants are obligatory nose breathers. If their nose or nasal passage becomes occluded, they can develop respiratory distress.
- Infants produce little respiratory mucus, so their coughs are nonproductive, thus increasing their risk for respiratory infection.
- Infants and young children have smaller airways, making it easier for them to become occluded with mucus or foreign objects.
- Young children have enlarged tonsillar tissue that can occlude the pharynx, especially when suffering from an upper respiratory infection.
- Infants and young children have a more flexible larynx, making it susceptible to spasm.
- Signs of respiratory distress in infants include respiratory rate greater than 60 breaths per minute, expiratory grunting, nasal flaring on inspiration, or sternal and intercostal retractions.

36. Connelly, S., Meissbach, S., Schmidt, M., & Ascano, F. (2022). *Respiratory system in pediatrics*. Stanford Medicine Children's Health. https://www.stanfordchildrens.org/content-public/pdf/respiratory-system-in-pediatrics.pdf

37. Saikia, D., & Mahanta, B. (2019). Cardiovascular and respiratory physiology in children. *Indian Journal of Anaesthesia, 63*(9), 690–697. https://doi.org/10.4103/ija.IJA_490_19

OLDER ADULT CONSIDERATIONS

As individuals age, these changes occur that affect the lungs and breathing[38]:

- **Changes to the bones and muscles of the chest and spine:** Bones become thinner, and the shape of the rib cage may change. As a result, the rib cage may not expand and contract as well during breathing. The diaphragm also becomes weakened and can decrease the ability to inhale.
- **Changes to lung tissue:** Muscles and other tissues near the airways may lose their ability to keep the airways completely open, causing them to close easily. The air sacs in the alveoli lose their shape and become baggy. These changes in lung tissue can allow air to become trapped in the lungs, decreasing the amount of gas exchange at the alveolar level.
- **Changes to the nervous system:** The part of the brain that controls breathing may lose some of its function. Nerves in the airways that trigger coughing also become less sensitive. Large amounts of particles like smoke or germs may collect in the lungs and may be hard to cough up.
- **Changes to the immune system:** The immune system can get weaker, making it more difficult for the body to fight lung infections and other diseases. The lungs are also less able to recover after exposure to smoke or other harmful particles.

As a result of these changes, older adults are at increased risk for the following[39]:

- Lung infections, such as pneumonia and bronchitis
- Shortness of breath
- Lower oxygen saturation levels

38. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Aging changes in the lungs*. https://medlineplus.gov/ency/article/004011.htm

39. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Aging changes in the lungs*. https://medlineplus.gov/ency/article/004011.htm

- Abnormal breathing patterns, resulting in problems such as sleep apnea (episodes of stopped breathing during sleep)

> Read additional information about performing a focused subjective and objective respiratory assessment in the "Respiratory Assessment" chapter in Open RN *Nursing Skills, 2e*.

Signs of Hypoxia and Respiratory Distress

Nurses must recognize and report early signs of hypoxia to prevent the client from progressing to **respiratory arrest**, the cessation of breathing. Hypoxia can have many causes, ranging from respiratory and cardiac conditions to anemia. Signs and symptoms of hypoxia and respiratory distress are as follows[40]:

- **New onset or worsening dyspnea:** Dyspnea is a subjective symptom of not getting enough air. Depending on severity, dyspnea causes increased levels of anxiety.
- **Restlessness**
- **New onset confusion or worsening level of consciousness**
- **Tachycardia:** An elevated heart rate (greater than 100 beats per minute in adults) can be an early sign of hypoxia as the heart compensates for decreased oxygenation.
- **Tachypnea:** A sustained increased respiration rate (above 20 breaths per minute in an adult) is a sign of respiratory distress.
- **Worsening oxygen saturation level (SpO2):** Oxygen saturation levels

40. Ernstmeyer, K., & Christman, E. (Eds.). (2024). Nursing fundamentals 2E. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

should be above 92% for an adult in room air. If oxygen therapy is already in place and SpO2 continues to decrease, this is also a sign of respiratory distress.

- **Use of accessory muscles**
- **Noisy breathing:** Audible noises with breathing are an indication of respiratory conditions.
- **Positioning:** Clients with dyspnea tend to sit up and lean over by resting their arms on their legs, referred to as the tripod position, to enhance lung expansion. They typically feel worse shortness of breath when lying flat in bed and avoid the supine position.
- **Ability of client to speak in full sentences:** Clients in respiratory distress may be unable to speak in full sentences or may need to catch their breath between sentences.
- **Cyanosis:** Bluish changes in skin color and mucus membranes is a late sign of hypoxia.

Psychosocial Assessment

Psychosocial factors can play a significant role in the experience of individuals dealing with respiratory problems. Stress and psychological well-being can impact the symptoms and management of respiratory conditions, and chronic respiratory conditions can also significantly affect an individual's sense of well-being.

Stress and anxiety can worsen respiratory symptoms by triggering the sympathetic nervous system's "flight or fight" response, thereby increasing respiratory rate and causing shallow respirations. Rapid, shallow breathing can worsen the clinical status of individuals with chronic obstructive pulmonary disease or asthma. Prolonged stress can also weaken an individual's immune system, making individuals more susceptible to respiratory infections.

Individuals who have chronic respiratory disease may experience stress and anxiety as a result of their feelings of dyspnea. This anxiety may result in social isolation as the individual attempts to avoid environmental triggers (like smoke) or the fear of appearing symptomatic in public. Additionally, chronic

disease can also lead to financial stress due to the cost of medications and respiratory equipment.

To help individuals cope with psychosocial challenges associated with respiratory problems, nurses can provide support in numerous ways. Clients may benefit from stress reduction techniques such as relaxation techniques, mindfulness, and yoga. Individuals may also benefit from pulmonary rehabilitation or peer support programs.

Laboratory and Diagnostic Testing

Diagnostic testing is ordered by health care providers to identify and diagnose respiratory conditions. There are various laboratory and diagnostic results that nurses review related to a comprehensive respiratory assessment and development of an effective nursing care plan.

LABORATORY TESTS

Common laboratory tests related to respiratory assessment include red blood cells (RBCs), hemoglobin (HGB), hematocrit (HCT), white blood cells (WBCs), and arterial blood gas (ABG)[41,42]:

- **Red Blood Cells (RBCs):** This test measures the number of red blood cells in a given volume of blood. Low RBC counts (i.e., anemia) can lead to reduced oxygen-carrying capacity in the blood, which can impact respiratory function.

41. American Lung Association. (n.d.). *Lung procedures, tests, and treatments.* https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

42. Dezube, R. (2023). *Overview of tests for lung disorders.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/arterial-blood-gas-abg-analysis-and-pulse-oximetry

- **Hemoglobin (Hgb) and Hematocrit (HCT):** Hemoglobin (hGB) is a protein in red blood cells that binds to oxygen. Low hemoglobin levels can indicate anemia, which can cause respiratory symptoms like fatigue, shortness of breath, and reduced activity tolerance. Hematocrit (HCT) measures the percentage of blood volume occupied by red blood cells. Low hematocrit levels are also associated with anemia and can affect oxygen transport in the bloodstream, although they can also be affected by an individual's fluid balance.
- **White Blood Cells (WBCs):** White blood cell levels indicate the immune system's response to fight infections. Elevated WBC counts can be a sign of an infection or inflammation in the respiratory system, such as pneumonia or bronchitis.
- **Arterial Blood Gases (ABGs):** ABG analysis involves measuring the levels of dissolved oxygen (PaO2), dissolved carbon dioxide (PaCO2), pH, bicarbonate (HCO3-), and oxygen saturation (SaO2) in arterial blood. ABGs provide valuable information about a client's respiratory and metabolic status. When assessing a client in respiratory distress, one of the most definitive signs requiring medical intervention is abnormal ABG results.
    - **PaO2:** PaO2 is the partial pressure of oxygen in arterial blood. Low PaO2 levels indicate hypoxemia.
    - **PaCO2:** PaCO2 is the partial pressure of carbon dioxide in arterial blood. High PaCO2 levels, referred to as hypercapnia, may be seen in acute conditions like acute exacerbations of chronic obstructive pulmonary disease (COPD).
    - **pH:** pH refers to the blood's acidity or alkalinity. Abnormally low pH levels can indicate respiratory acidosis (resulting from elevated PaCO2 levels) or metabolic acidosis. Abnormally high pH levels can indicate respiratory alkalosis (caused by reduced PaCO2 levels) or metabolic alkalosis.
    - **HCO3-:** Bicarbonate levels reflect the body's metabolic compensation for respiratory acid-base imbalances. Elevated HCO3- may indicate compensation by the kidneys for respiratory acidosis.
    - **SaO2:** Oxygen saturation measures the percentage of hemoglobin that is carrying oxygen. A low SaO2 indicates poor oxygenation of the

blood.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

> Read more information about ABG tests in the "Acid-Base Balance" section of the "Fluids and Electrolytes" chapter in Open RN *Nursing Fundamentals, 2e*.

SPUTUM TESTS

Sputum refers to the mucus and other material that is coughed up by a client from the lower airways (bronchi and lungs) and can be examined for diagnostic purposes. Sputum tests can help identify the presence of pathogens such as bacteria, viruses, or fungi in the respiratory tract. It can also contain inflammatory markers like white blood cells that can indicate inflammation in the airways.

Sputum culture and sensitivity tests help determine the specific type of bacteria that is causing a respiratory infection and its susceptibility and responsiveness to different antibiotics. Sputum samples may also undergo cytology testing that detects the presence of abnormal cells, such as lung cancer.[43]

DIAGNOSTIC TESTS

Common diagnostic tests for respiratory alterations include radiographic examinations, pulmonary function tests, bronchoscopy, and thoracentesis.

43. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

Radiographic Examinations

Radiographic examinations refer to imaging that provides information about the structure and function of the respiratory system. These tests allow providers to diagnose and monitor the progression of different respiratory conditions, as well as evaluate the client's response to treatment. Common radiographic examinations are as follows:

- **Standard Chest X-Rays:** A standard chest X-ray provides a quick and relatively low-radiation way to visualize the chest area, including the lungs, heart, ribs, and diaphragm. It is useful for identifying lung abnormalities like pneumonia, tuberculosis, cancerous masses, and pleural effusions. Chest X-rays also allow for the visualization of the heart and can help identify rib and chest wall injuries. See Figure 6.11[44] for an image of a chest X-ray on a healthy individual.
- **Digital Chest Radiography:** Digital chest radiography provides an advanced form of chest-ray imaging, allowing for improved image quality, digital retrieval, and comparison to previous X-rays, as well as remote consultation with other health care providers. Digital radiography also causes less radiation exposure.
- **Computed Tomography (CT):** CT scans provide cross-sectional, three-dimensional images of the chest and lungs. They allow for a detailed examination of the size and shape of organs, as well as lesions and nodules. CT scans are helpful for staging lung cancer, evaluating trauma, and detecting blood clots in the lungs. CTs are also helpful for guiding more invasive procedures such as lung biopsies and drain tube insertion.
- **Positron Emission Tomography (PET) Scan:** A PET scan is a medical imaging technique that provides information about the metabolic and functional activity of tissues within the body. PET scans utilize a small amount of radioactive substance injected into the client's bloodstream that is metabolized more rapidly by tumors or regions of inflammation.

44. "Chest_X-ray_2346.jpg" by Doctoroftcm is licensed in the Public Domain.

- **Magnetic Resonance Imaging (MRI):** An MRI can provide detailed images of the chest that are useful for evaluating vascular conditions, detecting lung tumors, and assessing congenital anomalies.
- **Fluoroscopy:** Fluoroscopy is an imaging technique that can assess the movement of the diaphragm and chest structures during respiration. It is useful for examining obstruction and guiding invasive procedures like bronchoscopy.
- **Lung Biopsy:** A medical procedure where a small piece of lung tissue is removed and analyzed under a microscope. The test may be performed using a needle, an open procedure or through a bronchoscope. The approach depends on the client's underlying health and the location of the tissue to be examined.
- **Capnography:** A sensor that measures the concentration of carbon dioxide exhaled, translated into a waveform and numerical value.
- **V/Q Scan:** A ventilation-perfusion (VQ) scan is a diagnostic test used to assess lung function and rule out pulmonary embolism. In this test, a radioactive substance is inhaled (ventilation) and injected into the bloodstream (perfusion). Areas with normal ventilation but reduced perfusion may indicate a pulmonary embolism. The VQ scan helps aid in the diagnosis or exclusion of pulmonary embolism without exposing the patient to ionizing radiation from traditional imaging methods.[45,46]

45. American Lung Association. (n.d.). *Lung procedures, tests, and treatments.* https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

46. Dezube, R. (2023). *Overview of tests for lung disorders.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/arterial-blood-gas-abg-analysis-and-pulse-oximetry

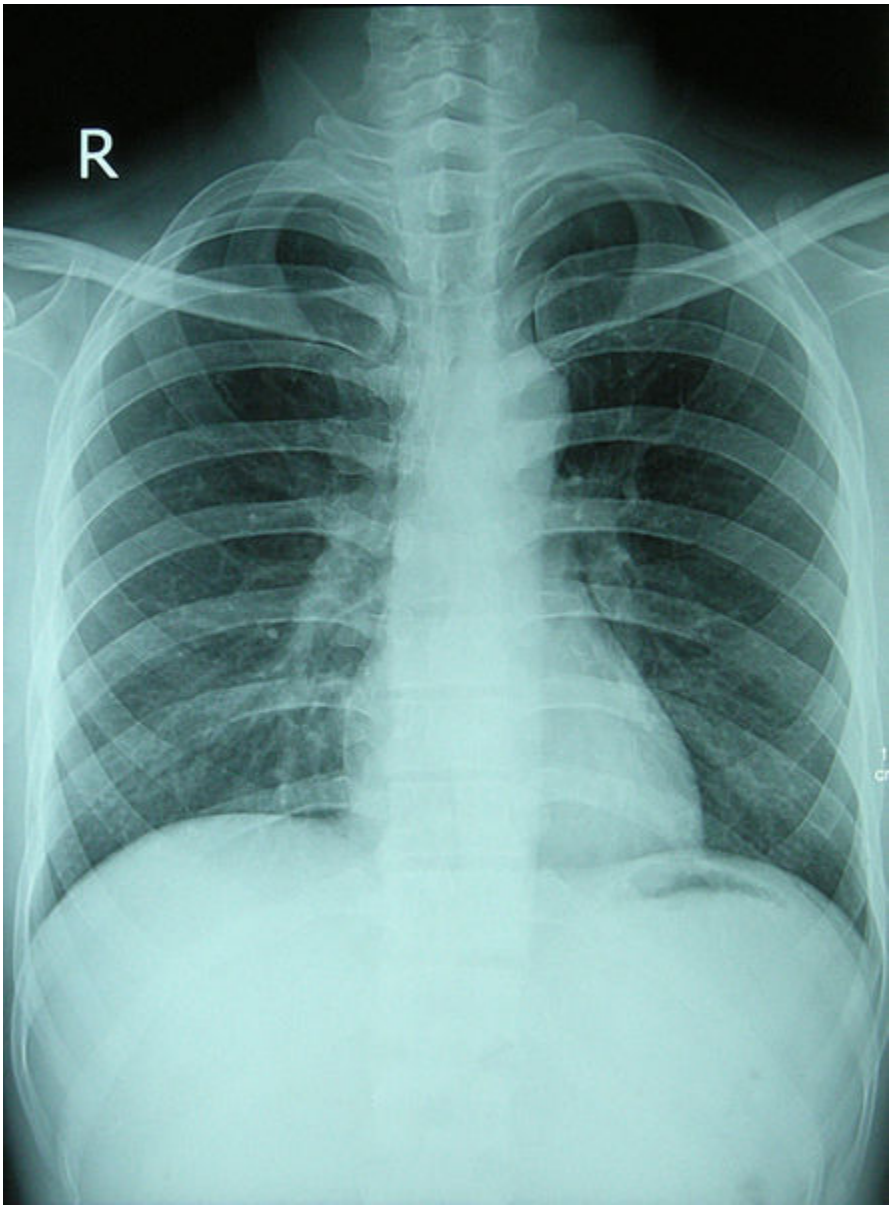


Figure 6.11 Chest X-Ray

Pulmonary Function Tests

Pulmonary function tests (PFTs) are a group of noninvasive diagnostic tests that assess the function of the respiratory system. These tests provide valuable information about lung capacity, airflow, and gas exchange. Common pulmonary function tests include spirometry, diffusion capacity testing, and bronchial responsiveness tests.

- **Spirometry** is useful for diagnosing conditions like asthma and COPD by providing information about lung volume and airflow resistance. See

Figure 6.12[47] for an image of an individual performing a spirometry test by breathing into a machine with the nostrils occluded. Spirometry involves the examination of these lung function parameters:

  - **Forced expiratory volume in one second (FEV1)**: The volume of air exhaled in the first second of forced expiration.
  - **Forced vital capacity (FVC)**: The maximum amount of air that can be exhaled after a deep inhalation.
  - **FEV1/FVC ratio**: This ratio of FEV1 and FVC is used to assess airflow obstruction.
- **Diffusion capacity testing** measures the lung's ability to transfer gases from alveoli into the bloodstream. Diffusion capacity testing is useful for detecting gas exchange disorders such as emphysema and pulmonary embolism.
- **Bronchial responsiveness testing** measures the responsiveness of the airway after it has been exposed to an allergen or bronchoconstrictive substance. This test is useful for diagnosing asthma.[48]

47. "DoingSpirometry.JPG" by Jmarchn is licensed under CC BY-SA 3.0

48. MedlinePlus [Internet]. (2023). *Lung function tests*. https://medlineplus.gov/lab-tests/lung-function-tests/



Figure 6.12 Spirometry Test

Bronchoscopy

Bronchoscopy is a medical procedure used to directly view airway structures and obtain tissue samples for biopsy or culture. During a bronchoscopy procedure, a provider will insert a thin, flexible tube with a camera and light through the nostril or oropharynx to visualize the airway structures and obtain samples. Because this is an invasive procedure, clients must provide written informed consent acknowledging their understanding of the procedure and its risks after they are explained by the health care provider.

To prevent complications such as aspiration, clients should be instructed to adhere to NPO restrictions for four to eight hours prior to the procedure. Many clients receive medications such as benzodiazepines to help them relax and decrease their anxiety before the procedure.

During the procedure, clients are carefully monitored with continuous vital signs monitoring and provided supplemental oxygen. Peripheral IV access is also maintained to provide medications as needed to support client comfort and promote hemodynamic stability. Following bronchoscopy, clients should be carefully observed to ensure their gag reflex has returned prior to consuming fluids or food.[49,50]

See Figure 6.13[51] for an image of a bronchoscopy procedure.

49. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

50. Dezube, R. (2023). *Overview of tests for lung disorders*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/arterial-blood-gas-abg-analysis-and-pulse-oximetry

51. "Bronchoskopie_Bronchoalveoläre_Lavage.jpg" by User:MrArifnajafov is licensed under CC BY-SA 3.0



Figure 6.13 Bronchoscopy

Thoracentesis

Thoracentesis is a medical procedure performed to remove fluid or air from the pleural space, which is the space between the lung and the chest wall. It is done to diagnose and treat various conditions, including pleural effusion (accumulation of fluid), pneumothorax (accumulation of air), or to obtain a sample for diagnostic purposes. Thoracentesis can help diagnose the underlying cause of pleural effusion, such as infection, cancer, or heart failure. It can also assist in identifying the type of fluid present. In cases of large pleural effusions or tension pneumothorax, thoracentesis can help relieve

symptoms and improve respiratory function.[52] See Figure 6.14[53] for an illustration of a thoracentesis.

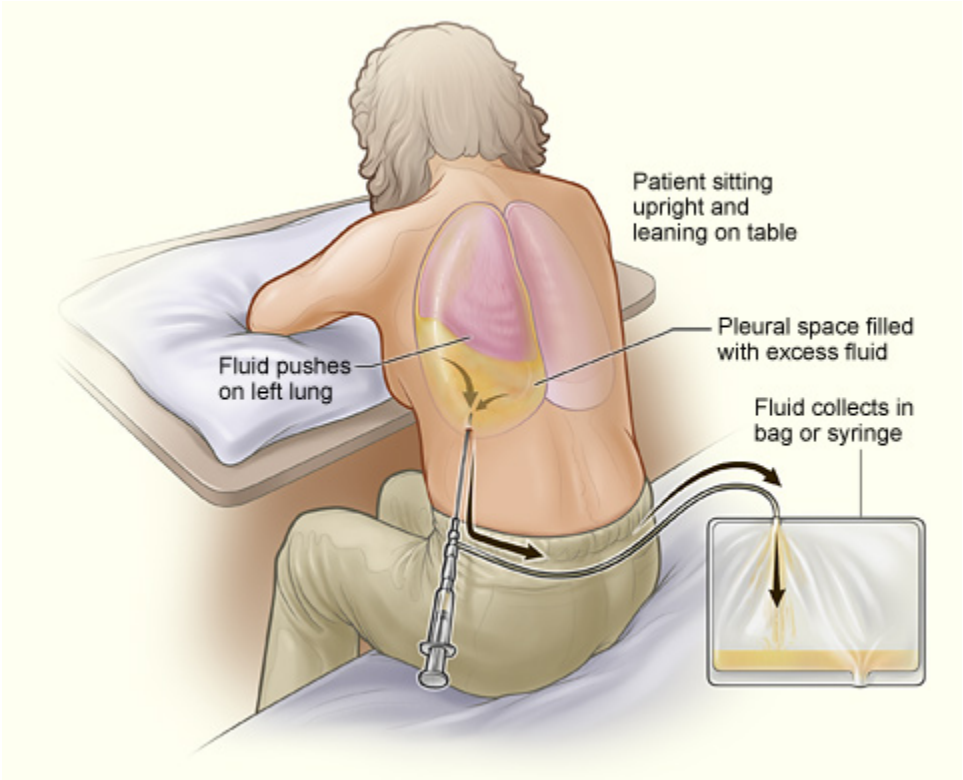


Figure 6.14 Thoracentesis

During a thoracentesis, the client is positioned sitting on the edge of the bed or lying on the unaffected side. The skin over the puncture site is cleaned and sterilized. A local anesthetic is injected into the skin and deeper tissues to numb the area where the needle will be inserted. A needle is inserted through the back and into the pleural space under ultrasound guidance or using physical landmarks. Using a syringe or vacuum bottle, the health care provider withdraws the fluid or air from the pleural space. The collected fluid

52. American Lung Association. (n.d.). *Lung procedures, tests, and treatments.* https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

53. "Thoracentesis.jpg" by National Heart, Lung and Blood Institute is licensed in the Public Domain.

or air is sent to the laboratory for analysis, including cell counts, chemistry, and microbiology to determine the cause.[54]

After the procedure, the client is closely monitored for any signs of complications, such as bleeding, infection, or pneumothorax. A chest X-ray is often performed to ensure that the lung has re-expanded properly and there are no complications, such as a pneumothorax. In some cases, if large volumes of fluid need to be drained or there is a risk of recurrence, a chest tube may be placed to allow continuous drainage.[55]

Complications of thoracentesis can include bleeding, infection, pneumothorax, and damage to surrounding structures. These risks are minimized by using ultrasound guidance and taking appropriate precautions during the procedure.[56]

See the following box for client preparation and additional information about the thoracentesis procedure.

Nursing Considerations Regarding Thoracentesis[57,58]

54. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

55. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

56. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

57. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

58. Dezube, R. (2023). *Overview of tests for lung disorders*. Merck Manual

Before the Procedure

Prior to the procedure, the health care provider must explain the purpose, potential risks, and benefits of the procedure. The nurse ensures the client has provided written informed consent signifying their understanding.

During the Procedure

Proper client positioning is crucial. The client may need to sit on the edge of the bed or lie on their side in a specific posture to allow for safe access to the pleural space. Health care providers will guide clients into the correct position. Clients are advised to remain as motionless as possible during the procedure to minimize the risk of injury. Clients should be informed that they may experience a stinging sensation and pressure during the procedure.

During the procedure, a short, thin needle is carefully inserted by the health care provider through the skin and into the pleural space under sterile conditions, typically done under local anesthesia. After the needle is in position, pleural fluid or air is slowly aspirated into a syringe, relieving pressure in the pleural space.

After the Procedure

Immediately after the procedure, a chest X-ray is typically performed to assess lung re-expansion and monitor for complications such as a pneumothorax. Vital signs, including blood pressure, heart rate, and oxygen saturation, are closely monitored. Breath sounds are auscultated to check for signs of

Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/arterial-blood-gas-abg-analysis-and-pulse-oximetry

complications. Clients are encouraged to take deep breaths and use incentive spirometers to prevent atelectasis and expand the lungs.

Thoracentesis procedures are considered relatively safe, but there are potential complications. Complications may include a reaccumulation of fluid, subcutaneous emphysema, infection, or tension pneumothorax. If pleural fluid reaccumulates in the pleural space, a drain might be required. **Subcutaneous emphysema** occurs when air leaks from the pleural space into subcutaneous tissue, resulting in crepitus and swelling. Subcutaneous emphysema typically resolves on its own. **Tension pneumothorax** occurs when pressure builds within the pleural space and compresses the lung. If a tension pneumothorax occurs, the heart and mediastinal structures are shifted toward the opposite of the chest, resulting in respiratory and cardiovascular compromise. Tension pneumothorax can often develop rapidly and result in severe difficulty breathing, chest pain, cyanosis, and decreased breath sounds. Immediate intervention is required and involves the insertion of a large bore needle or chest tube on the affected side of the chest to release the trapped air and decompress the pleural space.[59,60]

59. American Lung Association. (n.d.). *Lung procedures, tests, and treatments*. https://www.lung.org/lung-health-diseases/lung-procedures-and-tests

60. Dezube, R. (2023). *Overview of tests for lung disorders*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/lung-and-airway-disorders/diagnosis-of-lung-disorders/arterial-blood-gas-abg-analysis-and-pulse-oximetry

General Nursing Interventions Related to Respiratory Alterations

This section will provide an overview of common nursing interventions that may be implemented for a variety of respiratory alterations.

Dyspnea and Hypoxia

No matter the cause, respiratory alterations can cause dyspnea, hypoxia, or hypercapnia. Hypoxia and/or hypercapnia are medical emergencies and should be treated promptly by calling for assistance as indicated by agency policy.

Failure to initiate oxygen therapy for hypoxia can result in serious harm or death of the client. Although oxygen is considered a medication that requires a prescription, oxygen therapy may be initiated without a physician's order in emergency situations as part of the nurse's response to the "ABCs," a common abbreviation for airway, breathing, and circulation. Most agencies have a protocol in place that allows nurses to apply oxygen in emergency situations and obtain the necessary order at a later time.

In addition to administering oxygen therapy, there are several general interventions a nurse can implement to immediately assist a client with dyspnea and possible hypoxia as outlined in Table 6.3b.

Table 6.3b. General Nursing Interventions to Manage Dyspnea and Hypoxia

Interventions	Additional Information
Raise the head of the bed or use tripod positioning.	Raising the head of the bed to high Fowler's position promotes effective chest expansion and diaphragmatic descent, maximizes inhalation, and decreases the work of breathing. Clients with dyspnea may also gain relief by sitting upright and leaning over a bedside table while in bed, which is called a three-point or tripod position.
Encourage enhanced breathing and coughing techniques.	Enhanced breathing and coughing techniques such as using pursed-lip breathing, coughing and deep breathing, huffing technique, incentive spirometry, and flutter valves may assist clients to clear their airway while maintaining their oxygen levels. See the "Enhanced Breathing and Coughing Techniques" section below for additional information regarding these techniques.
Manage oxygen therapy and equipment.	If the client is already receiving supplemental oxygen, ensure the equipment is turned on, set at the required flow rate, and is properly connected to an oxygen supply source. If a portable tank is being used, check the oxygen level in the tank. Ensure the connecting oxygen tubing is not kinked, which could obstruct the flow of oxygen. Feel for the flow of oxygen from the exit ports on the oxygen equipment. In hospitals where medical air and oxygen are used, ensure the client is connected to the oxygen flow port. Various types of oxygenation equipment are prescribed for clients requiring oxygen therapy. Oxygenation equipment is typically managed in collaboration with a respiratory therapist in hospital settings. Equipment includes devices such as nasal cannula, masks, continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP), and mechanical ventilators. For more information, see the "Oxygenation Equipment" section of the "Oxygen Therapy" chapter in Open RN *Nursing Skills, 2e*.
Assess the need for respiratory medications.	Pharmacological management is essential for clients with respiratory disease such as asthma, COPD, or severe allergic response. Bronchodilators effectively relax smooth muscles and open airways. Glucocorticoids relieve inflammation and also assist in opening air passages. Mucolytics decrease the thickness of pulmonary secretions so that they can be expectorated.
Provide suctioning, if needed.	Some clients may have a weakened cough that inhibits their ability to clear secretions from the mouth and throat. Clients with muscle disorders or those who have experienced a stroke (i.e., cerebral vascular accident) are at risk for aspiration, which could lead to pneumonia and hypoxia. Provide oral suction if the client is unable to clear secretions from the mouth and pharynx.
Provide pain relief, if needed.	Provide adequate pain relief if the client is reporting pain because it can cause shallow breathing. Pain may be exacerbated with lung expansion, especially after thoracic or abdominal surgeries. Pain increases anxiety and metabolic demands, which, in turn, increase the need for oxygen and feelings of dyspnea.
Consider other devices to enhance clearance of secretions.	Chest physiotherapy and specialized devices assist with secretion clearance, such as handheld flutter valves or vests that inflate and vibrate the chest wall. Consult with a respiratory therapist as needed based on the client's situation.
Plan frequent rest periods between activities.	Plan interventions for clients with dyspnea so they can rest frequently and decrease oxygen demand.
Consider other potential causes of dyspnea.	If a client's level of dyspnea is worsening, assess for other underlying causes in addition to the primary diagnosis. For example, are there other respiratory, cardiovascular, or hematological conditions occurring? Start by reviewing the client's most recent hemoglobin and hematocrit lab results, as well as any other diagnostic tests such as chest X-rays and ABG results. Completing a thorough assessment may reveal abnormalities in these systems to report to the health care provider.
Consider obstructive sleep apnea.	Clients with obstructive sleep apnea (OSA) are often not previously diagnosed prior to hospitalization. The nurse may notice the client snores, has pauses in breathing while snoring, has decreased oxygen saturation levels while sleeping, or awakens feeling not rested. These signs may indicate the client is unable to maintain an open airway while sleeping, resulting in periods of apnea and hypoxia. If these apneic periods are noticed but have not been previously documented, the nurse should report these findings to the health care provider for further testing and follow-up. A prescription for a CPAP or BiPAP device while sleeping may be needed to prevent adverse outcomes.
Monitor client's anxiety.	Assess and address anxiety. Anxiety often accompanies the feeling of dyspnea and can worsen it. Nurses use nonpharmacological approaches such as teaching enhanced breathing and coughing techniques and encouraging relaxation techniques. If these approaches are not effective, then antianxiety medications may be prescribed by the health care provider.

Enhanced Breathing and Coughing Techniques

In addition to oxygen therapy and general interventions listed in Table 6.3b to address dyspnea, there are several techniques a nurse can teach a client to enhance their breathing and coughing. These techniques include pursed-lip breathing, diaphragmatic breathing, incentive spirometry, coughing and deep breathing, and the huffing technique. Additionally, vibratory positive expiratory pressure (PEP) therapy can be incorporated in collaboration with a respiratory therapist.

PURSED-LIP BREATHING

Pursed-lip breathing is a technique that decreases dyspnea by teaching people to control their oxygenation and ventilation. See Figure 6.15[61] for an illustration of pursed-lip breathing. The technique teaches a person to inhale through the nose and exhale through the mouth at a slow, controlled flow. This type of exhalation gives the person a puckered or pursed-lip appearance. By prolonging the expiratory phase of respiration, a small amount of positive end-expiratory pressure (PEEP) is created in the airways that helps to keep them open so that more air can be exhaled. This subsequently reduces air trapping that commonly occurs in conditions such as chronic obstructive pulmonary disease (COPD). Pursed-lip breathing relieves the feeling of shortness of breath, decreases the work of breathing, and improves gas exchange. People also regain a sense of control over their breathing while simultaneously increasing their relaxation.[62]

61. "v4-460px-Live-With-Chronic-Obstructive-Pulmonary-Disease-Step-8.jpg" by unknown is licensed under CC BY-SA 3.0. Access for free at https://www.wikihow.com/Live-With-Chronic-Obstructive-Pulmonary-Disease

62. Nguyen, J.D., & Duong, H. (2025). *Pursed-lip Breathing*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK545289/



Figure 6.15 Pursed-Lip Breathing

DIAPHRAGMATIC BREATHING

When breathing normally, individuals typically don't use their full lung capacity. **Diaphragmatic breathing**, also called abdominal breathing, encourages them to consciously use their diaphragm to take deep breaths. This promotes lung efficiency by using the lungs at 100% capacity.[63]

63. Cleveland Clinic. (2022). *Diaphragmatic breathing.* https://my.clevelandclinic.org/health/articles/9445-diaphragmatic-breathing

When teaching the diaphragmatic breathing technique, it may be easier for the client to follow your instructions lying down[64]:

- Lie on your back on a flat surface or in bed, with your knees bent and your head supported. You can use a pillow under your knees to support your legs.
- Place one hand on your upper chest and the other just below your rib cage. This will allow you to feel your diaphragm move as you breathe.
- Breathe in slowly through your nose so that your stomach moves out, causing your hand to rise. The hand on your chest should remain as still as possible.
- Tighten your stomach muscles, so that your stomach moves in, causing your hand to lower as you exhale through pursed lips (see "Pursed-lip Breathing" section above). The hand on your upper chest should remain as still as possible.

When first learning diaphragmatic breathing, clients should be encouraged to complete this exercise for five to ten minutes about three to four times per day and then gradually increase the amount of time spent doing this exercise.[65]

INCENTIVE SPIROMETRY

An **incentive spirometer** is a medical device commonly prescribed after surgery to expand the lungs, reduce the buildup of fluid in the lungs, and prevent pneumonia. See Figure 6.16[66] for an image of a client using an

64. Cleveland Clinic. (2022). *Diaphragmatic breathing*. https://my.clevelandclinic.org/health/articles/9445-diaphragmatic-breathing

65. Cleveland Clinic. (2022). *Diaphragmatic breathing*. https://my.clevelandclinic.org/health/articles/9445-diaphragmatic-breathing

66. "Incentive Spirometer.png" by BruceBlaus is licensed under CC BY-SA 4.0

incentive spirometer. While sitting upright, if possible, the client should place the mouthpiece in their mouth and create a tight seal with their lips around it. They should breathe in slowly and as deeply as possible through the tubing with the goal of raising the piston to their prescribed level. The resistance indicator on the right side should be monitored to ensure they are not breathing in too quickly. The client should attempt to hold their breath for as long as possible (at least five seconds) and then exhale and rest for a few seconds. Coughing is expected. Encourage the client to expel the mucus and not swallow it. This technique should be repeated by the client ten times every hour while awake.[67] The nurse may delegate this intervention to unlicensed assistive personnel, but the frequency in which it is completed and the volume achieved should be documented and monitored by the nurse.

67. Cleveland Clinic. (2022). *Incentive spirometer*. https://my.clevelandclinic.org/health/articles/4302-incentive-spirometer



Figure 6.16 Using an Incentive Spirometer

COUGHING AND DEEP BREATHING

Coughing and deep breathing is a breathing technique similar to incentive spirometry but no device is required. The client is encouraged to take deep, slow breaths and then exhale slowly. After each set of breaths (typically three to five), the client should cough. This technique is repeated three to five times

every hour. The client may be encouraged to splint the chest with a pillow or folded blanket to help facilitate deep breathing and coughing.

HUFFING TECHNIQUE

The **huffing technique** is helpful to teach clients who have difficulty coughing. Teach the client to inhale with a medium-sized breath and then make a sound like "Ha" to push the air out quickly with the mouth slightly open.

VIBRATORY PEP THERAPY

Vibratory positive expiratory pressure (PEP) therapy uses handheld devices such as flutter valves or Acapella devices for clients who need assistance in clearing mucus from their airways. These devices require a prescription and are used in collaboration with a respiratory therapist or advanced health care provider. To use vibratory PEP therapy, the client should sit up, take a deep breath, and blow into the device. A flutter valve within the device creates vibrations that help break up the mucus so the client can cough and spit it out. Additionally, a small amount of positive end-expiratory pressure (PEEP) is created in the airways that helps to keep them open so that more air can be exhaled. See Figure 6.17[68] for an image of PEP therapy.

68. "Flutter Valve Breathing Device 3I3A0982.jpg" by Deanna Hoyord, Chippewa Valley Technical College is licensed under CC BY 4.0



Figure 6.17 Flutter Device

Routine Nursing Interventions Related to Respiratory Management

The *Nursing Interventions Classification (NIC)* is a standardized classification of nurse-initiated and physician-initiated nursing treatments. There are several NIC classifications of nursing interventions that apply across multiple respiratory disorders such as "Respiratory Monitoring" and "Oxygen Therapy." Read more about these categories of interventions in the following boxes.

Selected NIC Nursing Interventions for Respiratory Monitoring[69]

NIC definition of *respiratory monitoring*: Collecting and

69. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications (NIC)* (8th ed.). Elsevier.

analyzing pertinent data to ensure airway patency and adequate air exchange, including, but not limited to, the following:

- Monitor rate, rhythm, depth, and effort of respirations.
- Note chest movement, watching for symmetry, use of accessory muscles, and supraclavicular and intercostal muscle retractions.
- Auscultate breath sounds, noting areas of decreased or absent ventilation and presence of adventitious sounds.
- Monitor oxygen saturation levels. Provide for noninvasive continuous oxygen sensors with appropriate alarm systems in clients with risk factors for hypoxia per agency policy and as indicated.
- Determine the need for suctioning by auscultating for rhonchi (coarse crackles) over major airways.
- Monitor for signs of hypoxia, such as increased restlessness, anxiety, and air hunger.
- Monitor the client's ability to cough effectively.
- Note onset, duration, and characteristics of cough.
- Monitor the client's respiratory secretions.
- Monitor for dyspnea and events that improve and worsen it.
- Monitor chest X-ray reports.

Selected NIC Nursing Interventions for Oxygen Therapy[70]

70. Wagner, C. M., Butcher, H. K., & Clarke, M. F. (2024). *Nursing interventions classifications (NIC)* (8th ed.). Elsevier.

NIC definition of *oxygen therapy*: Safely administering oxygen and monitoring its effectiveness, including, but not limited to, the following:

- Verify order for oxygen therapy (unless it is an emergency situation).
- Document baseline observations, including respiratory rate, heart rate, oxygen saturation, and blood pressure.
- Position for optimal breathing efficiency (e.g., high Fowler's or semi-Fowler's positions).
- Clear oral, nasal, and tracheal secretions to optimize airway patency.
- Ensure flow meter is set to prescribed dose.
- Attach a humidifying unit to the flow meter to avoid mucosal drying, as indicated.
- Instruct the client and family members about safety precautions associated with oxygen use, including the need to avoid smoking, candles, and other sources of open flame.
- Monitor for skin breakdown related to the oxygen delivery device.
- Provide for oxygen during transport.
- Change oxygen delivery device from mask to nasal cannula during meals, as tolerated.
- Evaluate and document effectiveness of oxygen therapy (e.g., pulse oximetry, respiratory rate, heart rate).

Review additional information in the "Oxygen Therapy" chapter in Open RN *Nursing Skills, 2e*.

6.4 Common Respiratory Disorders

Respiratory conditions discussed in this chapter include asthma, chronic obstructive pulmonary disease (COPD), lung cancer, pneumonia, tuberculosis, respiratory viral disorders, and miscellaneous respiratory disorders.

6.5 Asthma

Overview

Asthma is a common chronic condition that affects the airways in the lungs. Individuals have different symptoms of asthma, with symptom severity ranging from "mild intermittent" symptoms to "severe persistent" symptoms. Asthma can be well-controlled by taking prescription medication and avoiding specific exposures that trigger an asthma attack.[1,2]

Pathophysiology

Asthma is caused by chronic inflammation in the airways, resulting in narrowed air passages. Individuals with asthma also experience bronchoconstriction that tightens the smooth muscle surrounding the airways, further limiting airflow.[3] When individuals with asthma are experiencing symptoms of bronchoconstriction and inflammation, they may also have increased mucus, further blocking their airways. See Figure 6.18[4] for an illustration of asthma symptoms.

1. Centers for Disease Control and Prevention. (n.d.). *Asthma*. https://www.cdc.gov/asthma/
2. National Heart, Lung, and Blood Institute. (2024). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma
3. Litonjua, A. A., & Weiss, S. T. (2023). Risk factors for asthma. *UpToDate*. https://www.uptodate.com/
4. "Asthma_attack-illustration_NIH.jpg" by United States-National Institute of Health: National Heart, Lung, Blood Institute is licensed in the Public Domain.

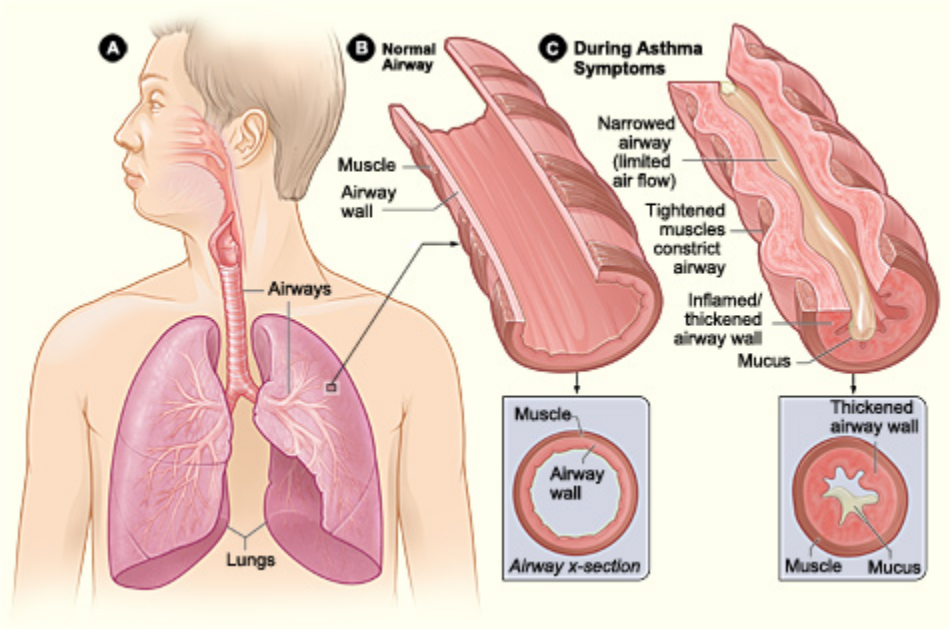


Figure 6.18 Asthma

Asthma causes repeated episodes of wheezing, dyspnea, chest tightness, and nighttime or early morning coughing. Between these episodes, many individuals with asthma are asymptomatic.[5]

Asthma can occur at any age and can be triggered by a variety of causes such as allergens, exercise, tobacco smoke, air pollutants, gastroesophageal reflux disease, cold air, and extreme emotion.[6] See Figure 6.19[7] for an illustration of common asthma triggers. Nurses teach clients diagnosed with asthma to recognize their triggers and avoid them to prevent asthma attacks.

5. Centers for Disease Control and Prevention. (n.d.). *Asthma.* https://www.cdc.gov/asthma/

6. Centers for Disease Control and Prevention. (n.d.). *Asthma.* https://www.cdc.gov/asthma/

7. "Asthma_triggers_2.PNG" by 7mike5000 is licensed under CC BY-SA 3.0

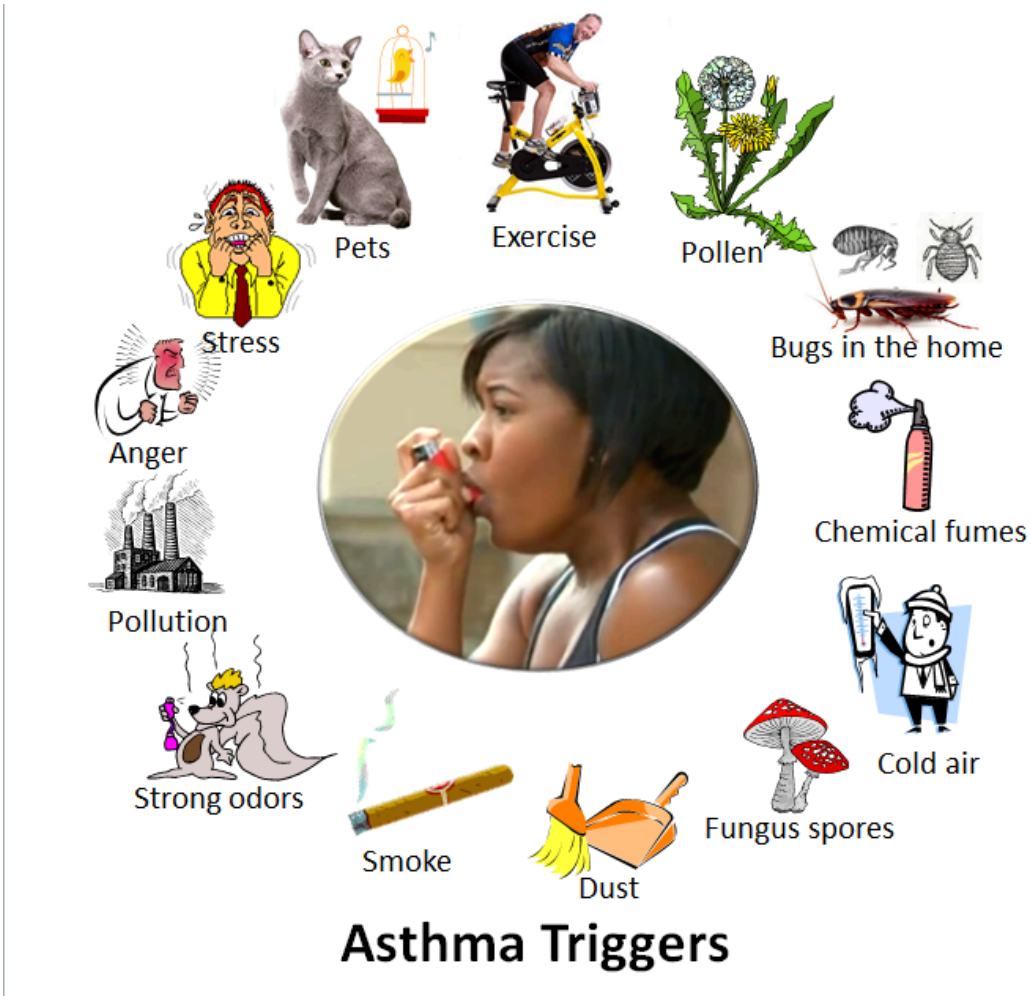


Figure 6.19 Asthma Triggers

There are two major classes of medications used to control asthma, referred to as quick-relief and long-term control. Quick-relief inhalers like albuterol and ipratropium are used to control symptoms that occur during an asthma attack. Long-term control medicines help prevent asthma attacks, but they do not resolve symptoms that occur during an asthma attack.[8] Asthma medications are further discussed in the "Medical Interventions" subsection later in this section.

8. Centers for Disease Control and Prevention. (n.d.). *Asthma.* https://www.cdc.gov/asthma/

Health Disparities Related to Asthma

The burden of asthma in the United States falls disproportionately on Black, Hispanic, and American Indian/Alaska Native people. These groups have the highest asthma rates, deaths, and hospitalizations. For example, when compared to White Americans, Black Americans are three times more likely to die from asthma.[9]

Racial and ethnic disparities in asthma are caused by complex factors, including these factors[10]:

- Social determinants such as socioeconomic status, education, neighborhood environment, employment, social support networks, and access to health care
- Structural determinants such as insurance and health care policies
- Biological determinants such as genetics
- Behavioral determinants such as tobacco use and adherence to prescribed medications

These strategies have been developed to improve asthma care in at risk populations[11]:

- Improving implementation of evidence-based guidelines, care, and treatments by expanding specialist care coverage, lowering copays, expanding eligibility criteria, and reducing barriers to treatment.
- Reducing exposure to pollution by strengthening clean air policies,

9. Asthma and Allergy Foundation of America. (2022). *Asthma symptoms*. https://aafa.org/asthma/asthma-symptoms/
10. Asthma and Allergy Foundation of America. (2022). *Asthma symptoms*. https://aafa.org/asthma/asthma-symptoms/
11. Asthma and Allergy Foundation of America. (2022). *Asthma symptoms*. https://aafa.org/asthma/asthma-symptoms/

reducing transportation-related emissions, restricting zoning of polluting sources, and transitioning to a clean energy economy.
- Providing personalized, culturally appropriate asthma action plans using the client's and caregivers' preferred language and learning styles (i.e., visual, audio, or kinesthetic).
- Improving trust in health care by engaging diverse clients, families, and community partners as early as possible when developing asthma prevention and care programs.

> Read additional information in the full Asthma Disparities in America Report by the Allergy and Asthma Foundation of America.

Assessment

Clinical manifestations of asthma are related to the inflammation and bronchoconstriction that occur in the airways. Individuals with well-controlled asthma may exhibit few or no symptoms. Signs and symptoms of individuals with asthma that is not well-controlled are as follows[12]:

- Wheezing
- Dyspnea
- Chest tightness
- Nighttime or early morning coughing
- Awakening at night with asthma symptoms

Severity of signs and symptoms during asthma attacks are further discussed

12. Asthma and Allergy Foundation of America. (2022). *Asthma symptoms*. https://aafa.org/asthma/asthma-symptoms/

in the “Asthma Action Plan” area under the “Medical Interventions” subsection.

Diagnostic Testing

Diagnostic testing for asthma involves several clinical assessment and lung function tests such as the following[13,14,15]:

- **Peak flow monitoring:** Peak flow monitoring is used by clients with moderate to severe asthma to monitor and manage their asthma symptoms. It involves a handheld device called a peak flow meter that measures the rate of air that can be forcefully breathed out of the lungs. This measurement is called a **peak expiratory flow rate (PEFR)**. A baseline PEFR is established for an individual diagnosed with asthma when their symptoms are well-controlled. Ranges of PEFRs are included on the client’s Asthma Action Plan to help determine if they are in the Green, Yellow, or Red Zone. See Figure 6.20[16] for an image of a peak flow meter. Additional information about teaching clients how to use a peak flow meter is discussed under “Health Teaching” in the “Nursing Interventions” subsection.

13. Litonjua, A. A., & Weiss, S. T. (2023). Risk factors for asthma. *UpToDate*. https://www.uptodate.com/

14. Fanta, C., & Barrett, N. (2023). An overview of asthma management. *UpToDate*. https://www.uptodate.com/

15. Wenzel, S. (2023). Treatment of severe asthma in adolescents and adults. *UpToDate*. https://www.uptodate.com/

16. “Peak_flow_meter_Philips_Respironics_PersonalBest_2019-11-29_5272.jpg” by Salicyna is licensed under CC BY-SA 4.0



Figure 6.20 Peak Flow Meter

- **Spirometry:** Read more about spirometry in the "Diagnostic Testing" subsection of the "General Respiratory System Assessment and Interventions" section. Decreased FEV1 compared to normal reference ranges, as well as a significant increase in FEV1 after bronchodilator administration, indicates asthma.
- **Methacholine Challenge:** A methacholine challenge test is used when other tests are inconclusive for diagnosing asthma. Methacholine is a

bronchoconstrictor that is inhaled to measure airway responsiveness.
- **Allergen Testing:** Allergen testing may be conducted to identify specific allergens that can trigger an individual's asthma symptoms.

Nursing Diagnoses

Nursing priorities for clients with asthma involve addressing dyspnea and inadequate oxygenation, promoting self-management and positive coping, and managing anxiety that is associated with asthma attacks.

Nursing diagnoses for clients with asthma are formulated based on the client's assessment data, medical history, and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions. Common nursing diagnoses include the following[17]:

- Ineffective Airway Clearance
- Anxiety
- Readiness for Enhanced Health Self-Management

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for individuals diagnosed with asthma are as follows:

- *The client will demonstrate accurate use of their prescribed inhalers by the end of the teaching session.*
- *The client will demonstrate accurate measurement of their peak flow*

17. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care (*13th ed.). Elsevier.

reading (PEFR) by the end of the teaching session.

- *The client and/or family member will verbalize how to accurately use the asthma action plan to manage worsening symptoms of asthma by the end of the teaching session.*
- *The client will verbalize how to use relaxation techniques to help manage feelings of anxiety when feeling short of breath by the end of the teaching session.*
- *The client will verbalize at least two personal triggers that contribute to worsening asthma symptoms by the end of the teaching session.*

Interventions

Medical Interventions

Medical interventions for asthma aim to achieve effective symptom control, improve lung function, prevent exacerbations, and enhance the client's quality of life. These interventions are prescribed by health care providers based on the individual's asthma severity, current symptoms related to their baseline, their asthma action plan, and specific triggers.

Common medical interventions used to address chronic asthma include lifestyle modifications, medication management, immunizations, asthma action plans, and surgical treatment.

LIFESTYLE MODIFICATIONS

Clients with asthma are advised to identify and minimize exposure to allergens or irritants that trigger their asthma, such as pollen, dust mites, or pet dander. They are also encouraged to receive flu, COVID, and pneumococcal vaccines to reduce the risk of respiratory infections that can trigger asthma exacerbations. For clients who smoke, quitting is strongly recommended to reduce exposure to irritants. For clients who don't smoke, exposure to second-hand tobacco smoke should be avoided.

MEDICATION THERAPY

The goal of asthma therapy is to control asthma symptoms with the least amount of medication and minimal risk for adverse effects. A "stepwise approach to therapy" is used by health care providers in determining the type of medication(s) prescribed, their dosage(s), and frequency of administration. These medications are increased as necessary and decreased when possible. Because asthma is a chronic inflammatory disorder of the airways with recurrent exacerbations, medication therapy focuses on long-term suppression of inflammation to prevent exacerbations. See Figure 6.21[18] for an illustration of the stepwise approach to asthma therapy.[19]

18. "Stepwise_approach_for_managing_asthma_in_youths_greater_than_or_equal_to_12_years_of_age_and_adults.gif" by National Heart, Blood, and Lung Institute is licensed under CC BY 2.5

19. National Asthma Education and Prevention Program, Third Expert Panel on the Diagnosis and Management of Asthma. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. (2007). *Stepwise approach for managing asthma in youths ≥12 years of age and adults*. https://www.ncbi.nlm.nih.gov/books/NBK7222/

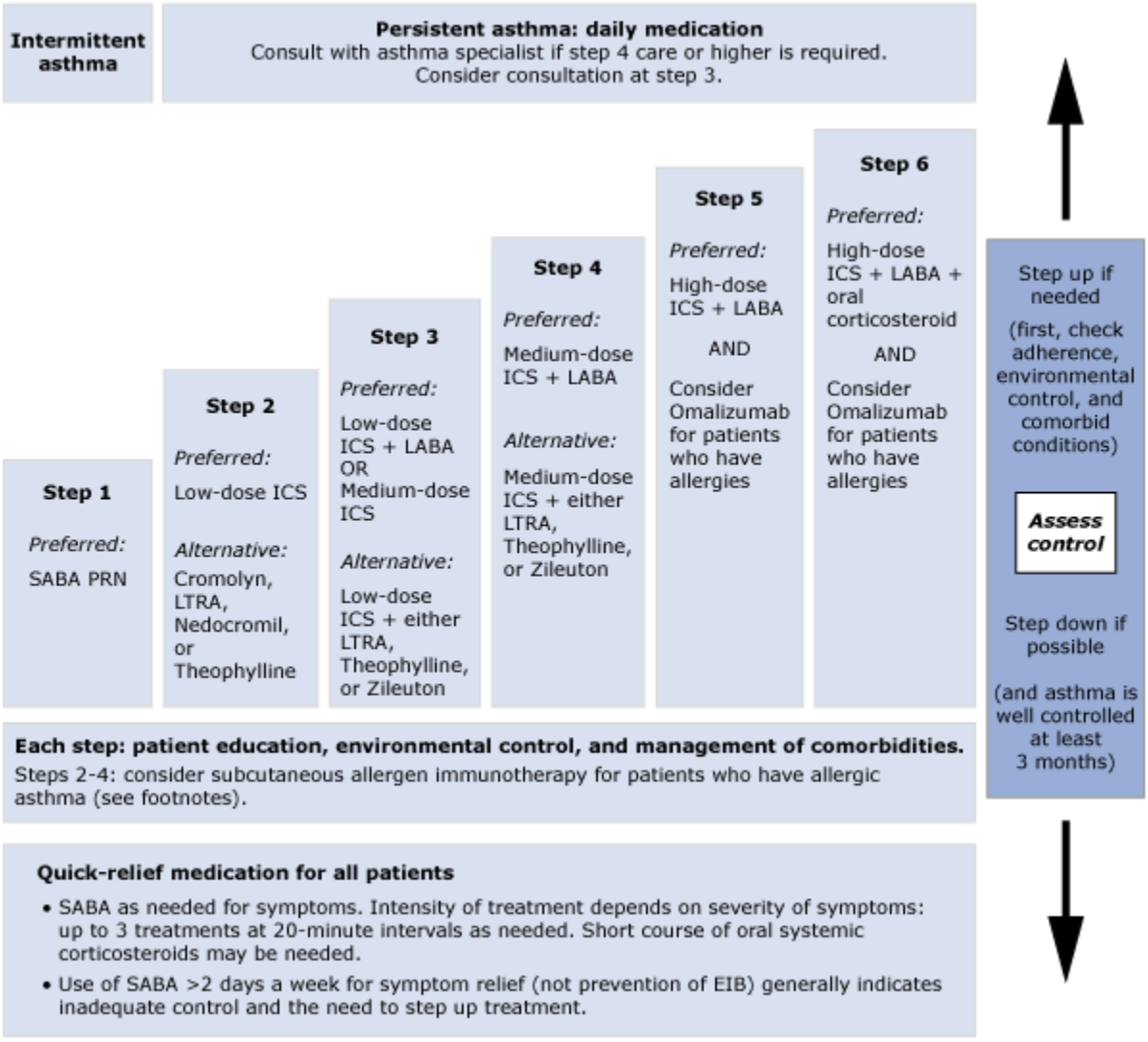


Figure 6.21 Stepwise Approach to Asthma Therapy for Adults and Children 12 Years and Older

As illustrated in Figure 6.21, several types of medication are prescribed to control asthma symptoms and prevent asthma attacks, as well as additional

medications like anti-IgE monoclonal antibodies and immunomodulators[20,21,22,23]:

- **Inhaled Bronchodilators**
  - **Short-Acting Beta-Agonists (SABA):** SABAs such as albuterol or ipratropium relax airway smooth muscles and rapidly relieve bronchoconstriction. SABAs are used as "rescue" medications during asthma attacks to quickly relieve acute symptoms.
  - **Long-Acting Beta-Agonists (LABA):** LABAs such as salmeterol provide long-term bronchodilation.
- **Inhaled Corticosteroids:** Inhaled corticosteroids, such as fluticasone and budesonide, are anti-inflammatory medications that reduce airway inflammation. They are used for long-term prevention and management of asthma symptoms.
- **Combination Inhalers With Inhaled Corticosteroid and Long-Acting Beta-Agonists (ICS-LABA):** ICS-LABA combination inhalers such as fluticasone/salmeterol, commonly known by the brand name Advair, reduce airway inflammation and promote bronchodilation to prevent asthma symptoms.
- **Oral or Intravenous Corticosteroids:** A short course of an oral corticosteroid, such as prednisone, may be prescribed for clients in the "Yellow Zone" to reduce inflammation and swelling in the airways. Clients

20. Sharma, S., Hashmi, M. F., & Chakraborty, R. K. (2023). *Asthma Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK531455/

21. Litonjua, A. A., & Weiss, S. T. (2023). Risk factors for asthma. *UpToDate*. https://www.uptodate.com/

22. Fanta, C., & Barrett, N. (2023). An overview of asthma management. *UpToDate*. https://www.uptodate.com/

23. Wenzel, S. (2023). Treatment of severe asthma in adolescents and adults. *UpToDate*. https://www.uptodate.com/

receiving emergency care for an acute asthma attack may receive intravenous administration of corticosteroids, such as methylprednisolone, for rapid reduction of airway swelling and inflammation.

- **Leukotriene Modifiers:** Oral leukotriene modifiers such as montelukast are used for long-term prevention of asthma symptoms and reduction of inflammation and bronchoconstriction by targeting leukotrienes that are involved in an allergic response related to asthma.
- **Cromolyn:** Cromolyn reduces the release of inflammatory mediators, including histamine and leukotrienes that cause bronchoconstriction and allergic symptoms that can trigger asthma.
- **Methylxanthine:** Methylxanthine, commonly known as theophylline, is an older medication used to treat asthma that may be prescribed if other alternatives are not effective. It decreases inflammation and causes bronchodilation but requires close monitoring of serum levels because it has a narrow range between therapeutic and toxic levels.
- **Anti-IgE Monoclonal Antibodies:** Monoclonal antibodies that target IgE, such as omalizumab, can be effective in reducing acute asthma exacerbations and improving quality of life for clients with severe asthma who have an allergic response component.[24]
- **Immunomodulators:** Mepolizumab is a biologic therapy that regulates levels of eosinophils, blood cells that often trigger asthma in individuals with an allergic component.
- **Oxygen Therapy:** Oxygen therapy is not a standard treatment for asthma management, but it may be used during acute asthma exacerbations for clients in the “Red Zone.”

24. Kardas, G., Panek, M., Kuna, P., Damiański, P., & Kupczyk, M. (2022). Monoclonal antibodies in the management of asthma: Dead ends, current status and future perspectives. *Frontiers in Immunology, 13*, 983852. https://doi.org/10.3389/fimmu.2022.983852

To read additional information about common medication classes used to treat asthma, visit the "Respiratory" chapter in Open RN *Nursing Pharmacology, 2e*.

IMMUNIZATIONS

Clients diagnosed with asthma are encouraged to remain up-to-date on recommended vaccinations, including influenza, pneumococcal (pneumonia), respiratory syncytial virus (RSV), pertussis (Tdap), and COVID vaccines.

Review current information about "Recommended Vaccines by Age" from the Centers for Disease Control and Prevention (CDC).

ASTHMA ACTION PLANS

An individual diagnosed with asthma should have a written "Asthma Action Plan" from their health care provider that advises them how to self-manage their asthma at home. Asthma action plans have three zones, referred to as green, yellow, and red.

Green Zone

Individuals whose asthma symptoms are well-controlled are considered to be in the "Green Zone." This means they don't have a cough, wheeze, chest tightness, or shortness of breath during the day or night, and they can do their usual activities. If they use a peak flow meter to monitor and manage

their asthma, their peak flow reading is at least 80% of their personal best.[25] Peak flow meters are further discussed under the "Diagnostic Testing" subsection.

Individuals in the "Green Zone" should continue taking their asthma medications as prescribed. If exercise is an asthma trigger for an individual, their asthma action plan may advise quick-relief medication before exercising to prevent an asthma attack (sometimes referred to as "pre-treatment").

Yellow Zone

Individuals are considered to be in the "Yellow/Caution Zone" when their asthma symptoms are worsening, including one or more of the following[26]:

- Coughing, wheezing, chest tightness, or shortness of breath
- Waking at night due to asthma
- Able to do some, but not all of their usual activities

If a client uses a peak flow meter to monitor and manage their asthma, peak flow readings of 50 to 79% of their personal best indicate they are in the "Yellow Zone." Individuals in the "Yellow Zone" should take their prescribed asthma medications as listed in the "Green Zone" of their asthma action plan, plus additional medications as described in the "Yellow Zone," such as a quick-relief inhaler and possibly an oral corticosteroid. They should also call their doctor as instructed.[27] Individuals who experience "Yellow Zone" symptoms two or more times per week should contact their health care

25. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

26. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

27. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

provider for a follow-up appointment because this frequency means their asthma is not considered "well-controlled," and they are at risk for a severe asthma attack.[28]

Red Zone

Individuals are considered to be in the "Red/Medical Alert Zone" if they are experiencing asthma symptoms that are worsening without resolution. Severe asthma episodes can be life-threatening and require emergency care. Signs and symptoms of an asthma emergency that requires urgent medical care include one or more of the following criteria[29]:

- Feeling very short of breath
- Symptoms are not relieved by quick-relief medicines
- Unable to do usual activities
- Same or worsening symptoms after 24 hours in Yellow Zone

Infants, toddlers, and children may have different asthma emergency signs and symptoms than adults. Additional signs and symptoms of a severe asthma episode in infants, toddlers, and children include the following[30]:

- Nasal flaring (i.e., nostrils are opening widely)
- Exaggerated belly breathing
- Failing to recognize or respond to their parents
- Irritable, agitated, and/or sluggish

28. Asthma and Allergy Foundation of America. (2022). *Asthma symptoms*. https://aafa.org/asthma/asthma-symptoms/

29. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

30. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

- Nasal grunting on expiration

Individuals in the “Red Zone” should immediately take a quick-relief medication and an oral corticosteroid and then call their health care provider. If they are still in the “Red Zone” after 15 minutes AND they have not reached their provider, they should go to the emergency room or call an ambulance. If at any time they experience trouble walking and talking due to shortness of breath or their lips or fingernails become cyanotic, they should take another dose of quick-relief medication and immediately call 911 or go to the emergency room.[31]

Status Asthmaticus

Status asthmaticus is a severe and life-threatening asthma attack that is unresponsive to standard treatments such as bronchodilators and corticosteroids. It is a medical emergency that requires immediate intervention, typically in an emergency department or by a medical response team.

Status asthmaticus is characterized by the following:

- Severe airway obstruction
- Rapid and labored breathing
- Worsening hypoxemia
- Decreased mental alertness
- Ineffective bronchodilator response
- Cyanosis
- Silent chest – minimal or no breath sounds heard on auscultation

31. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

- Exhaustion

Treatment for status asthmaticus typically involves the following[32,33,34]:

- **Oxygen Therapy:** Oxygen is administered to quickly resolve hypoxemia and improve oxygen levels in the blood.
- **Systemic Corticosteroids:** Corticosteroids (e.g., methylprednisolone) are administered intravenously to quickly reduce airway inflammation and swelling.
- **Continuous Nebulized Bronchodilators:** High-dose bronchodilators are continuously administered, such as albuterol nebulizers.
- **Magnesium Sulfate:** Intravenous magnesium sulfate may be administered to relax bronchial smooth muscles.
- **Intubation and Mechanical Ventilation:** In severe cases when hypoxia and hypercapnia are present, endotracheal intubation and mechanical ventilation may be necessary. This procedure is typically performed by respiratory therapists, paramedics, physicians, or anesthesiologists.
- **Continuous Monitoring of Vital Signs and ECG:** Continuous monitoring of vital signs and oxygen saturation levels and an electrocardiogram (ECG) are performed to closely monitor the client's condition because the hypoxia can trigger arrhythmias.

32. Litonjua, A. A., & Weiss, S. T. (2023). Risk factors for asthma. *UpToDate*. https://www.uptodate.com/

33. Fanta, C., & Barrett, N. (2023). An overview of asthma management. *UpToDate*. https://www.uptodate.com/

34. Wenzel, S. (2023). Treatment of severe asthma in adolescents and adults. *UpToDate*. https://www.uptodate.com/

- View or download the most recent copy of an Asthma Action Plan document from the National Heart, Lung, and Blood Institute.[35]

SURGICAL INTERVENTIONS

Clients with severe asthma for whom conventional treatment is not effective may undergo **bronchial thermoplasty**. This procedure is performed during a bronchoscopy and delivers heat to the muscles surrounding the airways to reduce smooth muscle mass and prevent them from narrowing.[36,37,38]

Nursing Interventions

Nursing interventions for asthma are aimed at symptom management and facilitating overall respiratory health through medication management, health teaching, and psychosocial support.

35. National Heart, Lung, and Blood Institute. (2022). *What is asthma?* National Institutes of Health. https://www.nhlbi.nih.gov/health/asthma

36. Litonjua, A. A., & Weiss, S. T. (2023). Risk factors for asthma. *UpToDate*. https://www.uptodate.com/

37. Fanta, C., & Barrett, N. (2023). An overview of asthma management. *UpToDate*. https://www.uptodate.com/

38. Wenzel, S. (2023). Treatment of severe asthma in adolescents and adults. *UpToDate*. https://www.uptodate.com/

MEDICATION MANAGEMENT

Nurses safely administer prescribed medications, evaluate their effectiveness, and monitor for potential side effects. They provide teaching about the purpose and use of medications as further described under the "Health Teaching" subsection.

DYSPNEA MANAGEMENT

Nurses implement and teach strategies for managing dyspnea during asthma attacks, in addition to administering medication. For example, sitting upright or using tripod positioning can help with lung expansion, and pursed-lip breathing reduces air trapping that can occur during an asthma attack. Review enhanced breathing techniques in the "General Nursing Interventions Related to Respiratory Alterations" subsection earlier in this chapter.

HEALTH TEACHING

Nurses provide comprehensive asthma education to clients and their family members, caregivers, or significant others. Teaching focuses on symptoms of asthma, triggers of their asthma attacks, how to use their prescribed medications according to their asthma action plan, and when to contact their provider with worsening symptoms. See teaching topics related to the asthma action plan in the following box.

A Closer Look: Health Teaching Regarding Asthma Action Plans[39]

Clients with asthma should have a written action plan

39. Fanta, C., & Barrett, N. (2023). An overview of asthma management. *UpToDate*. https://www.uptodate.com/

developed in collaboration with their health provider. If the client does not have a written action plan, the nurse should advocate for one. Nurses provide education to the client and their family members regarding how to use the asthma action plan and check for understanding.

Green Zone (Good Control): Teaching topics include the following:

- Using long-term control medications as prescribed.
- Identifying and avoiding triggers.
- Monitoring peak flow readings.
- Premedicating before exercise, if exercise is a trigger.

Yellow Zone (Caution): Teaching topics include the following:

- Understanding the symptoms that indicate the Yellow Zone.
- Using quick-relief medications and oral corticosteroids.
- Monitoring peak flow readings.
- Notifying the health care provider.

Red Zone (Danger): Teaching topics include the following:

- Knowing the symptoms that indicate the Red Zone.
- Understanding the actions to take if in the Red Zone.
- Knowing when to call the health care provider and/or seek emergency medical care.

It is helpful for the client to have written materials during and after the teaching session. See information on free handouts in the following box.

The National Heart, Lung, and Blood Institute provides free resources that can be downloaded and printed for clients. Here are a few key handouts that can be used during health teaching sessions:

- Monitoring Your Asthma with instructions on how to use a peak flow meter
- How to Use a Metered-Dose Inhaler
- How to Use a Nebulizer
- How to Use a Dry Powder Inhaler

PSYCHOSOCIAL SUPPORT

Nurses offer psychosocial support to clients with chronic disease to help them cope with the challenges of managing their symptoms and achieving quality of life.

It is common for clients with asthma and their family members to experience anxiety when dyspnea occurs. Anxiety can worsen dyspnea because it stimulates rapid, shallow breathing. During an asthma attack, in addition to implementing interventions to promote oxygenation, the nurse maintains a calm environment, stays with the client, and encourages relaxation techniques to decrease anxiety. Nurses can demonstrate and encourage the use of focused breathing, guided imagery, and progressive relaxation. Music therapy, based on the client's preferences, may also be helpful to promote relaxation. After an asthma attack has resolved, nurses teach clients and their family members how to use relaxation techniques to

help manage anxiety while also using their asthma action plan to manage their respiratory symptoms.[40]

Nurses also assess the coping skills, available resources, and social support for clients with asthma. By reinforcing the asthma action plan, nurses focus on positive coping strategies and self-monitoring techniques that reaffirm the client's and the family's ability to deal with the chronic illness. Effective resources and support can reduce asthma symptoms and result in fewer unscheduled health care visits, fewer activity limitations, and improved school/work attendance.[41,42]

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

40. Martin, P. (2024). *6 asthma nursing care plans.* NursesLabs. https://nurseslabs.com/asthma-nursing-care-plans/

41. Martin, P. (2024). *6 asthma nursing care plans.* NursesLabs. https://nurseslabs.com/asthma-nursing-care-plans/

42. Cicutto, L., Gleason, M., Haas-Howard, C., et al. (2018). Building bridges for asthma care program: A school-centered program connecting schools, families, and community health-care providers. *The Journal of School Nursing, 36*(3), 168-180. https://doi.org/10.1177/1059840518805824



RN Recap: Asthma

View a brief YouTube video overview of asthma.[43]

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1474#oembed-1

43. Open RN Project. (2024, June 23). *Health Alterations – Chapter 6 – Asthma* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/cCdROXkChUU?si=CMgPB9QkQMsdzqDB

6.6 COPD

Pathophysiology

Chronic obstructive pulmonary disease (COPD) is a chronic, progressive, and incurable respiratory condition that causes breathing difficulties and reduced lung function. COPD is characterized by the obstruction of airflow in and out of the lungs. The primary cause of COPD is cigarette smoking. A deficiency of Alpha 1 antitrypsin, an enzyme with lung protective properties, is also a potential cause of COPD. Other causes of COPD include prolonged exposure to irritants that damage the lungs, such as environmental exposures, including air pollution, dust, chemicals, or secondhand smoke.[1]

COPD includes two conditions called chronic bronchitis and emphysema. Chronic bronchitis is an inflammation of the bronchi and bronchioles characterized by increased mucus and chronic productive cough for at least three months of the year for at least two consecutive years. Emphysema is a destructive problem of lung elastic tissue that reduces its ability to recoil after stretching, leading to hyperinflation of the lung.

Most people who have COPD have a mixture of both emphysema and chronic bronchitis in different proportions, and the seriousness of each condition varies from person to person. In COPD, there is less air flow in and out of the airways because of one or more reasons[2]:

- The airways and alveoli lose their elastic quality.
- The walls between many of the air sacs are destroyed.
- The walls of the airways become thick and inflamed.
- The airways make more mucus than usual and can become clogged.

1. National Heart, Lung, and Blood Institute. (2024). *What is COPD?* National Institutes of Health. https://www.nhlbi.nih.gov/health/copd

2. National Heart, Lung, and Blood Institute. (2024). *What is COPD?* National Institutes of Health. https://www.nhlbi.nih.gov/health/copd

COPD is a progressive disease, meaning that symptoms worsen over time. In the early stages of COPD, individuals may not experience noticeable symptoms, but as the condition advances, breathing difficulties become more pronounced. Although there is no cure, treatments and lifestyle changes such as quitting smoking can help clients feel better, stay more active, and slow the progress of the disease. Oxygen therapy, pulmonary rehabilitation, and medications are prescribed to manage symptoms and enhance quality of life. Individuals with advanced COPD may require palliative and/or hospice care services.[3] See Figure 6.22[4] for an illustration of COPD.

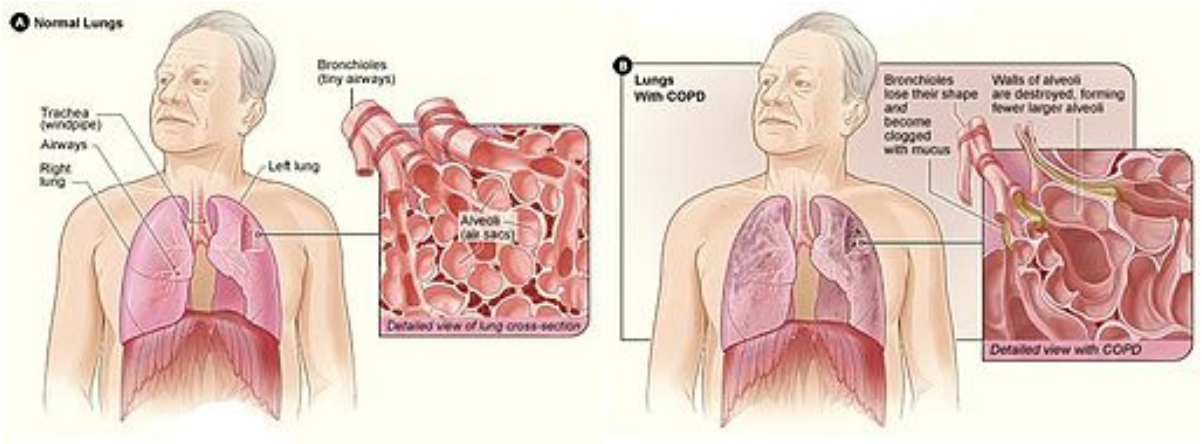


Figure 6.22 Chronic Obstructive Pulmonary Disease

Common Signs and Symptoms of COPD

Common signs and symptoms of COPD include the following[5]:

- Dyspnea, especially with physical activity. Clients may report breathing

3. National Heart, Lung, and Blood Institute. (2024). *What is COPD?* National Institutes of Health. https://www.nhlbi.nih.gov/health/copd
4. "Copd 2010Side.JPG" by National Heart, Lung, and Blood Institute is licensed in the Public Domain.
5. National Heart, Lung, and Blood Institute. (2024). *What is COPD?* National Institutes of Health. https://www.nhlbi.nih.gov/health/copd

takes more effort or they are gasping for air.
- Fatigue due to reduced oxygenation of the body's tissues and muscles.
- An ongoing cough or a cough that produces a lot of mucus, sometimes called a smoker's cough. This is often the first symptom of COPD. However, they are not always strong enough to cough up the mucus due to the associated fatigue.
- **Audible wheezing** (i.e., a whistling or squeaky sound when breathing).
- Chest tightness or heaviness. Clients may report it is hard to take a deep breath or it's painful to breathe.
- Nail clubbing from chronic hypoxia.
- Barrel chest due to hyperinflated alveoli

Acid-Base Balance

Because of the changes that occur in the bronchioles/alveoli and the air trapping that occurs in clients with COPD, the ability to inhale oxygen and exhale carbon dioxide is affected. It is common for clients with moderate to severe COPD to have ABG results with lower levels of dissolved oxygen in the blood (PaO2) and higher levels of dissolved carbon dioxide in the blood (PaCO2). As carbon dioxide is retained in the body, clients with COPD often develop chronic compensated respiratory acidosis as the kidneys compensate and retain bicarbonate to neutralize the acidic pH.[6]

Clients with acute exacerbations of COPD may develop uncompensated respiratory acidosis as gas exchange worsens. For this reason, ABGs are a common diagnostic test for clients hospitalized with a COPD exacerbation. Acute exacerbations of COPD are further discussed in the following subsection.

6. Pahal, P., Hashmi, M. F., & Sharma, S. (2023). *Chronic Obstructive Pulmonary Disease Compensatory Measures*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK525962/

Review information about ABG analysis and respiratory acidosis in the "Acid-Base Balance" section in the "Fluids and Electrolytes" chapter in Open RN *Nursing Fundamentals, 2e*.

Acute Exacerbations of COPD

In addition to chronic symptoms of COPD that worsen over time, clients can also experience acute exacerbations of COPD. Environmental triggers and respiratory infections can lead to a sudden worsening of symptoms called a COPD exacerbation. During a COPD exacerbation, clients have worsening dyspnea and oxygen saturation levels lower than their baseline. If associated with a respiratory infection, they may also have a fever, increased chest tightness, worsening cough, and purulent sputum. Acute exacerbations often require hospitalization, so rapid recognition of these symptoms and notification of the health care provider are vital.

Clients with acute exacerbations of COPD undergo additional diagnostic testing, such as a chest X-ray, complete blood count (with a focus on WBCs), and ABG. Read more about these diagnostic tests in the "General Respiratory System Assessment and Interventions" section. ABG results may indicate uncompensated respiratory acidosis as the PaCO2 levels increase and the kidneys are no longer able to compensate for the retained CO2. ABG results help guide medical treatment.

Inhaled or oral steroids and additional bronchodilators may be prescribed. Antibiotics may be prescribed when a respiratory bacterial infection is suspected or confirmed. Severe symptoms may require hospitalization. Intravenous corticosteroids may be prescribed, along with noninvasive positive pressure ventilation, commonly referred to as CPAP or BiPAP. In very severe cases, intubation and mechanical ventilation may be required.

Oxygen Therapy

Long-term oxygen therapy (LTOT) is prescribed for clients with chronic

obstructive pulmonary disease (COPD) when oxygen saturation levels are 88% or less when at rest and in a stable clinical condition. Research indicates that LTOT improves survival benefits and quality of life for clients with COPD with chronic hypoxemia. Other positive outcomes include decreased depression, improved cognitive function, improved exercise capacity, and decreased hospital admission rates.[7] Respiratory therapists typically assist clients in setting up LTOT, establish the oxygenation device and oxygen flow rates, and provide health teaching about its safe use in the home. Nurses reinforce this information on discharge and during follow-up visits.

> Read additional information about oxygen equipment and safety measures in the "Oxygen Therapy" chapter of Open RN *Nursing Skills, 2e*.

Clients with COPD may be prescribed supplementary oxygen therapy during acute exacerbations of COPD or for long-term therapy. When administering oxygen to a client with COPD, it is important to understand how their respiratory drive differs from people who do not have COPD. As previously discussed in the "Review of Anatomy and Physiology of the Respiratory System" section of this chapter, an individual's respiratory drive is primarily based on the level of carbon dioxide in their bloodstream. As carbon dioxide levels increase, the brain stimulates faster respiratory rates.

Clients with COPD chronically retain carbon dioxide, and their body's response to high PaCO2 levels to stimulate breathing becomes blunted. Instead of relying on PaCO2 levels to initiate breathing, their brains primarily rely on dissolved oxygen levels in the bloodstream, referred to as **hypoxic drive**. For this reason, supplementary oxygen must be administered carefully to clients with COPD. Administering high-flow oxygen to a COPD client could

7. Shebl, E., Modi, P., & Cates, T. D. (2023). *Home Oxygen Therapy*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK532994/

potentially suppress their drive to breathe and cause a decreased respiratory rate, leading to additional carbon dioxide retention. To ensure the safe administration of supplemental oxygen to clients with COPD, it is crucial to follow these guidelines[8]:

- Aim for their prescribed target oxygen saturation level (usually between 88-92%).
- Provide oxygen at a low-flow rate, typically no more than 2-3 liters unless otherwise prescribed, to prevent the suppression of the client's hypoxic drive.
- Continuously monitor the client's pulse oximetry level, respiratory rate, and clinical condition. Titrate oxygen therapy to maintain the targeted oxygen saturation range while simultaneously avoiding suppression of their hypoxic drive to breathe.

COPD and Right-Sided Heart Failure

Clients with severe COPD may develop right-sided heart failure called **cor pulmonale**. As the right ventricle has to work harder to pump blood into the lungs that are hyperinflated, the cardiac muscle may enlarge and become less efficient.[9]

8. Pahal, P., Hashmi, M. F., & Sharma, S. (2023). *Chronic Obstructive Pulmonary Disease Compensatory Measures*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK525962/

9. Mooney, L., et al. (2021). Impact of chronic obstructive pulmonary disease in patients with heart failure with preserved ejection fraction: Insights from PARAGON-HF. *Journal of the American Heart Association, 10*(23), e021494. https://www.ahajournals.org/doi/10.1161/JAHA.121.021494#d1e3937

- Review information about right-sided heart failure in the "Heart Failure" section of the "Cardiovascular Alterations" chapter.

Assessment

Clinical manifestations of COPD often develop as a result of reduced lung function. As with any chronic illness, it is vital for the nurse to be aware of a client's baseline status to recognize signs of clinical deterioration requiring health care provider notification. See Table 6.6 for a summary of common manifestations of COPD across body systems.

Table 6.6. Clinical Manifestations of COPD[10,11]

10. King Han, M., Dransfield, M. T., & Martinez, F. J. (2023). Chronic obstructive pulmonary disease: Diagnosis and staging. *UpToDate*. https://www.uptodate.com/

11. Stoller, J. K. (2023). COPD exacerbations: Management. *UpToDate*. https://www.uptodate.com/

Body System	Clinical Manifestations of COPD
Respiratory	Chronic cough, excessive sputum production, wheezing, dyspnea, reduced activity tolerance, barrel chest, adventitious lung sounds such as wheezing and rhonchi (coarse crackles), and frequent respiratory infections
Cardiovascular	Right-sided heart failure (Cor pulmonale) increases capillary refill time
Gastrointestinal	Decreased appetite and difficulty eating due to shortness of breath
Musculoskeletal	Reduced muscle strength or muscle wasting
Psychological & Emotional Well-Being	Anxiety and depression, reduced quality of life, and social isolation
Integumentary	Clubbing of the fingers and decreased skin turgor
Neurological	New onset confusion or change in level of consciousness if hypoxia or hypercapnia is present
General Symptoms	Fatigue or weakness

Diagnostic Testing

The primary diagnostic test for COPD is spirometry. Spirometry can detect COPD even before symptoms are recognized. Spirometry test results determine the severity of COPD and are used to set treatment goals. Read more about spirometry testing under "Pulmonary Function Tests" in the General Respiratory System Assessment and Interventions" section of this chapter.

Clients with chronic COPD may also exhibit elevated levels of red blood cells, hemoglobin (Hgb), and hematocrit (HCT) as a compensatory response to chronic hypoxemia, which stimulates the production of red blood cells to carry more oxygen. This is referred to as secondary polycythemia.

Clients who are hospitalized for an acute COPD exacerbation have additional diagnostic testing performed, such as ABG, sputum samples, and chest X-rays.

- **Arterial Blood Gas (ABG):** As discussed earlier in this chapter, clients with stable, chronic COPD are often in a continual state of compensated respiratory acidosis due to carbon dioxide retention. However, clients experiencing an acute exacerbation of COPD often have ABG results indicating hypoxemia (low PaO2) and worsening hypercapnia (high PaCO2), resulting in uncompensated respiratory acidosis.
- **Sputum Samples:** Sputum samples may be obtained if an upper respiratory infection is suspected. These samples can help identify the presence of infection or other respiratory conditions.
- **Chest X-ray:** A chest X-ray may be obtained to assess for pneumonia. In clients with advanced COPD, the lungs may appear hyperinflated due to the destruction of alveolar walls and the trapping of air. The diaphragm may appear lower and flattened as a result of increased lung volume and hyperinflation. The weakened diaphragm has difficulty contracting effectively.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing priorities for clients with COPD focus on improving respiratory function, enhancing quality of life, and promoting self-management.

Nursing diagnoses for clients with COPD are formulated based on the client's assessment data, medical history, and specific needs. These nursing diagnoses guide the development of individualized care plans and interventions. Common nursing diagnoses are as follows[12]:

12. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing*

- Decreased Activity Tolerance
- Ineffective Airway Clearance
- Impaired gas exchange
- Anxiety
- Imbalanced Nutrition: Less Than Body Requirements
- Powerlessness
- Impaired Social Interaction
- Readiness for Enhanced Health Self-Management

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to COPD include the following:

- *The client will maintain a patent airway as evidenced by clear breath sounds and absence of wheezing or crackles.*
- *The client will maintain oxygen saturation within the specified target range (i.e., 88-92%).*
- *The client will report increased ability to perform daily activities without excessive fatigue or dyspnea.*
- *The client will achieve and maintain an appropriate body weight and body mass index (BMI) for their age and height.*
- *The client will participate in support groups with other individuals with COPD.*

diagnosis handbook: An evidence-based guide to planning care (13th ed.). Elsevier.

Interventions

Medical Interventions

The primary intervention for clients with COPD who smoke is smoking cessation. Other medical interventions for COPD aim to achieve effective symptom control, improve lung function, prevent exacerbations, and enhance the client's quality of life. These interventions are prescribed by health care providers based on the client's COPD severity and their individualized needs.

SMOKING CESSATION

The chemicals in cigarettes, e-cigarettes, and cigars can damage the lungs and cause worsening symptoms, increase the risk of exacerbations, and decrease lung function. Continued smoking can also make lungs unresponsive to COPD medications.

> Read more information about smoking cessation on the American Lung Association's Quit Smoking web page.

MEDICATION THERAPY

Common medications prescribed for COPD are as follows[13, 14, 15]:

- **Bronchodilators:** Short-acting beta-agonists (SABAs) and long-acting beta-agonists (LABAs) help relax airway muscles, improving airflow. Anticholinergic bronchodilators reduce bronchoconstriction and mucus production.
    - **Short-acting Beta-Agonists (SABAs):** SABAs relieve symptomatic bronchoconstriction and improve airflow. They provide quick relief of symptoms. Albuterol is a Beta-2 agonist that relaxes the smooth muscle of bronchioles, producing bronchodilation. Ipratropium is an anticholinergic that blocks the action of acetylcholine in the smooth muscle of the bronchioles, causing bronchodilation.
    - **Long-acting Beta-Agonists (LABAs):** LABAs, like salmeterol, work as long-acting bronchodilators to maintain airway patency over an extended period. They are used as maintenance therapy for clients with moderate to severe COPD to reduce symptoms and exacerbations by promoting bronchodilation throughout the day.
- **Inhaled Corticosteroids (ICS):** ICS, like fluticasone, reduce and control inflammation in the airways and lung tissues.
- **Corticosteroids:** Some clients with severe COPD, or those experiencing an acute exacerbation of COPD, require oral corticosteroids, like prednisone,

13. American Lung Association. (2023). *COPD causes and risk factors*. https://www.lung.org/lung-health-diseases/lung-disease-lookup/copd/what-causes-copd

14. King Han, M., Dransfield, M. T., & Martinez, F. J. (2023). Chronic obstructive pulmonary disease: Diagnosis and staging. *UpToDate*. https://www.uptodate.com/

15. Stoller, J. K. (2023). COPD exacerbations: Management. *UpToDate*. https://www.uptodate.com/

to systemically reduce airway inflammation and suppress the immune response. Clients who are hospitalized for an acute exacerbation of COPD may be prescribed intravenous corticosteroids, like methylprednisolone IV, to rapidly reduce the immune response.

- **Mucolytics:** Mucolytic agents, like oral guaifenesin, may be used to thin mucus, making it easier to clear sputum from the airways. Some clients with severe COPD may be prescribed acetylcysteine or dornase alfa that are administered via a nebulizer.
- **Oxygen Therapy:** Clients with severe COPD may be prescribed long-term oxygen therapy. Review the "Oxygen Therapy" discussion in the "Overview" subsection.

> Read more information about medication classes used to treat COPD in the "Respiratory System" chapter of Open RN *Nursing Pharmacology, 2e*.

IMMUNIZATIONS

Clients diagnosed with COPD are encouraged to remain up-to-date on recommended vaccinations, including influenza, pneumococcal (pneumonia), respiratory syncytial virus (RSV), pertussis (Tdap), and COVID vaccines.

Review current information about "Recommended Vaccines By Age" from the Centers for Disease Control and Prevention (CDC).

PULMONARY REHABILITATION

Clients with COPD are often referred for pulmonary rehabilitation. **Pulmonary rehabilitation** is a supervised program that includes exercise training, health

education, and breathing techniques for people who have chronic lung conditions like COPD.[16]

> Read additional information about pulmonary rehabilitation on the National Heart, Lung, and Blood Institute's "Pulmonary Rehabilitation" web page.

SURGERY

Surgery is usually a last resort for people with COPD who have severe symptoms that have not improved from medication therapy. Potential surgeries for severe COPD include the following[17,18]:

- **Bullectomy:** In a **bullectomy**, one or more very large bullae are removed from the lungs. Bullae are larger air spaces that form when the walls of the air sacs are destroyed. These air spaces can become so large that they interfere with breathing.
- **Implantation of One-way Endobronchial Valves:** Valves may be implanted in one of the bronchial tubes that allow air to exit the damaged parts of the lung, but not reenter.
- **Lung Volume Reduction Surgery (LVRS):** LVRS helps people with severe emphysema that affects the upper lung lobes. LVRS is not a cure for

16. National Heart, Lung, and Blood Institute. (2024). *What is COPD?* National Institutes of Health. https://www.nhlbi.nih.gov/health/copd

17. National Heart, Lung, and Blood Institute. (2024). *What is COPD?* National Institutes of Health. https://www.nhlbi.nih.gov/health/copd

18. American Lung Association. (n.d.). *Chronic obstructive pulmonary disease. COPD.* https://www.lung.org/lung-health-diseases/lung-disease-lookup/copd

COPD but may improve exercise capacity and quality of life. The goal of the surgery is to remove about 30 percent of the most diseased lung tissue. While this reduces the size of the lungs, it also allows the remaining healthier part of the lungs to work better. LVRS also can help the diaphragm to return to its normal shape, allowing the person to breathe more efficiently and improve lung capacity.

- **Lung Transplant:** Lung transplant may be considered for individuals with advanced COPD who have not responded to other treatments. It may be considered if the client's lung damage cannot be repaired; if the client has had three or more severe, acute exacerbations of COPD within the last year; or they are not a candidate for LVRS. The transplant team will evaluate the client to see if they are physically and emotionally healthy enough for a lung transplant. Important factors include being a nonsmoker and at a healthy weight. Clients who are deemed qualified to receive a lung transplant are placed on a waiting list to receive a single- or double-lung transplant. After surgery, the client will remain on immunosuppressive medications for the rest of their life.

Nursing Interventions

Nursing interventions for COPD are centered around improving respiratory function, managing symptoms, and enhancing the client's quality of life. These interventions are designed to provide holistic care and support to individuals with COPD.

MEDICATION MANAGEMENT

Nurses in all settings evaluate the effectiveness of the prescribed medication therapy for COPD and monitor for potential side effects. Clients are taught the purpose of prescribed medications, how to use the inhalers, their potential side effects, and when to notify the health care provider.

DYSPNEA MANAGEMENT

The nurse continually monitors the client's level of dyspnea and implements

and teaches about strategies to manage dyspnea. For example, coughing and breathing techniques, positioning, and pursed-lip breathing are helpful techniques. The nurse also assists with other prescribed respiratory interventions, such as postural drainage, incentive spirometry, and vibratory pressure therapy. Postural drainage is a form of physical therapy where body fluids are drained from the lungs by working with gravity and changing position, along with chest percussion. Review information in the "General Respiratory System Assessment and Interventions" section earlier in this chapter.

ENERGY MANAGEMENT

Nurses teaching energy conservation techniques to clients with COPD to help them manage fatigue and activity intolerance.

> Review energy management techniques in the "Anemia" section of the "Hematological Alterations" chapter.

HEALTH TEACHING

Nurses provide health teaching about several topics. If the client smokes, they are encouraged to stop smoking. Clients are taught about the COPD disease process and how to recognize symptoms of acute exacerbations that require prompt notification of the health care provider. Breathing techniques, such as diaphragmatic breathing and pursed-lip breathing, are demonstrated, and the client is asked to perform a return demonstration to demonstrate understanding. Clients are also taught the importance of maintaining current vaccinations to prevent illness, such as influenza, COVID-19, and pneumococcal.

Healthy lifestyle choices such as balanced nutrition and regular physical activity are encouraged to maintain a healthy weight. Clients are also

encouraged to maintain proper hydration to keep secretions thin and easily removed by coughing.

PSYCHOSOCIAL SUPPORT

COPD is a chronic, progressive, incurable illness. Clients may experience feelings of powerlessness and hopelessness as the disease progresses and their ability to participate in activities they normally enjoy becomes limited. Nurses advocate for medical treatments, home oxygen therapy, and pulmonary rehabilitation to help clients to optimally manage dyspnea and improve activity intolerance. Clients are encouraged to verbalize their feelings, and nurses therapeutically promote positive coping strategies to empower clients to effectively self-manage their chronic disease at home.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: COPD

View a brief YouTube video[19] overview of COPD:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1489#oembed-1

19. Open RN Project. (2024, April 4). *Health Alterations – Chapter 6 Respiratory – COPD* [Video]. YouTube. CC BY-NC 4.0.https://youtu.be/VMT3dT82Xfg

6.7 Pneumonia

Pathophysiology

Pneumonia is a common respiratory infection that can affect people of all ages. It is characterized by inflammation and infection within the alveoli, causing them to fill with fluid or purulent material, resulting in a productive cough, fever, chills, and difficulty breathing. Pneumonia differs from chronic conditions like asthma and COPD in that it is an acute infection. Pneumonia can range in seriousness from mild to life-threatening. It is most serious for infants and young children, people older than age 65, and people with chronic health problems like COPD or weakened immune systems.[1,2]

Pneumonia can be caused by a variety of microorganisms, including bacteria, viruses, and fungi. Common bacteria that cause pneumonia include *Streptococcus pneumoniae* and *Mycoplasma pneumoniae*. A variety of respiratory viruses such as rhinovirus, influenza, respiratory syncytial virus (RSV), and COVID-19 also cause pneumonia. Fungi can also cause pneumonia, especially in individuals with weakened immune systems.[3] See Figure 6.23[4] for an illustration of pneumonia.

1. Ramirez, J. A. (2023). Overview of community-acquired pneumonia in adults. *UpToDate*. https://www.uptodate.com/

2. National Heart, Lung, and Blood Institute. (2022). *What is pneumonia?* https://www.nhlbi.nih.gov/health/pneumonia#:~:text=Pneumonia%20is%20an%20infection%20that,or%20fungi%20may%20cause%20pneumonia

3. Centers for Disease Control and Prevention. (2022). *Pneumonia*. https://www.cdc.gov/pneumonia/index.html

4. "Lobar_pneumonia_illustrated.jpg" by Heart, Lung and Blood Institute is licensed in the Public Domain.

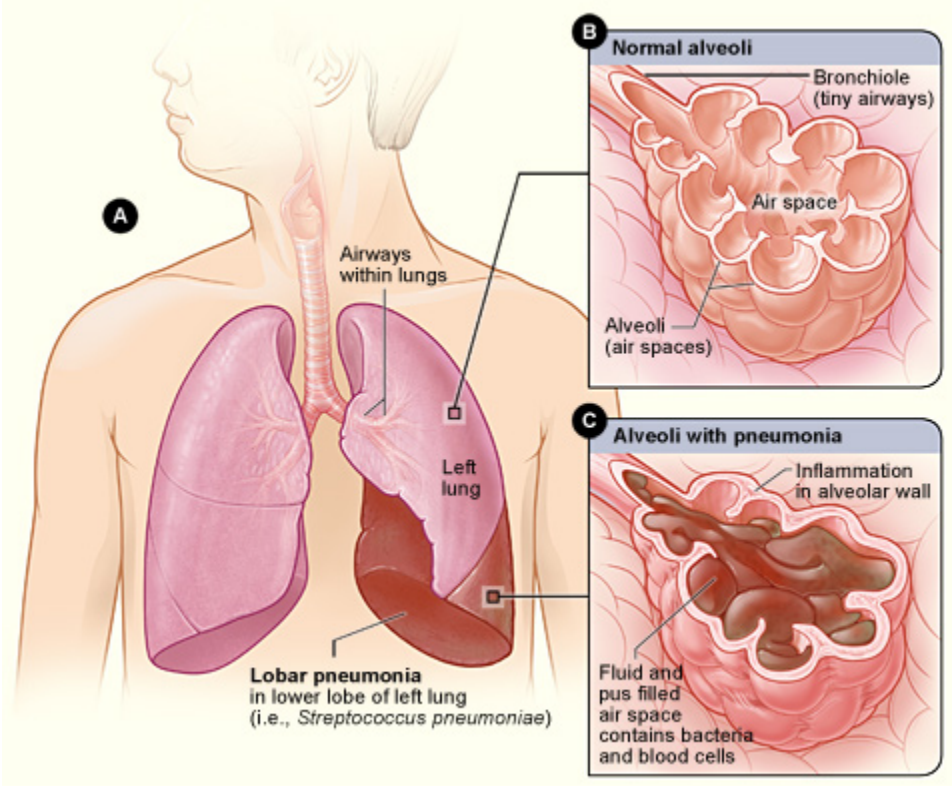


Figure 6.23 Pneumonia

Classifications of Pneumonia

Pneumonia is classified according to the type of microorganism that caused it and the location where the individual developed the infection. This classification affects the medical treatment plan and the antibiotics used to treat it. Classifications of pneumonia include the following[5]:

- **Community-acquired pneumonia (CAP)** refers to pneumonia that began in the community (not in a hospital).
- **Hospital-acquired pneumonia (HAP)** refers to pneumonia that began during or immediately following a stay in a health care setting. Health care settings include hospitals, long-term care facilities, and dialysis centers.

5. Centers for Disease Control and Prevention. (2022). *Pneumonia*. https://www.cdc.gov/pneumonia/index.html

- **Ventilator-associated pneumonia (VAP)** refers to when someone gets pneumonia during or after being on a ventilator.
- **Aspiration pneumonia** refers to when someone inhales food, drink, vomit, saliva, or medication into the lungs instead of swallowing it. Risk factors for aspiration pneumonia include difficulty swallowing, a brain injury that causes an impaired gag reflex, oversedation by medications, or excessive alcohol or drug use.[6]

Assessment

Clinical manifestations of pneumonia vary in severity and can be influenced by factors such as the causative pathogen, as well as the individual's age, overall health, and underlying medical conditions. See Table 6.7 for a summary of clinical manifestations of pneumonia across body systems. It is essential for nurses to recognize these symptoms early and notify the health care provider of suspected pneumonia.

Table 6.7. Clinical Manifestations of Pneumonia[7,8]

6. Mayo Clinic. (2020). *Pneumonia*. https://www.mayoclinic.org/diseases-conditions/pneumonia/symptoms-causes/syc-20354204

7. Ramirez, J. A. (2023). Overview of community-acquired pneumonia in adults. *UpToDate*. https://www.uptodate.com/

8. National Heart, Lung, and Blood Institute. (2022). *What is pneumonia?* https://www.nhlbi.nih.gov/health/pneumonia#:~:text=Pneumonia%20is%20an%20infection%20that,or%20fungi%20may%20cause%20pneumonia

Body System	Clinical Manifestations
Respiratory	Cough (nonproductive or productive of purulent sputum), dyspnea, pleuritic chest pain (worse with deep breathing or coughing), labored breathing, tachypnea, fine crackles on auscultation, and decreased pulse oximetry readings
Cardiovascular	Tachycardia
Nervous	New onset confusion or altered mental status
Gastrointestinal	Decreased appetite
Musculoskeletal	Muscle aches and joint pain, especially for viral causes, fatigue, and weakness
Integumentary	Diaphoresis and cyanosis (bluish or grayish skin due to lack of oxygen)
General	Fever, shaking chills (most often with high temperature), malaise (general discomfort or uneasiness), and weight loss (often due to reduced appetite)

Diagnostic Testing

Pneumonia is typically diagnosed through a combination of clinical assessment, medical history, and diagnostic tests. Common diagnostic tests used to diagnose pneumonia are as follows:

- **Chest X-Ray:** A chest X-ray identifies areas of the lung that are inflamed or filled with fluid, called "consolidation." The X-ray provides a visual confirmation of the infection and its extent in the lungs.
- **Complete Blood Count (CBC):** An elevated white blood cell count is often an indicator of an infection.
- **Sputum Culture:** A sputum sample (mucus coughed up from the lungs) may be collected for laboratory testing to identify the causative microorganism. This is especially important for selecting appropriate antibiotic treatment.

In serious cases of pneumonia, especially for hospitalized clients, additional diagnostic testing may be performed[9,10]:

9. Ramirez, J. A. (2023). Overview of community-acquired pneumonia in adults. *UpToDate*. https://www.uptodate.com/
10. National Heart, Lung, and Blood Institute. (2022). *What is pneumonia?* https://www.nhlbi.nih.gov/health/

- **Arterial Blood Gas (ABG):** ABG testing assesses the amount of dissolved oxygen and carbon dioxide levels in the blood and determines the severity of hypoxemia and hypercapnia.
- **Bronchoscopy:** In cases where the diagnosis is uncertain or when there is a need to examine the airways directly, a bronchoscopy may be performed. This involves passing a thin, flexible tube with a camera through the airways to visualize the lungs and collect samples.
- **CT Scan:** A computed tomography (CT) scan may be performed to provide more detailed images of the lungs.
- **Blood Cultures:** Blood cultures may be performed to determine if bacterial pneumonia has spread to the blood.
- **Pleural Fluid Culture:** A **pleural fluid culture** may be taken using a procedure called thoracentesis, which is a procedure where a health care provider uses a needle to take a sample of fluid from the pleural space between the lungs and chest wall.

> Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing priorities for clients with pneumonia are focused on improving respiratory function, alleviating symptoms, and supporting recovery while preventing complications.

Nursing diagnoses for clients with pneumonia are formulated based on the

pneumonia#:~:text=Pneumonia%20is%20an%20infection%20that,or%20fungi%20may%20cause%20pneumonia

client's assessment data, medical history, and specific needs. Common nursing diagnoses include the following[11]:

- Ineffective Airway Clearance
- Impaired Gas Exchange
- Ineffective Thermoregulation
- Decreased Activity Intolerance
- Risk for Deficient Fluid Volume

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to pneumonia are as follows:

- *The client will maintain oxygen saturation within the target range, typically above 92%.*
- *The client's signs of infection, such as fever above 101 degrees Fahrenheit and elevated white blood cell count, will improve with treatment.*
- *The client's reported level of dyspnea at rest and with activity will decrease with treatment.*

11. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

Interventions

Medical Interventions

Medical interventions for pneumonia aim to treat the underlying infection, alleviate symptoms, and support the client's recovery.

MEDICATION THERAPY

A variety of medications may be prescribed for clients with pneumonia[12,13]:

- **Antibiotic Therapy:** Antibiotics are prescribed if the suspected or confirmed causative agent is bacteria. The choice of antibiotic by the health care provider is based on the classification of pneumonia (i.e., CAP, HAP, VAP, or aspiration pneumonia). The antibiotic may be adjusted based on sputum or blood culture and sensitivity results. Duration of treatment is determined by the type of pneumonia and the client's clinical response.
- **Antiviral Medications:** If pneumonia is caused by a viral infection, antiviral medications may be prescribed. These medications aim to reduce viral replication and severity of symptoms.
- **Antifungal Medications:** If pneumonia is caused by a fungal infection, antifungal medications are utilized to target and eliminate fungal pathogens, disrupting their ability to grow and reproduce.
- **Bronchodilators:** Bronchodilators, such as albuterol, may be administered to alleviate bronchoconstriction and improve airflow, especially in clients

12. Ramirez, J. A. (2023). Overview of community-acquired pneumonia in adults. *UpToDate*. https://www.uptodate.com/

13. National Heart, Lung, and Blood Institute. (2022). *What is pneumonia?* https://www.nhlbi.nih.gov/health/pneumonia#:~:text=Pneumonia%20is%20an%20infection%20that,or%20fungi%20may%20cause%20pneumonia

with concurrent obstructive lung diseases like asthma or COPD.

- **Corticosteroids:** Corticosteroids may be prescribed in specific cases to reduce inflammation in the airways and improve breathing.
- **Antipyretics:** Antipyretic medications (e.g., acetaminophen or ibuprofen) may be prescribed to reduce fever and discomfort.
- **Pneumococcal and Influenza Vaccinations:** To prevent future episodes of pneumonia, clients are encouraged to receive influenza, COVID, and pneumococcal vaccines.
- **Oxygen Therapy:** Supplemental oxygen is prescribed to maintain adequate oxygen saturation levels. Oxygen delivery methods vary based on the client's needs and severity of respiratory distress.
- **Fluid Intake:** Clients are encouraged to increase fluid intake to maintain hydration and thin secretions, if not contraindicated. For hospitalized clients, IV fluids may be prescribed, especially if the client has a high fever, reduced oral intake, or difficulty swallowing.

> Read additional information about oxygen equipment and safety measures in the "Oxygenation Therapy" chapter of Open RN *Nursing Skills, 2e*.

RESPIRATORY THERAPIES

Chest physiotherapy techniques, such as postural drainage and percussion, may be used to assist in clearing mucus and secretions from the airways. **Vibratory positive expiratory pressure (PEP) therapy** (i.e., flutter valves) may be prescribed for clients who need assistance in clearing mucus from their airways. Clients are encouraged to cough and deep breathe, and incentive spirometry devices may be prescribed to treat/prevent atelectasis. Review information about vibratory positive expiratory pressure therapy, coughing and deep breathing, and incentive spirometers in the "General Nursing

Interventions Related to Respiratory Alterations" subsection earlier in this chapter.

VENTILATION SUPPORT

In severe cases of pneumonia, noninvasive positive pressure ventilation, commonly referred to as CPAP or BiPAP, or intubation and mechanical ventilation may be necessary to provide respiratory support.[14,15] See Figure 6.24[16] for an image of a simulated client with a BiPAP mask in place.

14. Ramirez, J. A. (2023). Overview of community-acquired pneumonia in adults. *UpToDate*. https://www.uptodate.com/

15. National Heart, Lung, and Blood Institute. (2022). *What is pneumonia?* https://www.nhlbi.nih.gov/health/pneumonia#:~:text=Pneumonia%20is%20an%20infection%20that,or%20fungi%20may%20cause%20pneumonia

16. "Simulated patient wearing a BiPAP mask" by Chippewa Valley Technical College is licensed under CC BY 4.0



Figure 6.24 BiPAP

> Read more about CPAP, BiPAP, and mechanical ventilation in the "Oxygen Equipment" section of the "Oxygen Therapy" chapter of Open RN *Nursing Skills, 2e*.

PLEURAL PROCEDURES

In cases of pleural effusion (accumulation of fluid in the pleural cavity), procedures such as thoracentesis or chest tube insertion may be required.[17,18]

Nursing Interventions

Nursing interventions for pneumonia focus on promoting recovery, preventing complications, and preventing future illness.

MEDICATION MANAGEMENT

Nurses safely administer prescribed antibiotics, antivirals, or antifungals that target the specific pathogen causing pneumonia. Antipyretic medications (e.g., acetaminophen or ibuprofen) are administered as needed to reduce fever and discomfort. Bronchodilators may be administered to alleviate

17. Ramirez, J. A. (2023). Overview of community-acquired pneumonia in adults. *UpToDate*. https://www.uptodate.com/

18. National Heart, Lung, and Blood Institute. (2022). *What is pneumonia?* https://www.nhlbi.nih.gov/health/pneumonia#:~:text=Pneumonia%20is%20an%20infection%20that,or%20fungi%20may%20cause%20pneumonia

bronchoconstriction and improve airflow, especially in clients with preexisting lung conditions. Nurses teach clients about the purpose of prescribed medications and the importance of taking the full course of antibiotics as directed.

MAINTAIN HYDRATION

Nurses monitor fluid intake and output and for signs of fluid volume deficit. Clients are encouraged to maintain adequate hydration, especially if they have a fever, productive cough, or increased respiratory rate that can contribute to fluid loss. Clients are encouraged to drink at least two liters of water daily to loosen secretions, unless they are on a fluid restriction.

ASSIST WITH RESPIRATORY THERAPY

Nurses assist clients with techniques such as postural drainage, coughing and deep breathing, incentive spirometry, and/or vibratory pressure therapy, as prescribed. Effective coughing techniques are demonstrated and encouraged. Review enhanced breathing and coughing techniques in the "General Nursing Interventions Related to Respiratory Alterations" subsection earlier in this chapter.

INFECTION CONTROL

Nurses implement appropriate infection control measures, including hand hygiene, personal protective equipment, and transmission-based precautions based on the infectious organism to prevent the spread of infection.

IMMUNIZATIONS

Nurses encourage clients to remain up-to-date on recommended vaccinations, including the pneumococcal vaccine for adults at risk and all those over age 65.

- Review current information about "Recommended Vaccines By Age" from the Centers for Disease Control and Prevention (CDC).

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Pneumonia

View a brief YouTube video overview of pneumonia[19]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1511#oembed-1

19. Open RN Project. (2024, June 23). *Health Alterations – Chapter 6 – Pneumonia* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/PDbrPS3X50I?si=BGo8htPvDJIqfW82

6.8 Lung Cancer

Overview

Cancer is a disease where cells grow out of control. Lung cancer is a type of cancer that begins in the cells of the lungs. Lung cancer can also be cancer that has spread from other parts of the body called metastasis.

Lung cancer is commonly classified into two main categories called Non-Small Cell Lung Cancer (NSCLC) or Small Cell Lung Cancer (SCLS). Each type grows differently and is treated differently. NSCLC is the most common type of lung cancer, accounting for approximately 85% of all lung cancer cases. NSCLC includes subtypes such as adenocarcinoma, squamous cell carcinoma, and large cell carcinoma. SCLC is a more aggressive type of cancer, often associated with a high growth rate and earlier metastasis.[1,2]

Smoking is the greatest risk for lung cancer, but nonsmokers can also have lung cancer. Other risk factors include family history; exposure to secondhand smoke; infection with human immunodeficiency virus (HIV); and exposure to radon gas, radiation, air pollution, and other workplace exposures like asbestos, arsenic, and chromium.[3,4]

The most common symptoms of lung cancer when it is initially diagnosed

1. Centers for Disease Control and Prevention. (2023). *What is lung cancer?* https://www.cdc.gov/lung-cancer/about/

2. Thomas, K. W., Gould, M., K., & Naeger, D. (2023). Overview of the initial evaluation, diagnosis, and staging of patients with suspected lung cancer. *UpToDate*. https://www.uptodate.com/

3. Centers for Disease Control and Prevention. (2023). *What is lung cancer?* https://www.cdc.gov/lung-cancer/about/

4. Thomas, K. W., Gould, M., K., & Naeger, D. (2023). Overview of the initial evaluation, diagnosis, and staging of patients with suspected lung cancer. *UpToDate*. https://www.uptodate.com/

include worsening cough, dyspnea, pleuritic chest pain (i.e., worse on deep breathing or coughing), hemoptysis (blood-tinged sputum), malaise, weight loss, and hoarseness.[5]

Staging is the process of determining how much cancer is within the body and if it has metastasized. Staging includes the location and size of the tumor, whether the cancer has spread to the lymph nodes, and whether the cancer has spread to the rest of the body. Stage has a critical role in the medical treatment plan. See Figure 6.25[6] for an illustration of the general stages of lung cancer.

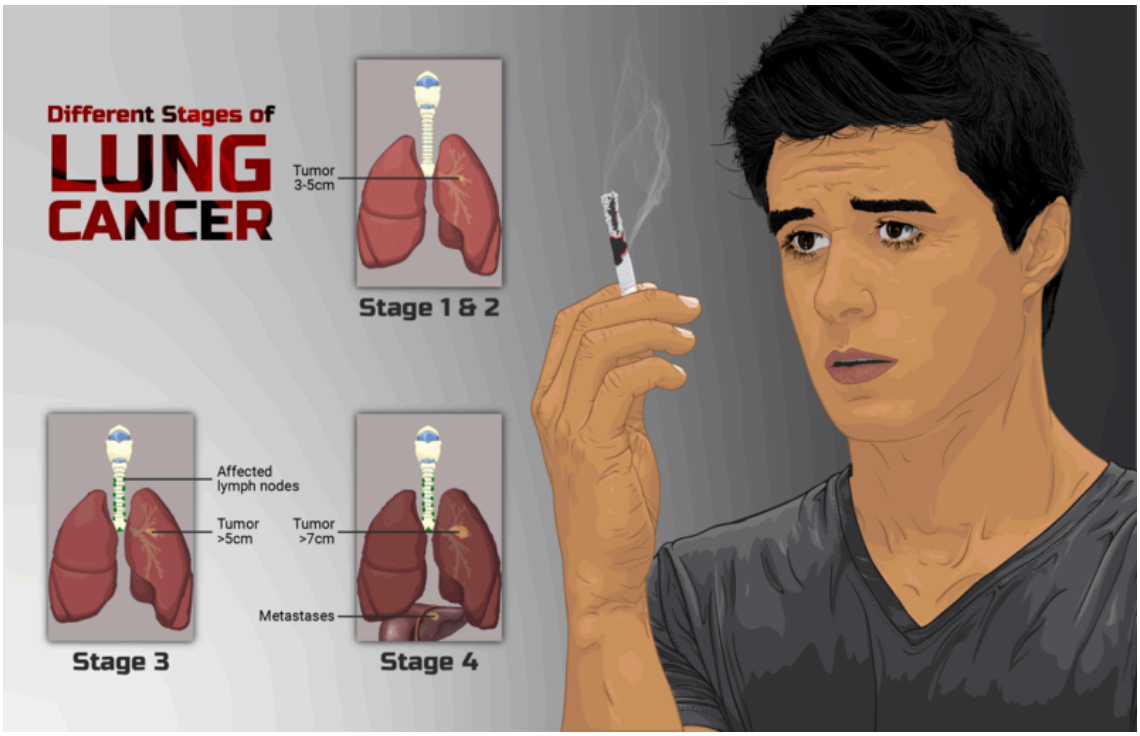


Figure 6.25 Stages of Lung Cancer

5. Centers for Disease Control and Prevention. (2023). *What is lung cancer?* https://www.cdc.gov/lung-cancer/about/

6. "Depiction_of_a_person_smoking_and_stages_of_Lung_Cancer.png" by https://www.myupchar.com/en is licensed under CC BY-SA 4.0

Assessment

Early detection and diagnosis are crucial for identifying and managing lung cancer effectively. Clinical manifestations of lung cancer vary depending on the stage and type of lung cancer, as well as the individual's overall health. See Table 6.8 for a summary of clinical manifestations of lung cancer by body system. Not all individuals with lung cancer will experience all these symptoms. Some symptoms are associated with advanced stages or specific types of lung cancer.

Table 6.8. Clinical Manifestations of Lung Cancer Across Body Systems[7,8]

7. Thomas, K. W., Gould, M., K., & Naeger, D. (2023). Overview of the initial evaluation, diagnosis, and staging of patients with suspected lung cancer. *UpToDate*. https://www.uptodate.com/

8. Midthun, D. E. (2022). Clinical manifestations of lung cancer. *UpToDate*. https://www.uptodate.com/

Body System	Clinical Manifestations Across Body Systems
Respiratory	Persistent cough, often with hemoptysis, dyspnea, hoarseness or voice changes, recurrent respiratory infections, pleuritic chest pain, and pleural effusion
General	Unexplained weight loss, fatigue, weakness, fever, night sweats, and loss of appetite
Cardiovascular	**Superior vena cava syndrome**, a blockage of blood flow into the superior vena cava, often caused by cancer, leading to swelling in the face, neck, or upper chest
Nervous	Neurological symptoms, such as severe headache or seizures if cancer has metastasized to the brain
Musculoskeletal	Bone pain and fractures if cancer has metastasized to the bones
Hepatobiliary	Jaundice (yellowing of the skin and sclera) if cancer has spread to the liver
Renal	Hydronephrosis (blockage of the ureters, leading to kidney swelling) if cancer has affected the lymph nodes near the kidneys

Diagnostic Testing

Diagnostic testing for lung cancer may include a variety of methods to confirm the presence of cancer, determine the type and stage of the cancer, and guide treatment decisions. Common diagnostic tests and procedures for lung cancer include the following[9,10]:

9. Thomas, K. W., Gould, M., K., & Naeger, D. (2023). Overview of the initial evaluation, diagnosis, and staging of patients with suspected lung cancer. *UpToDate*. https://www.uptodate.com/

10. Midthun, D. E. (2022). Clinical manifestations of lung cancer. *UpToDate*. https://www.uptodate.com/

- **Chest X-ray:** A chest X-ray is often the initial imaging test used to identify abnormal lung masses or other lung-related issues.
- **Computed Tomography (CT) Scan:** CT scans provide detailed cross-sectional images of the lungs and are often used to assess the size, location, and extent of lung tumors.
- **Positron Emission Tomography (PET) Scan:** PET scans help determine if lung cancer has spread to other parts of the body. It involves the injection of a radioactive tracer that is absorbed by fast-growing cells.
- **MRI (Magnetic Resonance Imaging):** In some cases, an MRI may be used to provide additional information, especially if there are concerns about the involvement of nearby structures.
- **Sputum Cytology:** Sputum is analyzed under a microscope to check for cancer cells.
- **Bronchoscopy:** A thin, flexible tube with a light and camera is inserted through the nose or mouth into the airways to collect small tissue samples.
- **Biopsy:** A biopsy is the definitive diagnostic procedure for lung cancer. There are several ways to obtain tissue samples for analysis:
    - **Needle Biopsy (Fine Needle Aspiration or Core Biopsy):** A thin, hollow needle is used to extract a sample of tissue from the lung, often guided by imaging (CT or ultrasound).
    - **Surgical Biopsy:** In some cases, a surgeon may perform a surgical procedure to remove a larger tissue sample for diagnosis. This may be necessary when other biopsy methods are inconclusive.
    - **Endobronchial Ultrasound (EBUS):** EBUS is a minimally invasive procedure used to obtain tissue samples from lymph nodes and lesions in the chest. It is often performed during bronchoscopy.

If cancer is confirmed, additional tests are performed to determine the stage of the cancer and whether the cancer has spread to distant organs.

Nursing Diagnoses

Nursing diagnoses for clients with lung cancer focus on addressing the unique challenges and needs associated with this condition. The nursing

priorities are centered around providing comprehensive care, managing symptoms, and enhancing the client's overall well-being while preventing complications.

Common nursing diagnoses for clients with cancer include the following[11]:

- Impaired Gas Exchange
- Decreased Activity Tolerance
- Disturbed Body Image
- Fear
- Imbalanced Nutrition: Less Than Body Requirements
- Powerlessness
- Risk for Spiritual Distress

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to lung cancer are as follow:

- *The client will maintain oxygen saturation within the prescribed target range (e.g., greater than 92%).*
- *The client will report decreased pain, at or below a level they have reported as "acceptable."*
- *The client will maintain an effective breathing pattern with a respiratory rate below 20 breaths per minute.*
- *The client will verbalize three positive coping strategies before discharge from the hospital.*

11. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

Interventions

Medical Interventions

Medical interventions for lung cancer vary based on the type and stage of cancer, as well as the client's overall health. These interventions aim to diagnose, treat, manage, and support clients with lung cancer and include surgical interventions, radiation therapy, chemotherapy, immunotherapy, and palliative or hospice care[12,13]:

- **Surgical Interventions:** Surgical interventions may include any of the following procedures:
  - **Lobectomy:** Removal of an entire lobe of the lung.
  - **Pneumonectomy:** Removal of an entire lung.
  - **Segmentectomy or Wedge Resection:** Removal of a portion of the lung.
  - **Video-Assisted Thoracoscopic Surgery (VATS):** A minimally invasive surgical approach for diagnostic and therapeutic purposes.
  - **Chest Wall Resection:** Involves removing parts of the chest wall if the cancer has spread.
- **Radiation Therapy:** Radiation therapy may be used to shrink or destroy cancer cells.
  - **External Beam Radiation:** Delivers targeted radiation to the tumor to shrink or destroy cancer cells.
  - **Brachytherapy:** Delivers internal radiation using implanted radioactive sources.

12. Thomas, K. W., Gould, M., K., & Naeger, D. (2023). Overview of the initial evaluation, diagnosis, and staging of patients with suspected lung cancer. *UpToDate*. https://www.uptodate.com/

13. Midthun, D. E. (2022). Clinical manifestations of lung cancer. *UpToDate*. https://www.uptodate.com/

    - **Stereotactic Radiosurgery (SRS):** Precisely targets small tumors with high-dose radiation.
- **Chemotherapy:** Chemotherapy is used to treat cancer or prevent its spread.
    - **Systemic Chemotherapy:** Administered orally or intravenously to treat cancer that has spread to other areas.
    - **Adjuvant Chemotherapy:** Given after surgery to reduce the risk of cancer recurrence.
- **Immunotherapy:** Immunotherapy enhances the immune system's ability to recognize and attack cancer cells, using medications like checkpoint inhibitors (e.g., PD-1 or PD-L1 inhibitors).
- **Palliative and Hospice Care:** Palliative and hospice care focuses on relieving symptoms, improving quality of life, managing pain and breathlessness, and other side effects. Palliative care may be prescribed any time after diagnosis to address comfort, symptom management, and support. Hospice care is available for clients with advanced or terminal lung cancer whose life expectancy is six months or less.

Nursing Interventions

Nursing interventions focus on symptom management and emotional support to promote overall well-being.

MEDICATION MANAGEMENT

Specially trained oncology nurses administer chemotherapy, but all nurses administer prescribed medications for symptom control and monitor for side effects.

PAIN MANAGEMENT

Nurses help manage the client's pain and other discomfort through pharmacological and nonpharmacological interventions, based on the client's preferences.

DYSPNEA MANAGEMENT

Nurses monitor the client's level of dyspnea and provide strategies to manage shortness of breath, such as coughing and breathing techniques, positioning, and oxygen therapy. Review enhanced breathing and coughing techniques in the "General Nursing Interventions Related to Respiratory Alterations" subsection earlier in this chapter.

ENERGY MANAGEMENT

Nurses teach clients to use energy conservation techniques to manage fatigue associated with the disease process, medical interventions, and medications.

> Review energy management techniques in the "Anemia" section of the "Hematological Alterations" chapter.

PSYCHOSOCIAL SUPPORT

Emotional distress commonly occurs in clients diagnosed with cancer and their family members. Side effects and adverse effects associated with the disease and medical treatments can compound this emotional distress. Most people experience feelings of grief and loss when cancer is diagnosed. They may experience spiritual distress with a common question being, "Why me?" Nurses can play an important role in helping clients find spiritual support and a feeling of hope, even in the midst of terminal cancer.

Nurses offer emotional support, empathy, and active listening to help clients and their family members cope with feelings resulting from the diagnosis, treatment, and resulting changes in role performance. Information is reinforced on medical treatments, as well as on available resources, counseling, and support groups. Nurses assess for signs of anxiety and depression and refer clients and family members to counseling as needed. Relaxation techniques and mindfulness practices are encouraged as positive

coping strategies. Palliative care services are offered to manage symptoms, relieve pain, and enhance the client's quality of life. Nurses also initiate discussions about advance care planning and end-of-life preferences with clients and their family members.

- Read more about palliative care, the loss/grief response, and end-of-life care in the "Grief and Loss" chapter of Open RN *Nursing Fundamentals, 2e*. Read more about the nursing role in spiritual care in the "Spirituality" chapter of Open RN *Nursing Fundamentals, 2e*.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Lung Cancer

View a brief YouTube video overview of lung cancer[14]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1507#oembed-1

14. Open RN Project. (2024, June 23). *Health Alterations – Chapter 6 – Lung cancer* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/GJl_bdFDL0k?si=byMSu9Dnj4C4ZlVM

6.9 Tuberculosis

Pathophysiology

Tuberculosis (TB) is a contagious bacterial infection caused by *Mycobacterium* tuberculosis. It primarily affects the lungs but can also target other parts of the body. TB spreads through the air when an infected person coughs or sneezes, releasing small infectious droplets into the environment. It is a serious public health concern worldwide.[1]

TB is caused by an organism called a bacillus that enters the lung. Over the course of 2 to 12 weeks, the bacillus replicates and the immune response becomes activated. The immune response involves macrophages and lymphocytes migrating to the site of inflammation and walling off the bacillus, forming a tubercle. Over time, cheese-like material develops in the center of the tubercle, called caseous necrosis. Individuals with healthy immune systems may heal this initial lesion and develop latent TB before any signs or symptoms of the illness occur. However, the tubercle may calcify and remain dormant for many years, but over time, or in immunocompromised states, spread to other areas of the lung or to other organs.

There are several risk factors for TB. Primary risk factors include close contact with an TB-infected person, HIV infection or otherwise weakened immune system, and substance misuse. TB is a common disease around the world, so individuals who travel or live in regions with high TB prevalence such as Africa, Asia, or parts of Latin America have increased risk. Individuals who immigrate from high-incidence countries or experience homelessness are also at increased risk. Additionally, individuals who live in overcrowded

1. Menzies, D. (2023). Tuberculosis infection (latent tuberculosis) in adults: Approach to diagnosis (screening). *UpToDate*. https://www.uptodate.com/

conditions are at increased risk for TB transmission, including individuals who work or live in long-term health care settings or prisons.[2]

In regions of the world with high TB prevalence, a Bacillus Calmette-Guérin (BCG) vaccine is commonly administered. Receiving a BCG vaccine has a substantial effect on tuberculin skin test reactivity, with individuals who received BCG after infancy having tuberculin skin test reactions up to 55 years post-immunization.[3] Nurses must be aware of an individual's history of receiving a BCG vaccine when interpreting the results of a tuberculin skin test. Anyone who has received the BCG vaccine within the last ten years will have a positive test result for their skin test.

Mycobacterium tuberculosis has developed drug resistance in many areas of the world, causing a significant treatment problem. Multidrug-resistant TB (MDR TB) is caused by an organism that is resistant to at least isoniazid and rifampin, the two most potent TB drugs used to treat all persons with TB disease. Extensively drug-resistant TB (XDR TB) is a rare type of MDR TB that is resistant to isoniazid and rifampin, plus any fluoroquinolone and at least one of the second-line drugs. XDR TB is of special concern for persons with HIV infection or other conditions that weaken the immune system. These persons are more likely to develop TB disease once they are infected, and they also have a higher risk of death once they develop TB. Resistance to anti-TB medications can occur when these drugs are mismanaged. Examples of mismanagement include when individuals do not complete their full course of treatment; when health care providers prescribe the wrong treatment, the wrong dose, or length of time for taking the drugs; when the supply of drugs is not always available; or when the drugs are of poor quality. The most important thing a person can do to prevent the spread of MDR TB is to take

2. Menzies, D. (2023). Tuberculosis infection (latent tuberculosis) in adults: Approach to diagnosis (screening). *UpToDate*. https://www.uptodate.com/

3. Okafor, C. N., Rewane, A., & Momodu, I. I. (2023). *Bacillus Calmette Guerin*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538185/

all of their medications exactly as prescribed by their health care provider. No doses should be missed, and treatment should not be stopped early.[4]

Assessment

Tuberculosis (TB) can affect various body systems, but it primarily targets the respiratory system. TB can mimic other diseases, and its presentation can vary widely among individuals. Identifying TB through clinical manifestations and diagnostic tests is crucial for early diagnosis and treatment. TB is a contagious disease, and timely intervention helps prevent its spread to others. It is important to note that some forms of tuberculosis may present with minimal or no symptoms, known as latent tuberculosis infection (LTBI). In LTBI, the individual carries the TB bacteria but does not exhibit active disease. See Table 6.9 for a summary of potential clinical manifestations of tuberculosis across body systems.

Table 6.9. Clinical Manifestations of Tuberculosis Across Body Systems[5,6]

Body System	Clinical Manifestations
Respiratory	Persistent cough for more than two weeks, hemoptysis, purulent sputum, pleuritic chest pain, dyspnea, and adventitious lung sounds.
General	Fever, chills, night sweats, fatigue, malaise (general discomfort), weakness, unexplained weight loss, and loss of appetite.
Lymphatic	Lymphadenopathy (swelling of lymph nodes), especially in the neck.
Nervous	Tuberculous meningitis can lead to symptoms such as severe headache, confusion, stiffness of the neck, and neurological deficits.
Genitourinary	Renal tuberculosis can cause hematuria (blood in the urine) and flank pain.
Musculoskeletal	Tuberculous osteomyelitis may lead to bone pain, joint pain, and limited mobility of affected joints.
Skin and Soft Tissues	Cutaneous tuberculosis can result in skin lesions or ulcers.

4. Centers for Disease Control and Prevention. (20239). *Tuberculosis (TB)*. https://www.cdc.gov/tb/

5. Menzies, D. (2023). Tuberculosis infection (latent tuberculosis) in adults: Approach to diagnosis (screening). *UpToDate*. https://www.uptodate.com/

6. Bernardo, J. (2022). Diagnosis of pulmonary tuberculosis in adults. *UpToDate*. https://www.uptodate.com/

Diagnostic Testing

Diagnosing tuberculosis (TB) involves a combination of clinical assessment, imaging, and laboratory tests to confirm the presence of *Mycobacterium* tuberculosis. If diagnostic tests reveal a positive result, TB is a reportable disease to the public health department.

A combination of tests may be necessary to confirm a TB diagnosis, and prompt diagnosis and treatment are crucial to prevent the spread of TB and improve client outcomes. Diagnostic testing may include the following[7,8]:

- **Tuberculin Skin Test (Mantoux Test):** A small amount of tuberculin protein is injected just beneath the skin, usually in the forearm. The test is read 48 to 72 hours later to check for induration at the injection site. A positive reaction indicates exposure to TB or the BCG vaccine, but it does not confirm active disease. Further testing is needed to determine if the infection is active or latent.
- **Blood Tests (Interferon-Gamma Release Assays – IGRA):** These tests measure the body's immune response to TB by detecting the release of interferon-gamma when exposed to TB proteins. Common IGRA tests include the QuantiFERON-TB Gold In-Tube (QFT-GIT) and the T-SPOT TB tests. Blood tests are particularly useful when the tuberculin skin test results may be affected by prior BCG vaccination or other factors.
- **Chest X-ray:** A chest X-ray is used to detect pulmonary TB and assess the extent of lung involvement. However, active TB cannot be distinguished from inactive disease using only radiography. See Figure 6.26[9] for an

7. Menzies, D. (2023). Tuberculosis infection (latent tuberculosis) in adults: Approach to diagnosis (screening). *UpToDate*. https://www.uptodate.com/

8. Bernardo, J. (2022). Diagnosis of pulmonary tuberculosis in adults. *UpToDate*. https://www.uptodate.com/

9. "Tuberculosis-x-ray-1.jpg" by Unknown author, for the Centers for Disease Control and Prevention, is licensed in the Public Domain.

image of a chest X-ray illustrating advanced active TB.

- **Sputum Smear Microscopy:** A sputum sample is examined in a lab under a microscope to detect acid-fast bacilli (AFB). It is a rapid method for diagnosing pulmonary TB. However, it may not always detect the *Mycobacterium* tuberculosis bacteria, particularly in early stages.
- **Sputum Culture:** A sputum sample is cultured to grow the *Mycobacterium* tuberculosis bacteria. A sputum culture confirms the diagnosis of active TB and is also used to evaluate the effectiveness of treatment. Culture allows for drug susceptibility testing to determine which antibiotics are effective against the specific strain. It is more sensitive than smear microscopy but takes several weeks to yield results.
- **Nucleic Acid Amplification Tests (NAAT):** NAAT tests can rapidly detect TB and simultaneously assess resistance to rifampin, an important anti-TB drug. These tests are particularly valuable in diagnosing drug-resistant TB. This type of test is performed by obtaining a swab of respiratory material.
- **Bronchoscopy and Bronchoalveolar Lavage (BAL):** These procedures involve inserting a thin, flexible tube into the airways and collecting samples for testing. They are used when sputum samples are not obtainable or when there is a need for a definitive diagnosis.
- **Biopsy:** A biopsy may be necessary if there is suspicion of extrapulmonary TB, affecting organs outside the lungs. Biopsies are performed to examine tissue samples for the presence of TB.
- **Molecular Diagnostic Tests:** These tests are highly sensitive and provide rapid results. They can identify *Mycobacterium* tuberculosis and determine rifampin resistance.

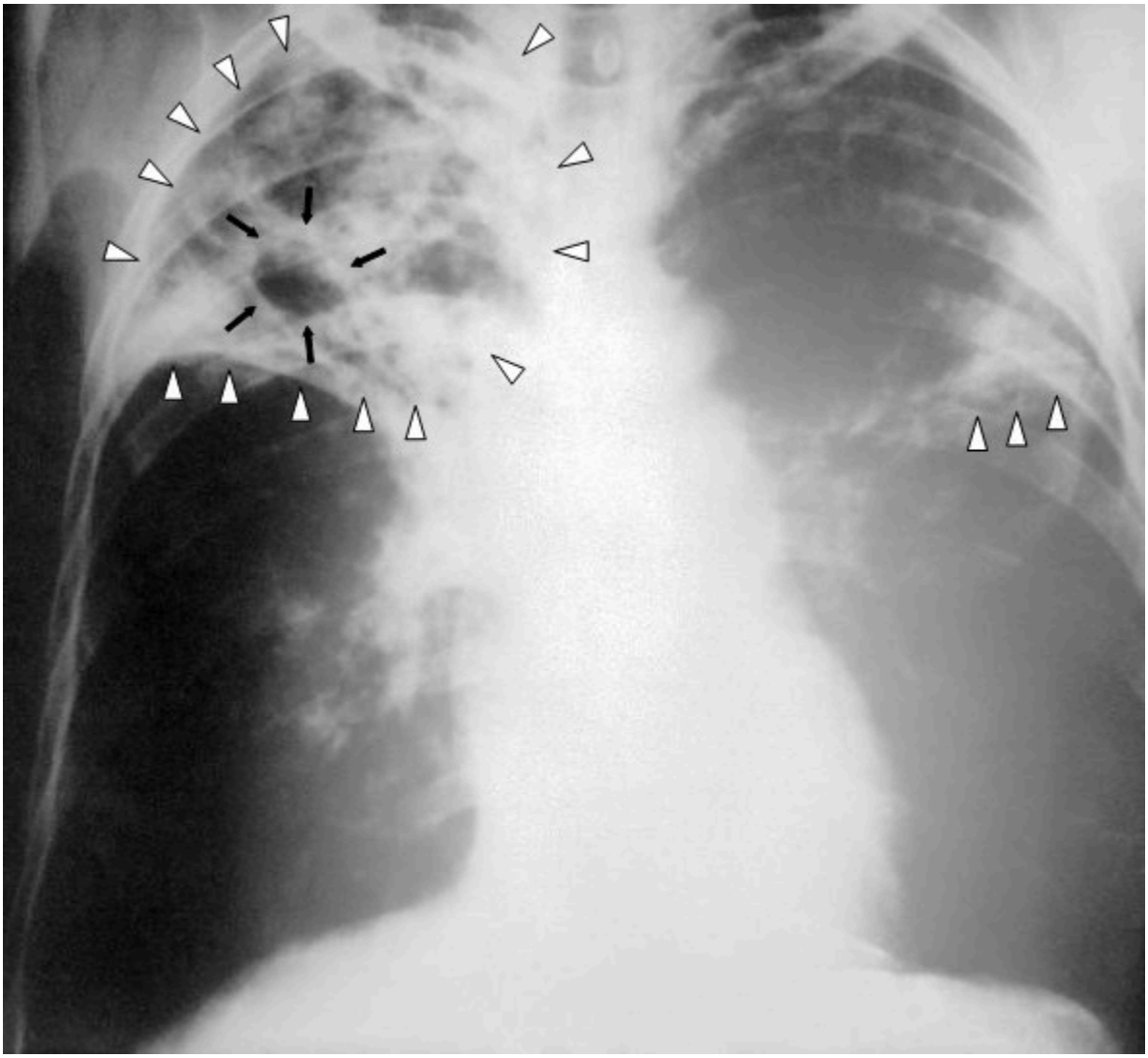


Figure 6.26 Advanced Active TB. The white arrows indicate bilateral pulmonary infiltrate and the black arrows indicate a TB lesion called a cavitation.

Nursing Diagnoses

Nursing care for clients with TB focuses on promoting adherence to treatment, preventing the spread of the disease, and addressing the physical and psychosocial challenges associated with TB. Common nursing diagnoses for clients with TB include the following[10]:

10. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

- Ineffective Airway Clearance
- Fatigue
- Impaired Gas Exchange
- Readiness for Enhanced Health Self-Management
- Social Isolation

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related to tuberculosis are as follows:

- *The client will effectively clear airway secretions as evidenced by improved breath sounds and productive coughing.*
- *The client will maintain adequate oxygenation with oxygen saturation levels above 92%.*
- *The client will verbalize the importance of adhering to prescribed therapy for the full treatment plan.*
- *The client will verbalize three positive coping strategies before discharge from the hospital.*

Interventions

Medical Interventions

Medical interventions for tuberculosis (TB) are primarily aimed at treating the infection and preventing its spread. Treatment regimens for TB typically involve a combination of antibiotics taken for an extended period of time and

the implementation of airborne transmission precautions when the disease is active.[11,12]

MEDICATION THERAPY

The cornerstone of TB treatment involves a combination of antibiotics to effectively kill the *Mycobacterium* tuberculosis bacteria. The standard treatment includes four first-line drugs: isoniazid, rifampin, ethambutol, and pyrazinamide. Drug-sensitive TB is treated with a combination of these antibiotics over a period of four to nine months, with the initial phase lasting two months. Multi-drug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) require more complex regimens with second-line drugs. Treatment for drug-resistant TB may last 18 to 24 months or longer. The selection of drugs and treatment duration depend on the type of TB and individual client factors. After medication therapy has been initiated, sputum cultures are obtained at specific intervals to monitor the presence of acid-fast bacilli (AFB) and to assess treatment response. Clients are considered infectious until three negative sputum samples have been obtained, typically after approximately three months of treatment.

To ensure medication adherence and reduce the risk of developing drug resistance, health care workers or trained observers may directly observe clients taking their medications, referred to as directly observed therapy (DOT). DOT is a crucial intervention to assist with medication compliance, prevent treatment failure, and control the spread of drug-resistant TB.

INFECTION CONTROL

Clients who are diagnosed with active TB and are hospitalized have airborne

11. Menzies, D. (2023). Tuberculosis infection (latent tuberculosis) in adults: Approach to diagnosis (screening). *UpToDate*. https://www.uptodate.com/

12. Bernardo, J. (2022). Diagnosis of pulmonary tuberculosis in adults. *UpToDate*. https://www.uptodate.com/

transmission precautions in place, including placement in private rooms with special air venting. Health care workers wear N95 masks when caring for clients with active TB. Individuals in close contact with newly diagnosed clients are tested and monitored for TB infection. Prophylactic treatment may be offered to those exposed to TB to prevent the progression to active TB.

Nursing Interventions

Nursing interventions for tuberculosis (TB) include supporting adherence to treatment and preventing the spread of the disease.

MEDICATION MANAGEMENT

For clients receiving inpatient care, nurses administer prescribed medications. During outpatient care, nurses may assist in providing directly observed therapy (DOT) to ensure clients take their medications as directed for the full course of treatment to help prevent the development of drug resistance. Nurses also monitor and teach clients about potential side effects of their medications, including when to notify their health care provider.

HEALTH TEACHING

Nurses teach clients cough etiquette, respiratory hygiene, and proper disposal of tissues to prevent the spread of infection. Airborne transmission precautions, including the use of N95 masks, are explained to hospitalized clients and their family members.

Malnutrition is common in clients with TB. Nurses monitor for signs of malnutrition and advocate for referrals to dieticians for meal plans and supplements to support weight gain and overall health.

PSYCHOSOCIAL SUPPORT

Nurses assess the psychosocial impact of TB, considering the potential stigma and anxiety associated with the disease. They provide emotional support to clients and their family members to help them cope with the diagnosis. They

also advocate for client access to health care services and help them navigate the health care system and connect with appropriate resources.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Tuberculosis

View a brief YouTube video overview of tuberculosis[13]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1530#oemed-1

13. Open RN Project. (2024, June 23). *Health Alterations – Chapter 6 – Tuberculosis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/LpH6ql_MENo?si=Zm6-gcGXC364lAAO

6.10 Respiratory Viral Infections

Overview

Influenza, COVID-19, and respiratory syncytial virus (RSV) represent three significant respiratory illnesses that have garnered global attention due to their contagious nature and potential for severe health complications. **Influenza**, commonly known as the flu, is caused by influenza viruses that primarily infect the respiratory tract, leading to symptoms such as fever, cough, sore throat, body aches, and fatigue. **COVID-19**, caused by the novel coronavirus SARS-CoV-2, emerged as a global pandemic in late 2019, causing a wide spectrum of symptoms, ranging from mild respiratory distress to severe pneumonia and organ failure. **RSV**, a common cause of respiratory infections in infants and young children, is characterized by symptoms similar to the common cold, including coughing, sneezing, and fever.[1]

Pathophysiology

Each pathogen has distinct pathophysiological mechanisms, but they share a commonality in targeting the respiratory system, often leading to inflammation, tissue damage, and compromised lung function. Understanding the pathophysiology behind these illnesses is crucial for developing effective preventive measures and treatment strategies to mitigate their impact on public health.

Influenza viruses primarily target epithelial cells lining the respiratory tract. The virus enters the body through inhalation of respiratory droplets or contact with contaminated surfaces. Once inside the respiratory tract, the virus attaches to specific receptors on the surface of epithelial cells, facilitating viral entry and replication. This process triggers an inflammatory response

1. Centers for Disease Control and Prevention. (2023). *Respiratory virus updates*. https://www.cdc.gov/respiratory-viruses/whats-new/index.html

characterized by the release of cytokines and chemokines, which recruit immune cells to the site of infection.[2]

COVID-19 is caused by the novel coronavirus SARS-CoV-2. Similar to influenza, SARS-CoV-2 enters the body through the respiratory tract via inhalation or contact with contaminated surfaces. The virus primarily targets cells expressing angiotensin-converting enzyme 2 (ACE2) receptors, which are abundant in the respiratory epithelium. Upon infection, SARS-CoV-2 attacks host cellular machinery to replicate, leading to the release of viral particles and cell damage. This triggers a dysregulated immune response characterized by the production of pro-inflammatory cytokines and chemokines, often referred to as a cytokine storm. The resulting inflammation and immune dysregulation contribute to the wide spectrum of symptoms observed in COVID-19, ranging from mild respiratory symptoms to severe pneumonia and acute respiratory distress syndrome (ARDS).[3]

Respiratory syncytial virus (RSV) primarily infects the respiratory epithelium, particularly in the lower airways. The virus enters the body through inhalation of respiratory secretions or contact with contaminated surfaces. RSV infects ciliated epithelial cells, leading to cell fusion and the formation of multinucleated syncytia, a hallmark of RSV infection. This process disrupts the integrity of the respiratory epithelium and impairs mucociliary clearance, leading to airway obstruction and inflammation. RSV infection triggers an immune response characterized by the recruitment of inflammatory cells such as neutrophils, macrophages, and T cells to the site of infection. The resulting inflammation and mucus production contribute to airway

2. Kalil, A. C., & Thomas, P. G. (2019). Influenza virus-related critical illness: Pathophysiology and epidemiology. *Critical Care, 23*(1), 258. https://doi.org/10.1186/s13054-019-2539

3. Parasher, A. (2021). COVID-19: Current understanding of its pathophysiology, Clinical presentation and treatment, *Postgraduate Medical Journal, 97*(1147), 312–320. https://doi.org/10.1136/postgradmedj-2020-138577

narrowing, respiratory distress, and symptoms such as coughing, wheezing, and difficulty breathing.[4]

Rhinoviruses are the most common cause of the common cold and are responsible for a large proportion of upper respiratory tract infections worldwide. Like the other mentioned pathogens, rhinoviruses primarily infect the respiratory tract, leading to symptoms such as nasal congestion, runny nose, sneezing, sore throat, and coughing. While rhinovirus infections are usually mild and self-limiting, they can occasionally lead to more severe respiratory complications, especially in individuals with weakened immune systems or underlying health conditions. Despite their prevalence and impact on public health, there are currently no specific antiviral treatments available for rhinovirus infections, highlighting the importance of preventive measures such as hand hygiene and respiratory etiquette in reducing transmission. Including rhinoviruses in discussions of respiratory viral alterations emphasizes the diverse range of pathogens that can affect the respiratory system and underscores the need for comprehensive strategies to address respiratory illnesses on a global scale.[5]

Assessment

Review Table 6.10a for common signs and symptoms of influenza, COVID-19, RSV, and rhinoviruses.

4. Kaler, J., Hussain, A., Patel, K., Hernandez, T., & Ray, S. (2023). Respiratory syncytial virus: A comprehensive review of transmission, pathophysiology, and manifestation. *Cureus,* 15(3), e36342. https://doi/org/10.7759/cureus.36342

5. Pappas, D. (2023). Epidemiology, clinical manifestations, and pathogenesis of rhinovirus infections. *UpToDate*. https://www.uptodate.com/

Table 6.10a. Signs and Symptoms of Influenza, COIVD-19, RSV, and Rhinoviruses[6,7,8,9]

Body System	Influenza	COVID-19	RSV	Rhinoviruses
General	Fever, fatigue, body aches	Fever, fatigue, body aches	Fever, fatigue	Fever, fatigue
Respiratory	Cough, sore throat, nasal congestion	Cough, shortness of breath, sore throat	Cough, wheezing, nasal congestion	Runny nose, sneezing
Gastrointestinal	Nausea, vomiting, diarrhea (less common)	Nausea, vomiting, diarrhea	Nausea, vomiting (more common in infants)	N/A
Neurological	Headache	Headache, loss of taste or smell, brain fog	Irritability (more common in infants)	N/A
Musculoskeletal	Muscle aches, joint pain	Muscle aches, joint pain	Muscle aches	N/A
Cardiovascular	Chest discomfort (more common in severe cases)	Chest pain, palpitations (more common in severe cases)	N/A	N/A
Skin	N/A	Rash, discoloration of fingers or toes (COVID toes)	N/A	N/A

Diagnostic Tests

Diagnostic tests play a crucial role in identifying respiratory viral infections, guiding treatment, and implementing appropriate infection control measures. Common diagnostic tests for respiratory viruses focus on the identification of specific viral pathogens. Examples of diagnostic testing for

6. Parasher, A. (2021). COVID-19: Current understanding of its pathophysiology, clinical presentation and treatment. *Postgraduate Medical Journal, 97*(1147), 312–320. https://doi.org/10.1136/postgradmedj-2020-138577

7. Centers for Disease Control and Prevention. (2023). *Respiratory virus updates*. https://www.cdc.gov/respiratory-viruses/guidance/

8. Pappas, D. (2023). Epidemiology, clinical manifestations, and pathogenesis of rhinovirus infections. *UpToDate*. https://www.uptodate.com/

9. Kaler, J., Hussain, A., Patel, K., Hernandez, T., & Ray, S. (2023). Respiratory syncytial virus: A comprehensive review of transmission, pathophysiology, and manifestation. *Cureus, 15*(3), e36342. https://doi.org/10.7759/cureus.36342

influenza, COVID-19, RSV, and rhinoviruses are described in the following subsections.

Influenza

Diagnostic testing for influenza includes the following:

- **Rapid Influenza Diagnostic Tests (RIDTs):** These tests detect influenza viral antigens in respiratory specimens (e.g., nasal swabs) within minutes. While rapid and convenient, they may have lower sensitivity compared to other tests.
- **Reverse Transcription Polymerase Chain Reaction (RT-PCR):** RT-PCR tests detect viral RNA and are considered the gold standard for diagnosing influenza. They offer high sensitivity and specificity and can differentiate between influenza virus types and subtypes.
- **Viral Culture:** This method involves growing influenza viruses in cell cultures from respiratory specimens. While less commonly used due to longer turnaround times, viral culture allows for virus isolation and further characterization.[10]

COVID-19

Diagnostic testing for COVID-19 includes the following:

- **RT-PCR Tests:** Similar to influenza, RT-PCR tests are the primary method for diagnosing COVID-19. They detect the presence of SARS-CoV-2 viral RNA in respiratory specimens (e.g., nasopharyngeal swabs, sputum).
- **Antigen Tests:** Rapid antigen tests detect specific proteins (antigens) from the SARS-CoV-2 virus. While generally less sensitive than RT-PCR, antigen tests provide quicker results and can be useful for rapid

10. Centers for Disease Control and Prevention. (2023). *Overview of influenza testing*. https://www.cdc.gov/flu/hcp/testing-methods/

screening.

- **Antibody Tests:** Serological tests detect antibodies produced by the immune system in response to SARS-CoV-2 infection. These tests can indicate past infection but are not typically used for diagnosing active COVID-19 cases.[11]

Respiratory Syncytial Virus (RSV)

Diagnostic testing for RSV includes the following:

- **RT-PCR Tests:** Similar to influenza and COVID-19, RT-PCR tests can detect RSV viral RNA in respiratory specimens. These tests are highly sensitive and specific for diagnosing RSV infections.
- **Direct Fluorescent Antibody (DFA) Test:** DFA tests use fluorescently labeled antibodies to detect RSV antigens in respiratory specimens. While less commonly used than RT-PCR, DFA tests provide rapid results and can be useful in certain settings.[12]

Rhinoviruses

- **RT-PCR Tests:** RT-PCR tests can also detect rhinovirus RNA in respiratory specimens. These tests offer high sensitivity and specificity for diagnosing rhinovirus infections.
- **Viral Culture:** Similar to influenza, rhinoviruses can be cultured from respiratory specimens in cell cultures. While less commonly used, viral culture allows for virus isolation and further characterization.[13]

11. National Institute of Health. *Testing for SARS-CoV-2 infection*. https://www.covid19treatmentguidelines.nih.gov/overview/sars-cov-2-testing/

12. National Institute of Health. (2022). *Respiratory syncytial virus (RSV) tests*. https://medlineplus.gov/lab-tests/respiratory-syncytial-virus-rsv-tests/

Nursing Diagnoses

Nursing care for clients with respiratory viruses focuses on promoting client well-being and recovery. Common nursing diagnoses for clients with respiratory viruses include the following[14]:

- Ineffective Airway Clearance
- Impaired Gas Exchange
- Altered Breathing Pattern
- Risk for Social Isolation

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

- *The client will maintain patent airway as evidenced by clear lung sounds and absence of audible secretions within 24 hours.*
- *The client will maintain adequate oxygenation as evidenced by stable oxygen saturation levels (SpO2 > 92%) on room air.*
- *The client will demonstrate effective use of respiratory techniques (e.g., deep breathing exercises, incentive spirometry) to promote airway clearance within 48 hours.*
- *The client will identify at least two methods of maintaining social connections while adhering to isolation precautions within 48 hours.*

13. Mayo Clinic. (2023). *Common cold.* https://www.mayoclinic.org/diseases-conditions/common-cold/diagnosis-treatment/drc-20351611

14. Flynn Makic, M. B., & Martinez-Kratz, M. R. (2023). *Ackley and Ladwig's Nursing diagnosis handbook: An evidence-based guide to planning care* (13th ed.). Elsevier.

Interventions

Medical Interventions

Medical interventions for respiratory viral infections vary depending on the specific virus and the severity of the illness.

MEDICATION THERAPY

Antiviral medications provide the cornerstone for the treatment of many respiratory viral disorders. Antiviral drugs like oseltamir (Tamiflu) may be prescribed to reduce the severity and duration of influenza symptoms. Antiviral drugs like remdesivir (Veklury) may be used to treat severe treatment of COVID-19 to inhibit viral replication. With more severe cases of respiratory viral infections, corticosteroids may be prescribed to reduce inflammation, and bronchodilator medications (e.g., albuterol) may be administered to relieve bronchospasm and improve airflow in clients with wheezing or bronchiolitis. If a bacterial co-infection is suspected, clients may be treated with antibiotics. Other common medications such as acetaminophen and ibuprofen may be ordered to help minimize symptoms of fever and alleviate body aches. Nebulized medications such as hypertonic saline and bronchodilators may also be used to help loosen respiratory secretions and improve airway clearance. In cases of COVID-19, monoclonal antibodies may

be used to treat high-risk clients and reduce the risk of severe illness and hospitalization.[15,16,17,18]

SUPPORTIVE CARE

Fluid intake helps prevent dehydration, especially in cases of fever and increased respiratory secretions. Supplemental oxygen may be provided to maintain adequate oxygenation. Clients with severe respiratory distress may require more significant respiratory support with continuous positive pressure ventilation, bilevel positive pressure ventilation, or mechanical ventilation to support breathing and improve oxygenation.

Nursing Interventions

Nursing interventions for respiratory viral disorders aim to alleviate symptoms, promote comfort, prevent complications, facilitate recovery, and prevent future illness.

15. Parasher, A. (2021). COVID-19: Current understanding of its pathophysiology, clinical presentation and treatment. *Postgraduate Medical Journal, 97*(1147), 312–320. https://doi.org/10.1136/postgradmedj-2020-138577

16. Centers for Disease Control and Prevention. (2023). *Respiratory virus updates*. https://www.cdc.gov/respiratory-viruses/guidance/

17. Pappas, D. (2023). Epidemiology, clinical manifestations, and pathogenesis of rhinovirus infections. *UpToDate*. https://www.uptodate.com/

18. Kaler, J., Hussain, A., Patel, K., Hernandez, T., & Ray, S. (2023). Respiratory syncytial virus: A comprehensive review of transmission, pathophysiology, and manifestation. *Cureus, 15*(3), e36342. https://doi.org/10.7759/cureus.36342

INFECTION CONTROL MEASURES

Nurses adhere to standard and transmission-based precautions to prevent the spread of the virus to other clients and health care workers. Clients and caregivers are educated on proper hand hygiene, respiratory hygiene and cough etiquette, and the use of personal protective equipment (PPE).

See Table 6.10b for infection control measures for droplet, contact, and airborne precautions.[19]

Table 6.10b. Infection Control Measures

19. Centers for Disease Control and Prevention. (2024). *Transmission based precautions*. https://www.cdc.gov/infection-control/about/index.html

Aspect	Droplet Precautions	Contact Precautions	Airborne Precautions
Mode of Transmission	Transmission via respiratory droplets (>5 micrometers)	Transmission via direct or indirect contact with client	Transmission via inhalation of infectious aerosols
Indications	Infections with pathogens transmitted by respiratory droplets (e.g., influenza, COVID-19)	Infections with pathogens transmitted by direct or indirect contact (e.g., MRSA, C. difficile)	Infections with pathogens transmitted by small-particle aerosols (e.g., TB, measles)
Room Placement	Private room, if available	Private room, if available	Negative-pressure room, if available (for airborne infections)
Hand Hygiene	Standard hand hygiene	Standard hand hygiene	Standard hand hygiene
Gloves	Not routinely required	Required for direct contact with client or contaminated surfaces	Not routinely required
Gown	Not routinely required	Required for anticipated contact with client's intact skin or environmental surfaces	Not routinely required
Mask	Surgical mask for health care workers and visitors	Not routinely required	Respirator (N95 or higher) for health care workers and visitors
Eye Protection	Not routinely required	Not routinely required	Not routinely required
Additional Precautions	Maintain at least three feet distance from client	Minimize client movement outside the room	Ensure room door is kept closed
	Use tissues or masks for client transport if necessary	Dedicate equipment to the client	Limit client movement outside the room

HEALTH TEACHING

Nurses provide education on the signs and symptoms of respiratory viral infections, including when to seek medical attention. They teach clients and caregivers about medication management, symptom management strategies, and the importance of adherence to treatment plans. Effective coughing and deep breathing exercise are encouraged to help clear respiratory secretions and maintain airway patency. Fluid intake is encouraged to prevent dehydration, especially in clients with fever or increased respiratory secretions, and clients are taught about the importance

of rest and sleep to support the body's immune response and facilitate recovery.

IMMUNIZATIONS

Nurses encourage clients to remain up-to-date on recommended vaccinations to prevent respiratory illness, including influenza, respiratory syncytial virus (RSV), and COVID vaccines.

- Review current information about "Recommended Vaccines By Age" from the Centers for Disease Control and Prevention (CDC).

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Respiratory Viral Infections

View a brief YouTube video overview of Respiratory Viral Infections[20]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1539#oembed-1

20. Open RN Project. (2024, June 23). *Health Alterations – Chapter 6 – Respiratory viral infections* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/tlLMvQ_D8kE?si=n4xxVZnFEZt1iTcu

6.11 Other Disorders of Head and Neck

Sinusitis

Sinusitis is the medical diagnosis for inflamed sinuses that can be caused by a viral or bacterial infection. When the nasal membranes become swollen, the drainage of mucous is blocked and causes pain.

There are several types of sinusitis, including these types:

- Acute Sinusitis: Infection lasting up to 4 weeks
- Chronic Sinusitis: Infection lasting more than 12 weeks
- Recurrent Sinusitis: Several episodes of sinusitis within a year

Symptoms of sinusitis can include fever, weakness, fatigue, cough, and congestion. There may also be mucus drainage in the back of the throat, called postnasal drip. Health care providers diagnose sinusitis based on symptoms and an examination of the nose and face. Treatments include antibiotics, decongestants, and pain relievers.[1]

Pharyngitis

Pharyngitis is the medical term used for infection and/or inflammation in the back of the throat (pharynx). Common causes of pharyngitis are the cold viruses, influenza, strep throat caused by group A *streptococcus*, and mononucleosis. Strep throat typically causes white patches on the tonsils with a fever and enlarged lymph nodes. It must be treated with antibiotics to prevent potential complications in the heart and kidneys. See Figure 6.27[2] for an image of strep throat in a child.

1. MedlinePlus [Internet]. (2020). Sinusitis. https://medlineplus.gov/sinusitis.html
2. "Strep throat2010.JPG" by James Heilman, MD is licensed under CC BY-SA 3.0

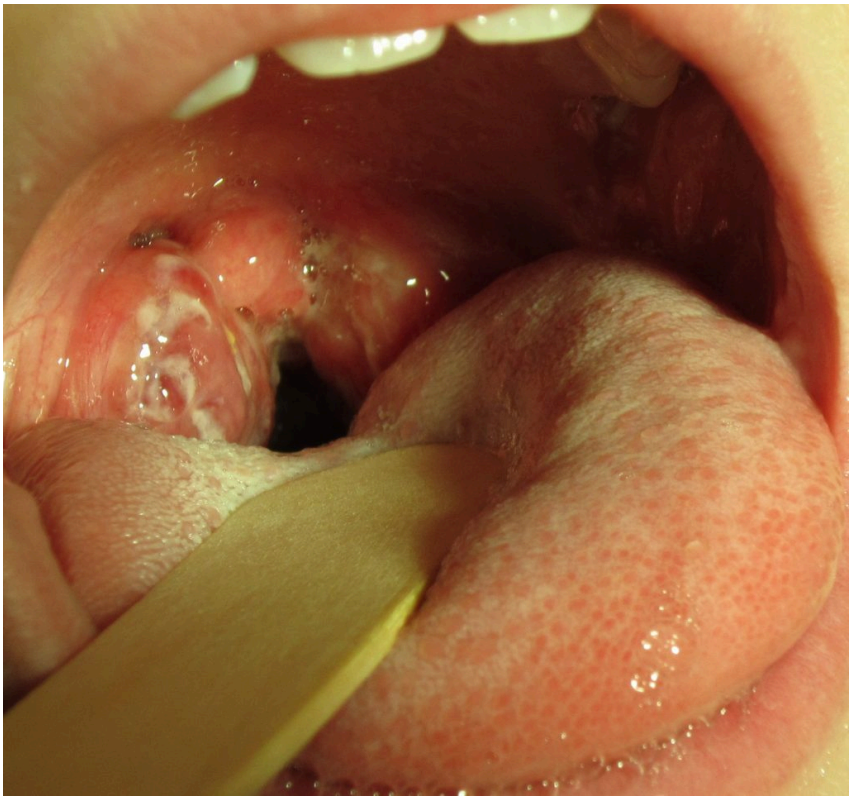


Figure 6.27 Strep Throat

If not diagnosed as strep throat, most cases of pharyngitis are caused by viruses, and the treatment is aimed at managing the symptoms. Nurses can teach clients the following ways to decrease the discomfort of a sore throat:

- Drink soothing liquids such as lemon tea with honey or ice water.
- Gargle several times a day with warm salt water made of 1/2 tsp. of salt in 1 cup of water.
- Suck on hard candies or throat lozenges.
- Use a cool-mist vaporizer or humidifier to moisten the air.
- Try over-the-counter pain medicines, such as acetaminophen.[3]

3. Centers for Disease Control and Prevention. (n.d.). *Disparities in oral health*. https://www.cdc.gov/oral-health/health-equity/

Tonsillitis

Tonsillitis is a common condition particularly in children that involves inflammation of the tonsils, which are two oval-shaped pads of tissue at the back of the throat. It is often caused by viral or bacterial infections, with the most frequent culprits being the *Streptococcus* bacteria. The inflammation can lead to symptoms such as sore throat, difficulty swallowing, fever, swollen lymph nodes, and sometimes a distinctive white or yellow coating on the tonsils. In severe cases, individuals may experience difficulty breathing due to swollen tonsils obstructing the airway.

Interventions for tonsillitis typically depend on the underlying cause. Viral tonsillitis often resolves on its own with rest, hydration, and over-the-counter pain relievers to manage symptoms. Bacterial tonsillitis, particularly when caused by *Streptococcus*, may require antibiotic treatment to prevent complications such as rheumatic fever. In recurrent or severe cases, surgical removal of the tonsils, known as a tonsillectomy, may be recommended to alleviate symptoms and prevent future occurrences. Regular gargling with warm salt water and maintaining good oral hygiene can also help soothe symptoms and prevent infection spread.[4]

Epistaxis

Epistaxis, the medical term for a nosebleed, is a common problem affecting up to 60 million Americans each year. Although most cases of epistaxis are minor and manageable with conservative measures, severe cases can

4. Anderson, J., & Paterek, E. (2023). *Tonsillitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544342/

become life-threatening if the bleeding cannot be stopped.[5] See Figure 6.28[6] for an image of a severe case of epistaxis.

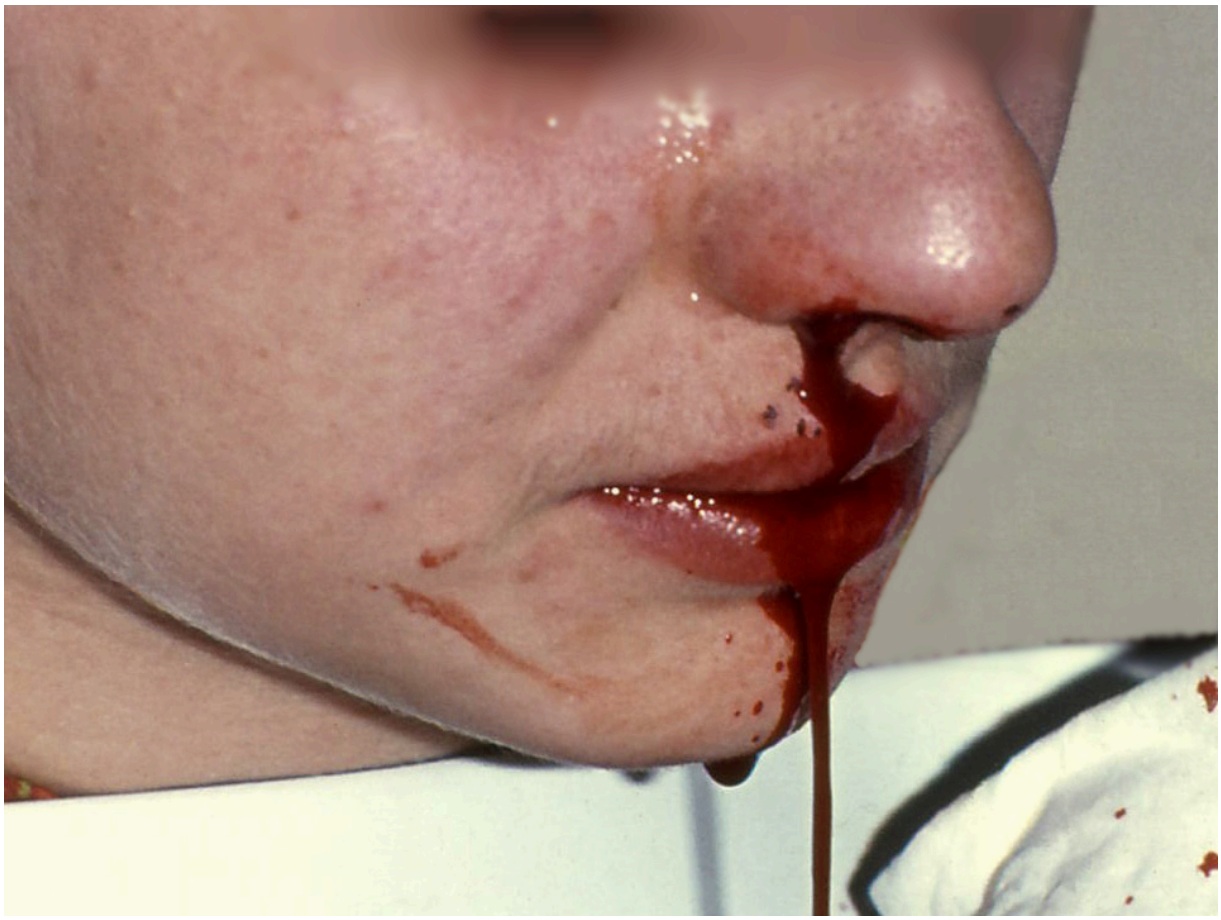


Figure 6.28 Serious Epistaxis

The most common cause of epistaxis is dry nasal membranes in winter months due to low temperatures and low humidity. Other common causes are picking inside the nose with fingers, trauma, anatomical deformity, high blood pressure, and clotting disorders. Medications associated with epistaxis

5. Fatakia, A., Winters, R., & Amedee, R. G. (2010). Epistaxis: A common problem. *The Ochsner Journal, 10*(3), 176–178. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096213/

6. "Epstaxis1.jpg" by Welleschik is licensed under CC BY-SA 3.0

are aspirin, clopidogrel, nonsteroidal anti-inflammatory drugs, and anticoagulants.[7]

To treat a nosebleed, have the victim lean forward at the waist and pinch the lateral sides of the nose with the thumb and index finger for up to 15 minutes while breathing through the mouth.[8] Continued bleeding despite this intervention requires urgent medical intervention such as nasal packing.

7. Fatakia, A., Winters, R., & Amedee, R. G. (2010). Epistaxis: A common problem. *The Ochsner Journal, 10*(3), 176–178. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3096213/

8. American Heart Association. (2000). Part 5: New guidelines for first aid. *Circulation, 102(*supplement 1). https://www.ahajournals.org/doi/10.1161/circ.102.suppl_1.I-77

6.12 Learning Activities

Learning Activities

Asthma Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Jeremy, a 13-year-old boy, was brought to the emergency room by his parents after experiencing acute respiratory distress while playing basketball with his friends. He complained of chest tightness, severe shortness of breath, and audible wheezing. Members of Jeremy's family have experienced a "cold" within the last two weeks. Jeremy attempted to manage his acute symptoms at home by using his salmeterol inhaler. However, he reported that it did not provide any relief.

Assessment findings include wheezing in bilateral upper and lower lungs, current peak flow meter reading: 180 (Personal Best: 425), and pulse oximetry (SpO2): 90% on room air.

1. What is your hypothesis for Jeremy's current condition and what are two possible causes?

2. How would you teach Jeremy and his parents about his salmeterol inhaler and why did it not offer relief in this situation?

3. Evaluate Jeremy's peak flow reading. What zone is he currently in? What will you teach Jeremy and his parents regarding his

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asthma management using peak flow meter readings and the asthma action plan?

COPD Case Study (Case Study answers are located in the Answer Key at the end of the book.)[2]

Maria, a 65-year-old woman, presents to her primary care physician's office with complaints of worsening breathing difficulties and a persistent, productive cough that has lasted for several months. She has a history of smoking for over 40 years, averaging one pack of cigarettes per day. She retired last year from her work as a dairy farmer. Her symptoms have progressively worsened over the last two years, limiting her ability to perform daily activities. Her medical history includes hypertension, but she is not on any regular medications.

Physical Assessment: Maria appears fatigued and breathless. She reports the breathlessness increases with activity. She is leaning forward in her chair with her hand on her knees and has an increased respiratory rate. Breath sounds are diminished with occasional wheezing. She reports a chronic cough with thick yellow/green sputum. Her chest is barrel shaped, but no clubbing is noted. She has slight cyanosis in the nail beds.

1. Based upon the information above, what signs and symptoms suggest the client may have COPD?

2. What are potential contributing factors to Maria's COPD diagnosis?

3. The health care provider prescribes daily fluticasone inhaler use with albuterol inhaler for rapid treatment of dyspnea. What will you teach Maria about these medications?

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4. The health care provider recommends Maria to participate in pulmonary rehabilitation. Maria states, “Why should I drive into town to go to pulmonary rehab?” How should the nurse respond to Maria?

Tuberculosis Case Study (Case Study answers are located in the Answer Key at the end of the book.)[3]

Mrs. Xiong is a 38-year-old woman who presents with a three-week history of fatigue, night sweats, anorexia, weight loss, and a persistent dry cough. She was admitted to the hospital for further evaluation. Mrs. Xiong’s chest X-ray shows cavitary lesions in her right upper lung lobe. She is diagnosed with pulmonary tuberculosis (TB) based on her clinical presentation and imaging findings. The following is an account of her hospital stay, including nursing assessments, interventions, and education.

Upon admission, Mrs. Xiong appears fatigued and malnourished. She has a body temperature of 101°F, pulse 100 bpm, and respirations 24 breaths per minute. Her blood pressure is 120/80 mmHg. Her chest examination reveals reduced breath sounds in the right upper lobe and occasional crackles. She has no apparent respiratory distress. Her skin is warm and dry with no evidence of cyanosis or clubbing. Laboratory tests show an elevated white blood cell count and a positive sputum acid-fast bacilli (AFB) test.

1. What are the key findings in Mrs. Xiong’s physical examination that suggest a diagnosis of pulmonary tuberculosis (TB)?
2. What is the first-line therapy for treating active pulmonary TB, and what are the possible side effects of these medications?

3. “Tuberculosis Case Study” by Open RN is licensed under CC BY-NC 4.0

3. What nursing interventions are essential to prevent the spread of TB infection in the hospital setting and ensure Mrs. Xiong's safety and well-being?
4. What should Mrs. Xiong be educated about regarding her condition, including the importance of medication adherence, infection control measures, and follow-up care?



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- Test your knowledge on respiratory conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[4]

- Test your knowledge on pediatric respiratory conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[5]

4. "Respiratory Bowtie" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

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- Test your knowledge on COPD exacerbations using this NCLEX Next Generation-style Case Study. You may reset and resubmit your answers to this question an unlimited number of times.[6]

- Test your knowledge on pneumonia using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[7]

- Test your knowledge on asthma using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[8]

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7. "Pneumonia" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

8. "Asthma" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on COPD using this NCLEX Next Generation-style case study.
  You may reset and resubmit your answers to this question an unlimited number of times.[9]

Telehealth Scenarios

Telehealth is an innovative technology that can bridge the gap between health care professionals and clients, especially for clients who live in remote areas. Telehealth not only makes health care more accessible but can also provide continuity of care and prevent unnecessary hospitalizations. Nurses who provide telehealth services become digital communicators and educators, merging clinical expertise with empathy and effective online communication.

Practice using effective telehealth communication in the following three scenarios with a 78-year-old Asian female with chronic COPD who is on home oxygen therapy[10]:

- Chen Xiulan, Telehealth Visit 1: Post-hospitalization Follow-Up
- Chen Xiulan, Telehealth Visit 2: Identifying Learning Needs

9. "COPD" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

10. Telehealth Simulations by Open RN and Codaptive Labs are licensed under CC BY-NC 4.0

- Chen Xiulan, Telehealth Visit 3: Evaluating Effectiveness of Health Teaching

VI Glossary

Adenoiditis: Inflammation of the adenoids, a common medical condition in young children that can hinder speaking and breathing. (Chapter 6.2)

Adenoids: Lymphatic tissue between the back of the nasal cavity and the pharynx. (Chapter 6.2)

Alveoli: Small, grape-like sacs responsible for gas exchange. (Chapter 6.2)

Apnea: Absence of breathing. (Chapter 6.2)

Aspiration: Inhalation of food or fluids into the trachea and lower respiratory tract. (Chapter 6.2)

Aspiration pneumonia: Refers to when someone inhales food, drink, vomit, saliva, or medication into the lungs instead of swallowing it. (Chapter 6.7)

Asthma: A condition caused by chronic inflammation in the airways, resulting in narrowed air passages. Individuals also experience bronchoconstriction that tightens the smooth muscle surrounding the airways, further limiting airflow. (Chapter 6.5)

Atelectasis: Collapse of alveoli and/or small passageways of the lungs. (Chapter 6.2)

Audible wheezing: Whistling or squeaky sound when breathing. (Chapter 6.6)

Bradypnea: Slow breathing. (Chapter 6.2)

Bronchi: Main air passageways of the lungs. (Chapter 6.2)

Bronchial responsiveness testing: Measures the responsiveness of the airway after it has been exposed to an allergen or bronchoconstrictive substance. (Chapter 6.3)

Bronchial thermoplasty: Procedure is performed during a bronchoscopy and delivers heat to the muscles surrounding the airways to reduce smooth muscle mass and prevent them from narrowing. (Chapter 6.5)

Bronchioles: Small branches of the bronchi that lead to the alveolar sacs. (Chapter 6.2)

Bronchitis: Inflammation of the bronchi. (Chapter 6.2)

Bronchoscopy: Procedure in which a tube is inserted by a health care provider to visually examine the bronchi. (Chapter 6.3)

Bronchospasm: Symptom of many respiratory conditions; sudden constriction of the muscles in the walls of the bronchioles. (Chapter 6.2)

Bullectomy: One or more very large bullae are removed from the lungs. (Chapter 6.6)

Capnography: A sensor that measures the concentration of carbon dioxide exhaled, translated into a waveform and numerical value. (Chapter 6.3)

Carina: A raised structure that contains specialized nervous system tissue that induces violent coughing if a foreign body, such as food, is present. (Chapter 6.2)

Chest physiotherapy techniques: Techniques such as postural drainage and percussion, which may be used to assist in clearing mucus and secretions from the airways. (Chapter 6.7)

Chronic obstructive pulmonary disease (COPD): A chronic, progressive, and incurable respiratory condition that causes breathing difficulties and reduced lung function. (Chapter 6.6)

Community-acquired pneumonia (CAP): Refers to pneumonia that began in the community (not in a hospital). (Chapter 6.7)

Cor pulmonale: Right-sided heart failure. (Chapter 6.6)

Coughing and deep breathing: A breathing technique similar to incentive spirometry but no device is required. (Chapter 6.3)

COVID-19: Caused by the novel coronavirus SARS-CoV-2; emerged as a global pandemic in late 2019, causing a wide spectrum of symptoms ranging from mild respiratory distress to severe pneumonia and organ failure. (Chapter 6.10)

Cyanosis: Bluish discoloration. (Chapter 6.3)

Diaphragmatic breathing: Also called abdominal breathing; encourages them to consciously use their diaphragm to take deep breaths. (Chapter 6.3)

Diffusion capacity testing: Measures the lung's ability to transfer gases from alveoli into the bloodstream. (Chapter 6.3)

Dyspnea: Common symptom of respiratory disorders and refers to difficulty breathing. (Chapter 6.1, Chapter 6.2)

Epiglottis: A flap of tissue that covers the trachea during swallowing to prevent aspiration. (Chapter 6.2)

Epistaxis: Bleeding from the nose. (Chapter 6.2, Chapter 6.11)

Exhalation: Act of breathing out. (Chapter 6.2)

FEV1/FVC ratio: Ratio used to assess airflow obstruction. (Chapter 6.3)

Fluoroscopy: An imaging technique that can assess the movement of the diaphragm and chest structures during respiration. (Chapter 6.3)

Forced expiratory volume in one second (FEV1): The volume of air exhaled in the first second of forced expiration. (Chapter 6.3)

Forced vital capacity (FVC): The maximum amount of air that can be exhaled after a deep inhalation. (Chapter 6.3)

Gas exchange: Main function of the respiratory system, providing a supply of oxygen to the body and removing carbon dioxide. (Chapter 6.2)

Hilum: The area that connects the lungs to the supporting structures and where the pulmonary vessels enter and exit the lungs. (Chapter 6.2)

Hospital-acquired pneumonia (HAP): Refers to pneumonia that began during or immediately following a stay in a health care setting. (Chapter 6.7)

Huffing technique: A technique in which an individual inhales with a medium-sized breath and then make a sound like “Ha” to push the air out quickly with the mouth slightly open. (Chapter 6.3)

Hypercapnia: Elevated levels of carbon dioxide. (Chapter 6.2)

Hyperventilation: Rapid and deep breathing. (Chapter 6.2)

Hypoventilation: Slow and shallow breathing. (Chapter 6.2)

Hypoxemia: A decreased amount of dissolved oxygen in the blood. (Chapter 6.2)

Hypoxia: Low levels of oxygen in the tissues. (Chapter 6.2)

Hypoxic drive: Instead of relying on PaCO2 levels to initiate breathing, the brain primarily relies on dissolved oxygen levels in the bloodstream to initiate respiratory effort. (Chapter 6.6)

Incentive spirometer: A medical device commonly prescribed after surgery to expand the lungs, reduce the buildup of fluid in the lungs, and prevent pneumonia. (Chapter 6.3)

Influenza: Commonly known as the flu; caused by influenza viruses that primarily infect the respiratory tract, leading to symptoms such as fever, cough, sore throat, body aches, and fatigue. (Chapter 6.10)

Inhalation: Act of breathing in. (Chapter 6.2)

Labored breathing: Additional muscle contractions during inspiration. (Chapter 6.2)

Laryngitis: Inflammation of the larynx, typically resulting in huskiness or loss of one's voice and a cough. (Chapter 6.2)

Larynx: Formed by several pieces of cartilage, it contains the vocal cords that allow for speech. (Chapter 6.2)

Lobectomy: Surgical removal of a lobe of the lung. (Chapter 6.2)

Lobes: Smaller units within the lungs. (Chapter 6.2)

Long-term oxygen therapy (LTOT): Prescribed for clients with chronic obstructive pulmonary disease (COPD) when oxygen saturation levels are 88% or less when at rest and in a stable clinical condition. (Chapter 6.6)

Lungs: Organ of the respiratory system responsible for gas exchange. (Chapter 6.2)

Nasal septum: Separates the left and right sections of the nasal cavity. (Chapter 6.2)

Peak expiratory flow rate (PEFR): Measures the rate of air that can be forcefully breathed out of the lungs. (Chapter 6.5)

Peak flow monitoring: Involves a handheld device called a peak flow meter that measures the rate of air that can be forcefully breathed out of the lungs. (Chapter 6.5)

Perfusion: The passage of blood through the blood vessels. (Chapter 6.2)

Pharyngitis: Inflammation of the pharynx. (Chapter 6.2, Chapter 6.11)

Pharynx: Commonly known as the throat. (Chapter 6.2)

Pleural cavity: Area between the two membranes of the lung. (Chapter 6.2)

Pleural effusion: Excessive fluid between the pleural membranes caused by disease or trauma. (Chapter 6.2)

Pleural fluid culture: A procedure where a health care provider uses a needle to take a sample of fluid from the pleural space between the lungs and chest wall. (Chapter 6.7)

Pleural rub: The rubbing together of leather and can be heard on inspiration and expiration. (Chapter 6.2)

Pleuritic chest pain: Pain that worsens with deep breathing or coughing. (Chapter 6.3)

Pneumonia: Characterized by inflammation and infection within the alveoli,

causing them to fill with fluid or purulent material, resulting in a productive cough, fever, chills, and difficulty breathing. (Chapter 6.7)

Pulmonary circulation: The flow of blood in the lungs. (Chapter 6.2)

Pulmonary edema: Fluid accumulation in alveoli; often caused by heart failure or kidney failure. (Chapter 6.2)

Pulmonary function tests (PFTs): Group of noninvasive diagnostic tests that assess the function of the respiratory system. (Chapter 6.3)

Pulmonary rehabilitation: A supervised program that includes exercise training, health education, and breathing techniques for people who have chronic lung conditions. (Chapter 6.6)

Pursed-lip breathing: A technique that decreases dyspnea by teaching people to control their oxygenation and ventilation. (Chapter 6.3)

Rales: Also called fine crackles; popping or crackling sounds heard on inspiration. (Chapter 6.2)

Respiratory arrest: Cessation of breathing. (Chapter 6.3)

Respiratory rate: The number of breaths taken per minute. (Chapter 6.2)

Rhinitis: Inflammation of the nasal mucosa. (Chapter 6.2)

Rhinorrhagia: Bleeding from the nose. (Chapter 6.2)

Rhinorrhea: Commonly referred to as a “runny nose”; medical term for excess mucus production by the nasal cavities. (Chapter 6.2)

Rhinoviruses: The most common cause of the common cold and are responsible for a large proportion of upper respiratory tract infections worldwide. (Chapter 6.10)

Rhonchi: Also referred to as coarse crackles; low-pitched, continuous sounds heard on expiration that are a sign of turbulent airflow through mucus in the large airways. (Chapter 6.2)

RSV: A common cause of respiratory infections in infants and young children, is characterized by symptoms similar to the common cold, including coughing, sneezing, and fever. (Chapter 6.10)

Sinusitis: Inflammation of the sinus cavities. (Chapter 6.2, Chapter 6.11)

Spirometry: Diagnostic testing that provides information about lung volume and airflow resistance. (Chapter 6.3)

Sputum: Mucus secretions that can be expelled through the mouth. (Chapter 6.2, Chapter 6.3)

Status asthmaticus: A severe and life-threatening asthma attack that is unresponsive to standard treatments such as bronchodilators and corticosteroids. (Chapter 6.5)

Stridor: Heard only on inspiration; sound associated with obstruction of the trachea/upper airway. (Chapter 6.2)

Subcutaneous emphysema: Occurs when air leaks from the pleural space into subcutaneous tissue, resulting in crepitus and swelling. (Chapter 6.3)

Superior vena cava syndrome: Compression of the superior vena cava by a cancerous tumor. (Chapter 6.8)

Surfactant: Substance that keeps the lungs from collapsing. (Chapter 6.2)

Tachypnea: Rapid breathing. (Chapter 6.2)

Tension pneumothorax: Occurs when pressure builds within the pleural space and compresses the lung. (Chapter 6.3)

Thoracentesis: Medical procedure performed as a diagnostic tool and to alleviate respiratory discomfort by aspirating pleural fluid (effusion) or air (pneumothorax) from the pleural space. (Chapter 6.3)

Thoracic cavity: Space inside the chest that contains the heart, lungs and other organs. (Chapter 6.2)

Tonsillitis: Inflammation of the tonsils. (Chapter 6.11)

Trachea: Formed by stacked C-shaped pieces of cartilage that are connected by dense connective tissue. (Chapter 6.2)

Tracheostomy: An incision created in the trachea to create an artificial opening to allow breathing when an obstruction is present. (Chapter 6.2)

Tuberculosis (TB): A contagious bacterial infection caused by *Mycobacterium* tuberculosis. (Chapter 6.9)

Upper respiratory infection (URI): Viral infection of the nose, nasal cavities, sinuses, pharynx, and larynx. (Chapter 6.2)

Ventilation: The mechanical movement of air into and out of the lungs. (Chapter 6.2)

Ventilator-associated pneumonia (VAP): Refers to when someone gets pneumonia during or after being on a ventilator. (Chapter 6.7)

Vibratory positive expiratory pressure (PEP) therapy: Therapy that uses handheld devices such as flutter valves or Acapella devices for clients who

need assistance in clearing mucus from their airways. (Chapter 6.3, Chapter 6.7)

V-Q mismatch: Hypoxia occurring due to inadequate ventilation or impaired perfusion where the ratio of air entering the lungs' alveoli (ventilation, V) to blood flowing through the surrounding capillaries (perfusion, Q) is not properly matched. (Chapter 6.2)

V-Q scan: A diagnostic test used to assess lung function and rule out pulmonary embolism. (Chapter 6.3)

Wheezes: Whistling noises produced when air is forced through airways narrowed by bronchoconstriction or mucosal edema. (Chapter 6.2)

PART VII

CHAPTER 7 ENDOCRINE ALTERATIONS

7.1 Endocrine Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Explore the roles and responsibilities of the nurse in caring for the client with endocrine disorders
- Explain the pathophysiology of endocrine disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Recognize the value of therapeutic communication in caring for the client with endocrine disorders
- Consider use of common pharmacological and nonpharmacological measures for the client with endocrine disorders
- Recognize common laboratory and diagnostic tests

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https://wtcs.pressbooks.pub/healthalts/?p=87#h5p-41

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The endocrine system is considered the body's "chemical messenger system." It is a complex network that plays a role in maintaining homeostasis within the human body. Endocrine glands secrete hormones into the bloodstream, where they travel to target organs and tissues and initiate specific physiological responses.

Central to the endocrine system's responsibilities are the regulation of metabolism, growth, and energy balance. Metabolism, the complex set of chemical reactions that occur within our cells, determines how our bodies use and store energy. For example, insulin, a hormone produced by the pancreas, plays a critical role in regulating glucose metabolism and ensures that blood sugar levels are maintained within an optimal range. Thyroid hormones, produced by the thyroid gland, influence the metabolic rate and affect how our bodies utilize energy and synthesize essential molecules.

Growth, a second responsibility of the endocrine system, is primarily governed by the secretion of growth hormone from the pituitary gland. This hormone stimulates the growth and development of various tissues, particularly during childhood and adolescence. It also continues to play a role in tissue maintenance and repair throughout adulthood.

Energy balance, the third responsibility of the endocrine system, refers to the equilibrium between energy intake (through food and drink) and energy expenditure (through physical activity and metabolic processes). Hormones like leptin, released by adipose (fat) tissue, help regulate appetite and satiety, while others, such as adrenaline, manage short-term energy demands, like the "fight or flight" response.

Although the endocrine system has intricate control over these vital processes of metabolism, growth, and energy balance, it is vulnerable to disruption. One of the most common endocrine disorders, diabetes mellitus, impacts millions of individuals worldwide. Diabetes mellitus disrupts the finely tuned balance of blood glucose levels when the pancreas does not produce enough insulin (type 1 diabetes) or when the body's cells do not respond effectively to insulin (type 2 diabetes). This disruption results in chronically elevated blood sugar levels, which can cause serious complications affecting the cardiovascular system, kidneys, and nerves.

Adrenal and thyroid disorders encompass a wide spectrum of conditions

that manifest in various ways. These disorders can range from minor hormonal imbalances to significant impacts on metabolism, energy levels, and overall well-being. For example, an overactive thyroid, referred to as hyperthyroidism, can cause symptoms like rapid heart rate, weight loss, and anxiety. An underactive thyroid, referred to as hypothyroidism, can cause fatigue, weight gain, and depression. The adrenal glands, situated atop the kidneys, secrete hormones like cortisol and adrenaline, which play crucial roles in stress responses and metabolic regulation. Disorders of the adrenal glands, such as Cushing's syndrome or Addison's disease, can disrupt these processes with a wide range of symptoms, affecting blood pressure, immune function, and more.

This chapter will review the anatomy and physiology of the endocrine system and discuss risk factors, cultural factors, socioeconomic factors, and assessments related to the general endocrine system. Three major glands of the endocrine system include the pancreas, thyroid, and adrenal glands. This chapter will also discuss common alterations affecting these three glands.

7.2 Review of Anatomy and Physiology of the Endocrine System

The endocrine system includes several glands, including the pineal, hypothalamus, pituitary, thyroid, parathyroid, and adrenal glands, as well as the pancreas, ovaries, and testes. See Figure 7.1 for an illustration of these organs of the endocrine system.[1]

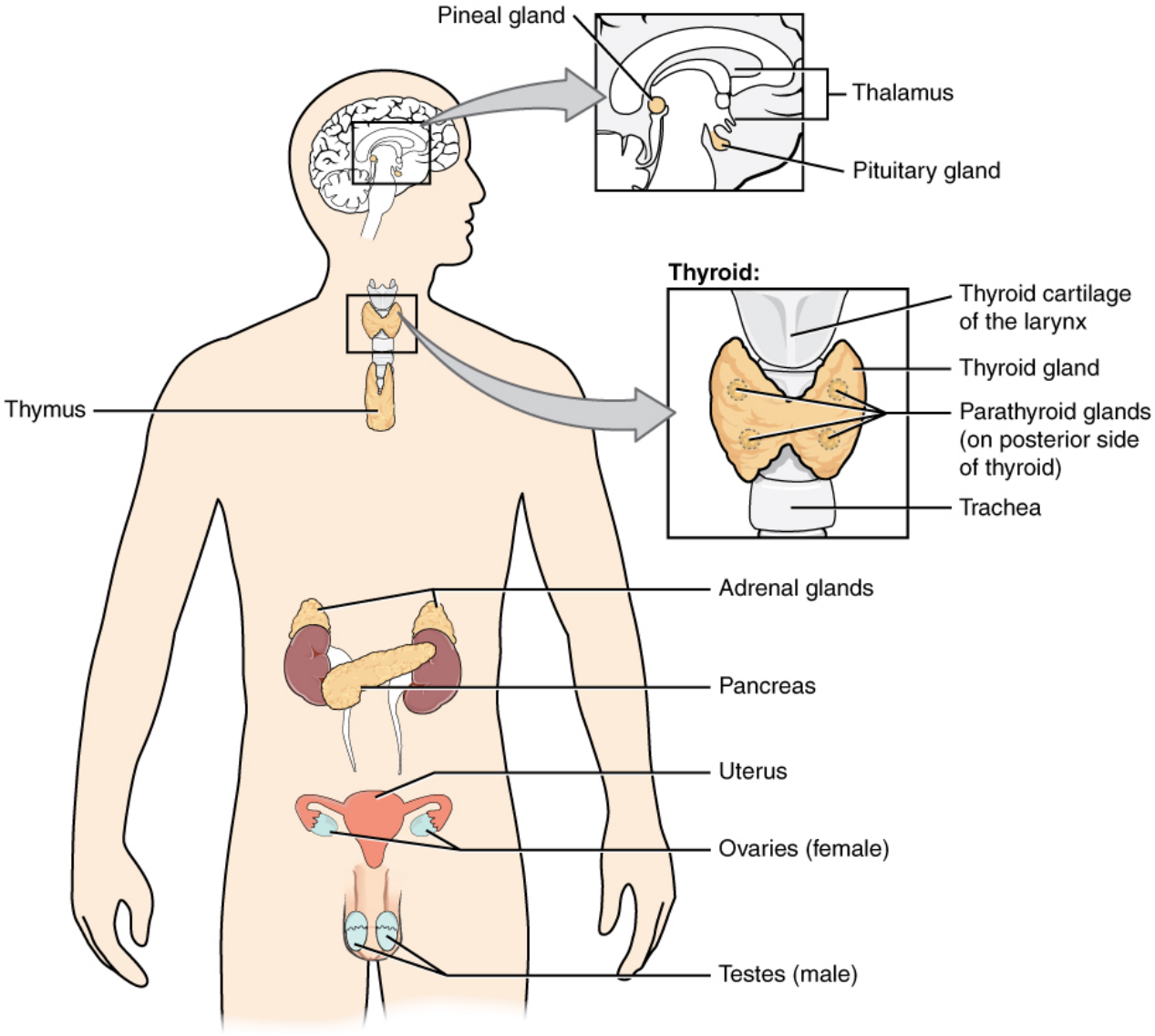


Figure 7.1 Endocrine System

1. "1801 The Endocrine System.jpg" by OpenStax is licensed under CC BY 3.0

Endocrine glands secrete **hormones** as chemical signaling. Hormones are transported via the bloodstream throughout the body, where they bind to receptors on target cells, triggering a characteristic response. This long-distance communication is the fundamental function of the endocrine system.

Pineal Gland

The **pineal gland** is a small cone-shaped structure that extends posteriorly from a ventricle of the brain. The pineal gland produces the hormone melatonin and secretes it directly into the cerebrospinal fluid, which carries it into the blood. **Melatonin** affects reproductive development and daily circadian rhythms.[2]

Thymus Gland

The **thymus gland** is located in the mediastinum. It is responsible for production of T lymphocytes for the body's immune response.

Hypothalamus and Pituitary

The **hypothalamus** can be viewed as the body's control center. The hypothalamus connects to the pituitary gland by the stalk-like infundibulum. The **pituitary gland** is about the size of a pea and consists of an anterior and posterior lobe. Each secretes different hormones in response to signals from the hypothalamus. See Figure 7.2 for an illustration of the hypothalamus–pituitary complex.[3]

2. National Cancer Institute. (n.d.). *Endocrine glands & their function.* https://training.seer.cancer.gov/anatomy/endocrine/glands/

3. "1806 The Hypothalamus-Pituitary Complex.jpg" by OpenStax is licensed under CC BY 3.0

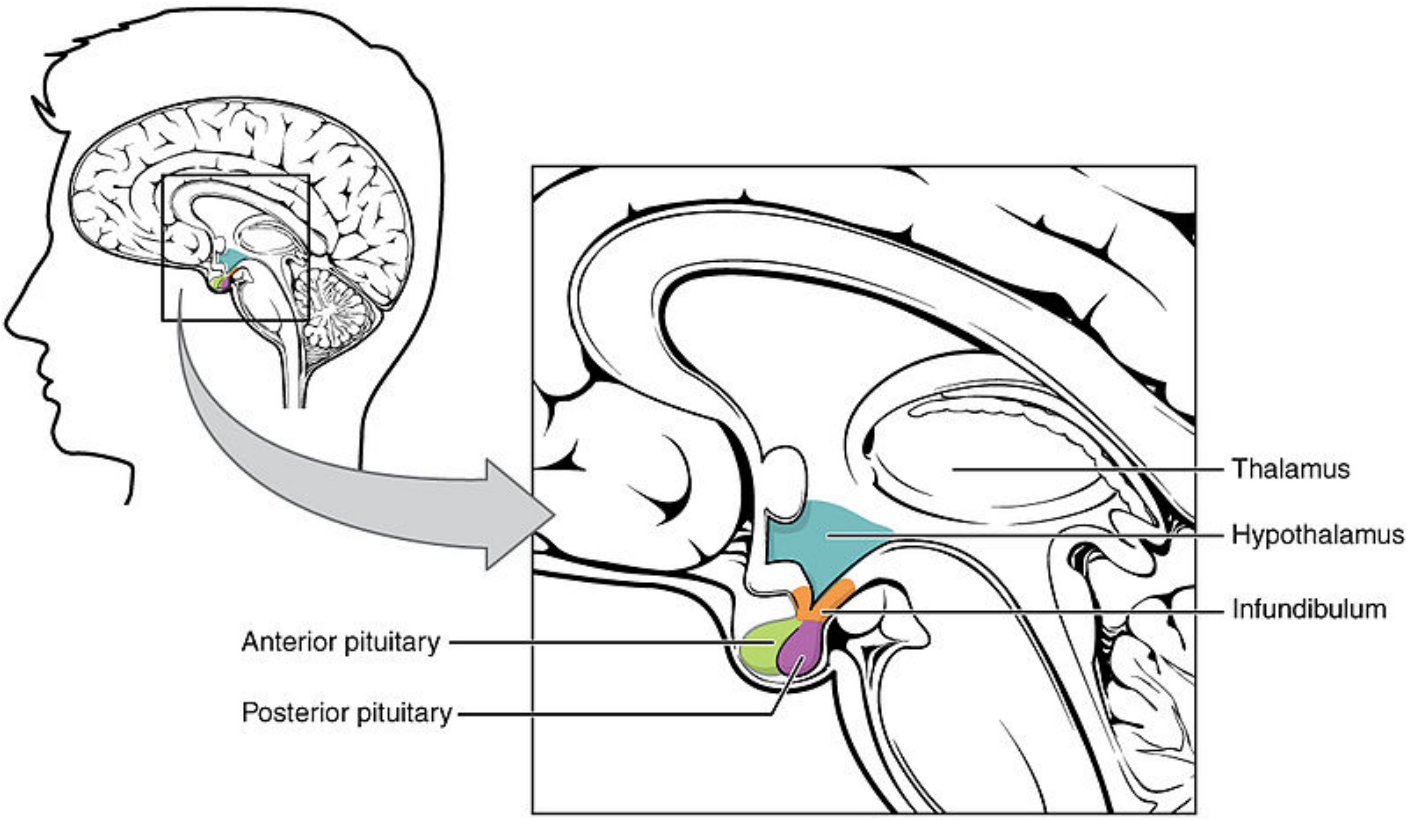


Figure 7.2 Illustration of the Hypothalamus–Pituitary Complex

The **hypothalamus–pituitary complex** releases hormones that stimulate secretion of other hormones by other endocrine glands and also produce direct responses in target tissues. Its main function is to maintain a stable state called **homeostasis**. See Figure 7.3[4] for an illustration of the effects of the hormones released by the anterior and posterior pituitary glands.

4. "Pituitary Gland" by Meredith Pomietlo is licensed under CC BY 4.0

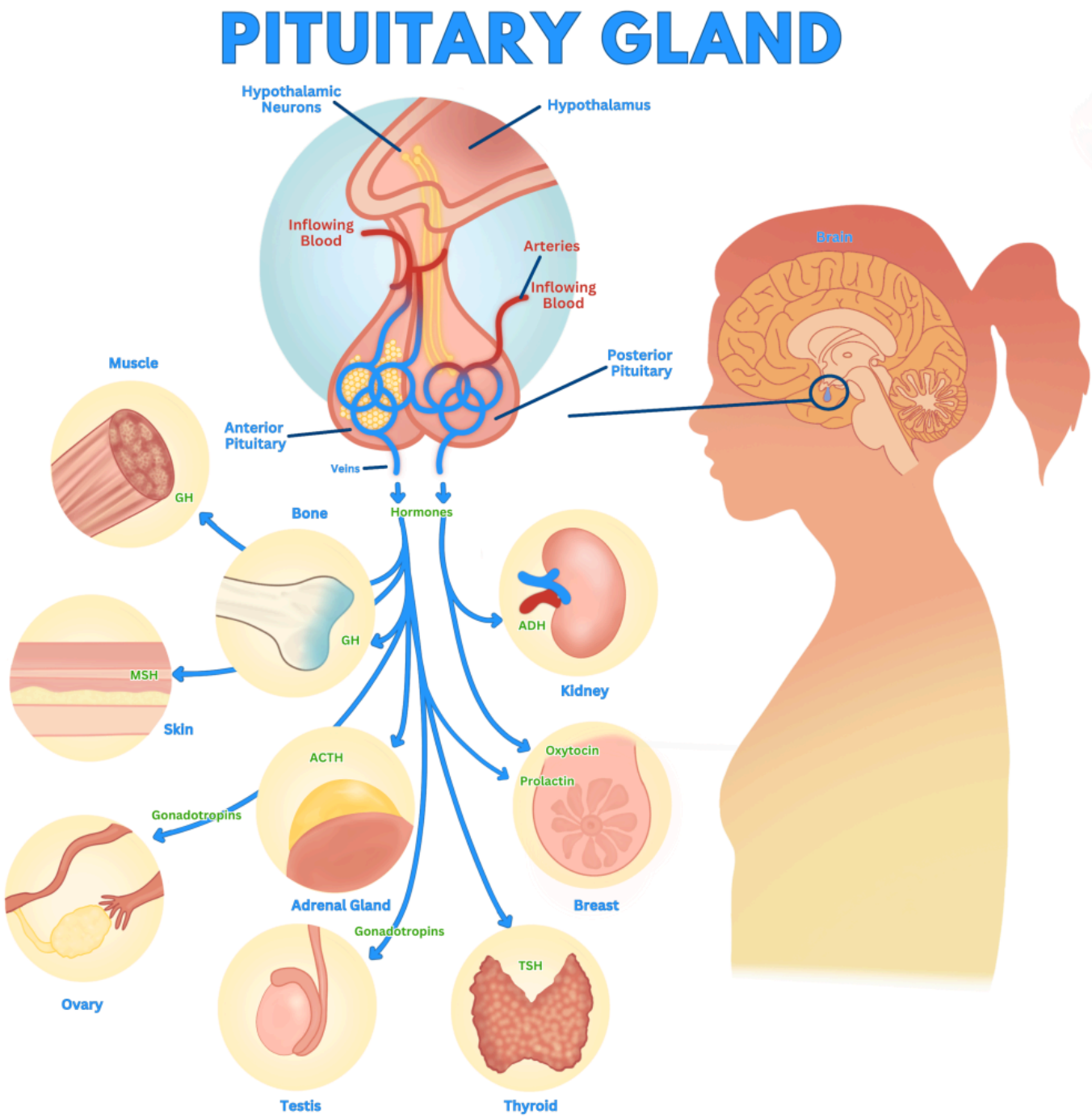


Figure 7.3 Effects of Hormones Released by the Pituitary

Posterior Pituitary

The **posterior pituitary gland** secretes two hormones produced by the hypothalamus called oxytocin and antidiuretic hormone (ADH).

- **Oxytocin** stimulates labor contractions and lactation after delivery.

- **Antidiuretic hormone (ADH)** regulates blood osmolarity by targeting the kidneys to increase water reabsorption.

Blood osmolarity refers to the concentration of sodium and other solutes in the blood. Blood osmolarity levels change in response to fluid intake, salty food ingestion, head injuries, disease, and side effects of medications. Blood osmolarity is constantly monitored by **osmoreceptors** in the hypothalamus.

As blood osmolarity increases beyond normal levels, the posterior pituitary is stimulated to release ADH. For example, high blood osmolarity can occur if someone eats a very salty meal or becomes dehydrated from inadequate intake of fluids. Osmoreceptors sense the high blood osmolarity and trigger the sensation of thirst, while also stimulating the posterior pituitary to release ADH. ADH targets the kidneys to increase water reabsorption. As more water is reabsorbed by the kidneys and is returned to the blood, blood osmolarity decreases.

In contrast, if blood osmolarity decreases beyond normal levels, the release of ADH is inhibited, causing the kidney to increase the elimination of water and resulting in dilute urine.

Drugs can also affect the secretion of ADH or imitate its effects. For example, alcohol consumption inhibits the release of ADH, resulting in increased dilute urine production that can eventually lead to dehydration (and a hangover). Another example is vasopressin, a synthetic ADH medication that is used to treat very low blood pressure by causing the kidneys to retain water. Vasopressin is also used to treat a disease called **diabetes insipidus (DI)**. People with DI have decreased amounts of ADH released by their pituitary, resulting in excessive amounts of dilute urine and severe dehydration.[5]

5. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

Anterior Pituitary

The anterior pituitary produces seven hormones:

- **Growth hormone (GH):** Promotes growth in children, helps maintain normal body structure in adults, and plays a role in metabolism in both children and adults.
- **Thyroid-stimulating hormone (TSH):** Stimulates thyroid hormone release by the thyroid gland. For example, if thyroid hormone levels in the blood are too low, the pituitary gland makes larger amounts of TSH to tell the thyroid to work harder. Conversely, if thyroid hormone levels are too high, the pituitary gland releases little or no TSH.
- **Adrenocorticotropic hormone (ACTH):** Regulates the release of glucocorticoid hormone (cortisol) by the adrenal gland.
- **Follicle-stimulating hormone (FSH):** Plays a role in sexual development and reproduction by affecting the function of the ovaries and testes.
- **Luteinizing hormone (LH):** Plays a role in sexual development in children and in women and triggers ovulation (the release of an egg from the ovary) during the menstrual cycle.
- **Beta-endorphin:** Possesses morphine-like effects and plays a role in pain management and natural reward circuits such as feeding, drinking, sex, and maternal behavior.
- **Prolactin:** Stimulates breast development and milk production in females.

Of the hormones released by the anterior pituitary, TSH, ACTH, FSH, and LH are referred to as **tropic hormones** because they turn on or off the function of other endocrine glands.

Negative Feedback Loop

TSH and ACTH levels in the blood are controlled by a negative feedback loop with the hypothalamus.

THYROID-STIMULATING HORMONE (TSH)

The hypothalamus stimulates the anterior pituitary with thyrotropin-releasing hormone (TRH). In response, the anterior pituitary stimulates the thyroid with thyroid-stimulating hormone (TSH). In response to TSH, the thyroid releases thyroid hormones called T3 and T4.

A **negative feedback loop** regulates the release of TSH by the anterior pituitary. For example, if the level of thyroid hormones (T3 and T4) decreases in the bloodstream, the hypothalamus increases the secretion of TRH. TRH causes the anterior pituitary to increase the secretion of TSH. TSH stimulates the thyroid to increase production and release of T3 and T4. For this reason, a hypofunctioning thyroid is often diagnosed by elevated TSH levels. See Figure 7.4[6] for an image of the hypothalamus-anterior pituitary-thyroid axis and the corresponding negative feedback loop.

6. "Thyroid_system.svg" by Mikael Häggström is licensed in the Public Domain.

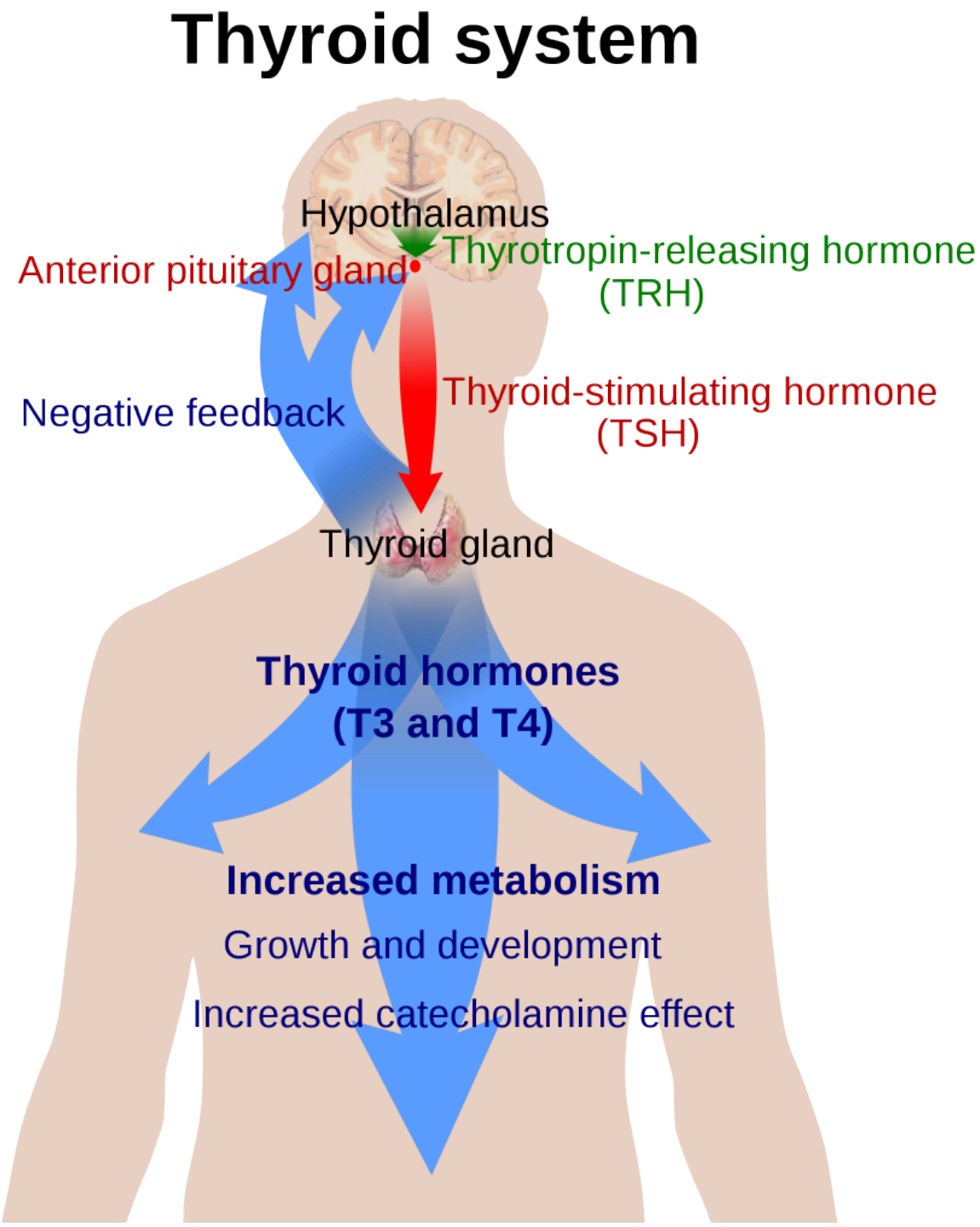


Figure 7.4 Hypothalamus-Pituitary-Thyroid Axis and Negative Feedback Loop

ADRENOCORTICOTROPIC HORMONE (ACTH)

The hypothalamus stimulates the anterior pituitary with corticotropin-releasing hormone (CRH). In response, the anterior pituitary releases

adrenocorticotropic hormone (ACTH) to stimulate the adrenal cortex to release corticosteroids.[7]

A negative feedback loop regulates the release of ACTH by the anterior pituitary. For example, if levels of corticosteroids decrease in the bloodstream, the hypothalamus increases the secretion of CRH, causing the anterior pituitary to increase the secretion of ACTH. This is often referred to as the hypothalamus-pituitary-adrenal (HPA) axis. See Figure 7.5[8] for an image of the HPA axis and negative feedback loop.

7. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

8. "Brian_M_Sweis_HPA_Axis_Diagram_2012.pdf" by BrianMSweis is licensed under CC BY-SA 3.0

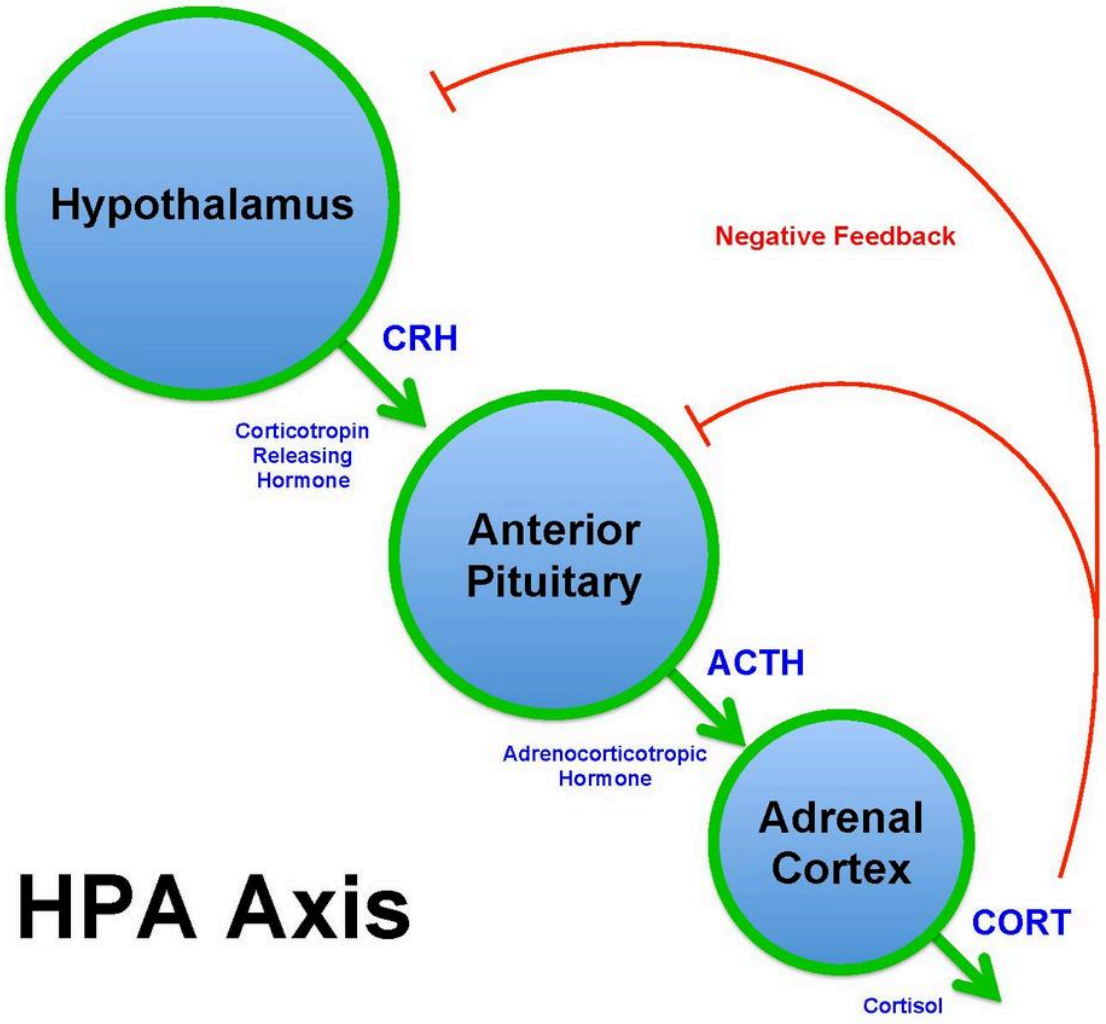


Figure 7.5 Hypothalamus-Pituitary-Adrenal Axis

Thyroid Gland

The **thyroid gland** is a butterfly-shaped endocrine gland located in the neck, just below the larynx. It helps to regulate metabolic processes in the body by producing and releasing thyroid hormones.

The thyroid releases these two hormones:

- Thyroxine (T4)
- Triiodothyronine (T3)

Both T3 and T4 are iodine-containing compounds. These hormones are

critical for regulating the body's basal metabolic rate (BMR), the rate at which the body burns energy at rest.

The primary functions of thyroid hormones T3 and T4 include the following:

- **Regulation of Metabolism:** Control how the body uses energy and oxygen, impacting processes such as digestion, heart rate, and temperature regulation.
- **Growth and Development:** Impact normal growth and development, particularly in children and infants. They influence the growth of bones, as well as the development of the brain and the nervous system.
- **Temperature Regulation:** Regulate body temperature by controlling heat production and heat dissipation mechanisms.
- **Energy Production:** Involved in the conversion of food into energy. They affect the breakdown of carbohydrates, fats, and proteins for energy use.
- **Heart Rate and Blood Pressure:** Influence heart rate and the strength of heart contractions, helping to maintain cardiovascular function.
- **Brain Function:** Play a role in cognitive function, mood regulation, and mental alertness. For example, hypothyroidism (low thyroid hormone levels) can lead to cognitive and emotional changes.

The production and release of thyroid hormones are regulated by the hypothalamus-pituitary complex discussed earlier in this chapter.

Parathyroid Glands

Four small masses of tissue are embedded on the surface of the thyroid gland called **parathyroid glands**.

Parathyroid glands secrete **parathyroid hormone (PTH)**. PTH maintains homeostasis between calcium and phosphorus via a negative feedback loop. Calcium and phosphorus have an inverse relationship, meaning if phosphorus levels rise, calcium levels will drop.

Adrenal Glands

The **adrenal glands** are small glands located on top of each kidney. There are

two parts to the adrenal gland called the adrenal cortex and the adrenal medulla. Each part has distinct functions:

- **Adrenal Cortex:** The adrenal cortex is responsible for producing a group of steroid hormones known as corticosteroids. **Corticosteroids** can be further divided into three categories called mineralocorticoids, glucocorticoids, and androgens.
    - **Mineralocorticoids:** The principal mineralocorticoid is aldosterone. Aldosterone regulates electrolyte and fluid balance in the body by controlling sodium and potassium levels in the blood. It is a key component of the renin-angiotensin-aldosterone system (RAAS) in which specialized cells of the kidneys secrete renin in response to low blood volume or low blood pressure. Renin then catalyzes angiotensinogen to the hormone Angiotensin I. Angiotensin I is converted to Angiotensin II by the angiotensin-converting enzyme (ACE). Angiotensin II stimulates the release of aldosterone. Many cardiac medications target the effects of aldosterone and the RAAS system. For example, ACE inhibitors block the production of Angiotensin II and are used to reduce high blood pressure.
    - **Glucocorticoids:** The principal glucocorticoid is cortisol. **Cortisol** is the most important glucocorticoid because it plays a crucial role in metabolism, immune response, and the body's response to stress. Cortisol helps regulate blood sugar levels, suppress inflammation, and manage the stress response.
    - **Androgens:** These are secreted in minimal amounts in both sexes by the adrenal cortex, but their effect is usually masked by the hormones from the testes and ovaries.
- **Adrenal Medulla:** The adrenal medulla is responsible for producing epinephrine and norepinephrine. These hormones play a central role in the body's "fight or flight" response to stress that is triggered by the sympathetic nervous system. Epinephrine and norepinephrine prepare the body for action by increasing heart rate, dilating airways, and redirecting blood flow to muscles, among other effects.

View a supplementary YouTube video[9] on ACTH and the adrenal gland:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1856#oembed-1

Ovaries and Testes

In females, the ovaries produce ova (eggs), and in males, the testes produce sperm. Ovaries and testes also secrete hormones.

Ovaries secrete estrogen and progesterone[10]:

- At the onset of puberty, **estrogen** promotes the development of breasts and the maturation of the uterus.
- **Progesterone** causes the uterine lining to thicken in preparation for pregnancy.
- Together, progesterone and estrogen are responsible for the changes that occur in the uterus during the female menstrual cycle.

9. Forciea, B. (2015, May 12). *Anatomy and physiology: Endocrine system: ACTH (Adrenocorticotropin hormone) V2.0* [Video]. YouTube. All rights reserved. Video reused with permission. https://youtu.be/4m7XflJzm2w.

10. National Cancer Institute. (n.d.). *Gonads*. https://training.seer.cancer.gov/anatomy/endocrine/glands/gonads.html

Testes secrete **testosterone**. At the onset of puberty, testosterone is responsible for the following actions[11]:

- The growth and development of the male reproductive structures
- Increased skeletal and muscular growth
- Enlargement of the larynx accompanied by voice changes
- Growth and distribution of body hair

Pancreas

The **pancreas** is a long, flat gland that lies behind the stomach. The pancreas serves two roles called exocrine and endocrine. The **exocrine role** refers to the release of digestive enzymes called amylase and lipase that help to digest food. The **endocrine role** refers to the production of glucagon and insulin by clusters of cells called islet cells to regulate blood glucose levels and keep them within a healthy range. See Figure 7.6[12] for an illustration of the pancreas.

11. National Cancer Institute. (n.d.). *Gonads*. https://training.seer.cancer.gov/anatomy/endocrine/glands/gonads.html

12. "1820 The Pancreas.jpg" by OpenStax is licensed under CC BY 3.0

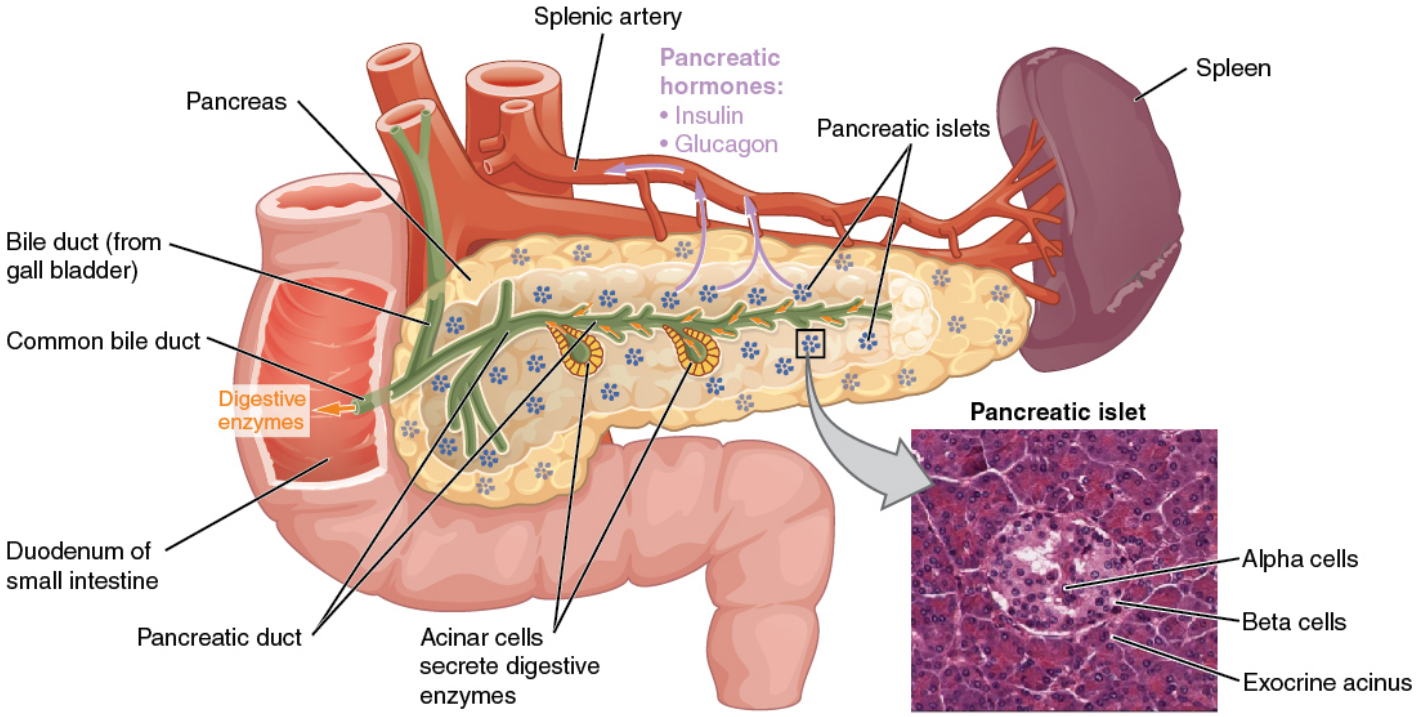


Figure 7.6 Pancreas

The islet cells in the pancreas include alpha, beta, and delta cells:

- **Alpha Cells:** Alpha cells secrete a hormone called glucagon. The primary function of **glucagon** is to increase blood glucose levels. When blood glucose levels drop (such as between meals or during exercise), glucagon is released.
- **Beta Cells:** Beta cells secrete insulin. **Insulin** facilitates the uptake of glucose by cells from the bloodstream, thus reducing blood glucose levels.
- **Delta Cells:** Delta cells secrete somatostatin. **Somatostatin** slows down the secretion of insulin and glucagon when needed to maintain blood glucose homeostasis.

Regulation of Blood Glucose Levels by Insulin and Glucagon

Glucose is the primary fuel for all body cells and the only fuel source for the brain. The digestive system breaks down carbohydrates into glucose, where it

is absorbed into the bloodstream. Glucose is taken up by cells for fuel. Glucose that is not immediately used by cells is stored in the liver and muscles as **glycogen**. It is also converted into triglycerides and stored in adipose (fat) tissue.

Blood glucose levels are maintained by healthy individuals' bodies between 70 mg/dL and 110 mg/dL. Receptors located in the pancreas sense blood glucose levels, and the islet cells secrete glucagon or insulin to maintain normal blood glucose levels. If blood glucose levels rise above this range, insulin is released, which stimulates body cells to take in glucose from the blood. If blood glucose levels drop below this range, glucagon is released, which stimulates cells to release glucose from the stored glycogen into the bloodstream.

GLUCAGON

When blood glucose levels drop between meals or during exercise, the alpha cells secrete glucagon, which increases blood glucose levels by stimulating the following actions:

- Within cells, it inhibits the uptake of glucose.
- It stimulates the liver to convert stored glycogen into glucose and release it into the bloodstream, a process called **glycogenolysis**.
- It stimulates the liver to take up amino acids from the blood and converts them into glucose, a process called **gluconeogenesis**.
- It stimulates the breakdown of stored triglycerides into free fatty acids and glycerol, a process called **lipolysis**. Glycerol travels to the liver, where it is converted into glucose. This is also a form of gluconeogenesis.

INSULIN

The presence of food in the intestine triggers the beta cells in the pancreas to produce and secrete insulin. As blood glucose levels continue to rise as nutrients are absorbed into the bloodstream, insulin continues to be released and stimulates the following actions:

- It stimulates the uptake of glucose by cells by triggering the movement of glucose transporters to the cell membranes, which move glucose into the interior of cells for energy. **Glycolysis** is the first step in the breakdown of glucose to extract energy for cellular metabolism.
- It stimulates the liver to convert excess blood glucose into glycogen for storage. It also inhibits glycogenolysis and gluconeogenesis.
- Excess glucose is synthesized into triglycerides, a process called **lipogenesis**.

The secretion of insulin and glucagon by the pancreas is regulated through a negative feedback loop. As glucose levels decrease in the bloodstream, insulin release is inhibited. Conversely, as glucose levels rise in the bloodstream, glucagon release is inhibited. See Figure 7.7[13] for an illustration of the homeostatic regulation of blood glucose levels.

13. "1822 The Homeostatic Regulation of Blood Glucose Levels.jpg" by OpenStax is licensed under CC BY 3.0

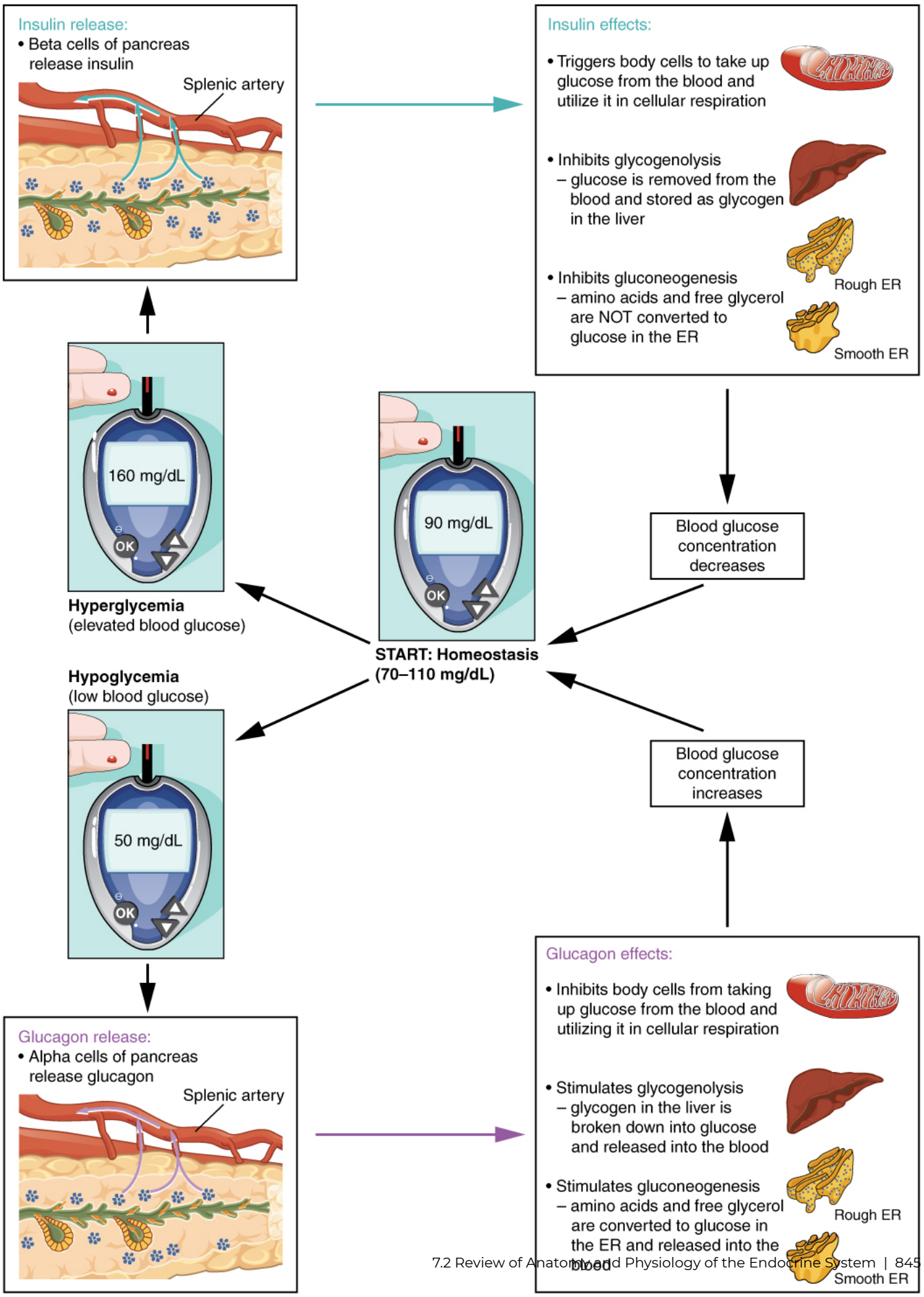

Insulin release:
• Beta cells of pancreas release insulin
Splenic artery
Insulin effects:
• Triggers body cells to take up glucose from the blood and utilize it in cellular respiration
• Inhibits glycogenolysis
– glucose is removed from the blood and stored as glycogen in the liver
• Inhibits gluconeogenesis
– amino acids and free glycerol are NOT converted to glucose in the ER
Rough ER
Smooth ER
160 mg/dL
OK
Hyperglycemia
(elevated blood glucose)
90 mg/dL
OK
START: Homeostasis
(70–110 mg/dL)
Blood glucose concentration decreases
Hypoglycemia
(low blood glucose)
50 mg/dL
OK
Blood glucose concentration increases
Glucagon release:
• Alpha cells of pancreas release glucagon
Splenic artery
Glucagon effects:
• Inhibits body cells from taking up glucose from the blood and utilizing it in cellular respiration
• Stimulates glycogenolysis
– glycogen in the liver is broken down into glucose and released into the blood
• Stimulates gluconeogenesis
– amino acids and free glycerol are converted to glucose in the ER and released into the blood
Rough ER
Smooth ER

Figure 7.7 Homeostatic Regulation of Blood Glucose Levels

7.3 General Endocrine System Assessment

When evaluating a client for possible disorders of the endocrine system, the nurse assesses individual and population risk factors, cultural influences, and socioeconomic factors that may impact health. Client health history, physical examination findings, and diagnostic test results also play an important role in endocrine system assessment.

Risk Factors and Social Determinants of Health Related to the Endocrine System

Understanding the risk factors associated with endocrine system alterations is important for identifying potential endocrine disorders facing many individuals. Risk factors can be diverse and vary depending on the specific endocrine disorder or condition.

Common risk factors for endocrine system alterations include the following:

- **Age:** Many endocrine disorders, such as diabetes and thyroid disorders, are more common in certain age groups.[1] For example, type 1 diabetes is often diagnosed in childhood, while type 2 diabetes is more common in adults. Thyroid disorders are also more prevalent with age.
- **Genetics:** A family history can increase an individual's risk. Many endocrine conditions, such as diabetes, have a genetic component.[2]
- **Autoimmune Conditions:** Autoimmune diseases, where the immune system mistakenly attacks the body's own tissues, can affect the

1. Young, W. F. (2025). *Effects of aging on the endocrine system*. Merck Manual Professional Version. https://www.merckmanuals.com/home/hormonal-and-metabolic-disorders/biology-of-the-endocrine-system/effects-of-aging-on-the-endocrine-system

2. Centers for Disease Control and Prevention. (n.d.). *Diabetes risk factors*. https://www.cdc.gov/diabetes/risk-factors/

endocrine system. Conditions like Hashimoto's thyroiditis and Addison's disease are autoimmune disorders that impact the thyroid and adrenal glands, respectively.[3]

- **Obesity:** Obesity is a significant risk factor for type 2 diabetes. It can also lead to insulin resistance, a condition where the body's cells don't respond effectively to insulin.[4]
- **Environmental Factors:** Exposure to environmental toxins, such as certain chemicals or radiation, can increase the risk of endocrine disorders. For example, exposure to radiation can increase the risk of thyroid cancer.[5]
- **Diet and Lifestyle:** Poor dietary habits and sedentary lifestyles can contribute to endocrine disorders. Unhealthy eating habits and lack of physical activity can lead to conditions like obesity, which is a risk factor for diabetes.[6]
- **Stress:** Chronic stress can disrupt the endocrine system, particularly the hypothalamic-pituitary-adrenal (HPA) loop. This disruption can lead to conditions like adrenal fatigue and alterations in cortisol levels.[7]
- **Medications:** Some medications, such as corticosteroids, can affect the functioning of the endocrine system. Long-term use of these drugs can

3. National Institute of Environmental Health Sciences. (2025). *Autoimmune diseases*. National Institutes of Health. https://www.niehs.nih.gov/health/topics/conditions/autoimmune/index.cfm#:~:text=Introduction,and%20even%20turning%20life%2Dthreatening

4. Centers for Disease Control and Prevention. (n.d.). *Diabetes risk factors*. https://www.cdc.gov/diabetes/risk-factors/

5. United States Environmental Protection Agency. (2023). *Overview of endocrine disruption*. https://www.epa.gov/endocrine-disruption/overview-endocrine-disruption

6. Centers for Disease Control and Prevention. (n.d.). *Diabetes risk factors*. https://www.cdc.gov/diabetes/risk-factors/

lead to conditions like Cushing's syndrome.[8]

- **Pregnancy:** Pregnancy can lead to temporary alterations in the endocrine system, such as gestational diabetes or thyroid dysfunction. Some women may develop permanent endocrine disorders following pregnancy.[9]
- **Underlying Health Conditions:** Some preexisting health conditions, such as polycystic ovary syndrome (PCOS) or pituitary tumors, can affect the endocrine system directly or indirectly.[10]

Cultural Factors

Cultural risk factors refer to aspects of a person's culture or lifestyle that can contribute to an increased risk of endocrine-related health issues. Cultural dietary practices can have a significant impact on endocrine health. For example, high consumption of sugary foods and processed carbohydrates can increase the risk of obesity and type 2 diabetes. In contrast, diets rich in fruits, vegetables, and whole grains can have a protective effect. Some cultures also have dietary restrictions or fasting practices as part of their religious or cultural traditions. These practices can impact blood sugar regulation and management.[11]

7. Endocrine Society. (2022). *Adrenal fatigue*. https://www.endocrine.org/patient-engagement/endocrine-library/adrenal-fatigue

8. Khowaja, A., Alkhaddo, J. B., Rana, Z., & Fish, L. (2018). Glycemic control in hospitalized patients with diabetes receiving corticosteroids using a neutral protamine hagedorn insulin protocol: A randomized clinical trial. *Diabetes Therapy, 9*, 1647–1655. https://doi.org/10.1007/s13300-018-0468-3

9. Centers for Disease Control and Prevention. (n.d.). *Diabetes risk factors*. https://www.cdc.gov/diabetes/risk-factors/

10. Centers for Disease Control and Prevention. (n.d.). *Diabetes risk factors*. https://www.cdc.gov/diabetes/risk-factors/

11. Mora, N., & Golden, S. H. (2017). Understanding cultural influences on dietary

Norms regarding alcohol and substance use can vary significantly across cultural groups. For example, some cultural groups abstain from alcohol and drug use, whereas other cultural groups may commonly use alcohol and other substances. Excessive alcohol consumption and substance use can harm the endocrine system, leading to conditions like liver damage or hormone imbalances. Additionally, some cultures may rely heavily on traditional medicines and healing practices, which is important to consider as the treatment plan is developed.[12] Nurses must consider cultural factors when developing a nursing care plan.

Socioeconomic Factors

Socioeconomic status can affect access to health care, nutrition, and education. Lower socioeconomic status is associated with a higher risk of endocrine-related conditions, such as obesity, diabetes, and cardiovascular diseases. People with lower incomes or inadequate health insurance may delay seeking medical attention, miss regular check-ups, or forgo preventive care. This can result in undiagnosed or poorly managed endocrine disorders. Additionally, many endocrine disorders require lifelong medication management. The cost of medications can be a barrier for those with limited financial resources. Skipping or rationing medication due to cost concerns can lead to poor disease control and complications.[13]

habits in Asian, Middle Eastern, and Latino patients with type 2 diabetes: A review of current literature and future directions. *Current Diabetes Reports, 17*(126). https://doi.org/10.1007/s11892-017-0952-6

12. Mora, N., & Golden, S. H. (2017). Understanding cultural influences on dietary habits in Asian, Middle Eastern, and Latino patients with type 2 diabetes: A review of current literature and future directions. *Current Diabetes Reports, 17*(126). https://doi.org/10.1007/s11892-017-0952-6

13. Kyrou, I., Tsigos, C., Mavrogianni, C., et al. (2020). Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2

Individuals with low-income levels may have limited access to nutritious foods, which can contribute to obesity and diet-related endocrine disorders like type 2 diabetes. Food insecurity can also lead to irregular meal patterns and unhealthy eating habits. Additionally, socioeconomic factors can impact opportunities for physical activity. People in lower-income communities may have limited access to safe recreational spaces, gym facilities, or affordable sports activities. A sedentary lifestyle is also a risk factor for endocrine disorders.[14]

Education levels are closely tied to socioeconomic status. Individuals with lower levels of education may have less health literacy and awareness about endocrine disorders, preventive measures, and effective management of these conditions. Lower health literacy levels can lead to misunderstandings about endocrine alterations and the importance of adherence to treatment plans.[15]

General Assessment of the Endocrine System

A comprehensive evaluation of overall health status is important for identifying potential alterations within the endocrine system. The endocrine system controls many different body functions so signs and symptoms of potential disorders can be seen in many different areas. Endocrine dysfunction can result in improper hormone regulation, which subsequently

diabetes: A narrative review with emphasis on data from Europe. *BMC Endocrine Disorders 20*, 134. https://doi.org/10.1186/s12902-019-0463-3

14. Kyrou, I., Tsigos, C., Mavrogianni, C., et al. (2020). Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2 diabetes: A narrative review with emphasis on data from Europe. *BMC Endocrine Disorders 20*, 134. https://doi.org/10.1186/s12902-019-0463-3

15. Kyrou, I., Tsigos, C., Mavrogianni, C., et al. (2020). Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2 diabetes: A narrative review with emphasis on data from Europe. *BMC Endocrine Disorders 20*, 134. https://doi.org/10.1186/s12902-019-0463-3

can impede growth, metabolism, mood, and other imbalances within the body.

Health History

Several health history factors can significantly impact endocrine function. Examination of current symptoms, family history, medications and allergies, as well as past medical history, including surgeries and radiation therapy, may help identify undiagnosed endocrine disorders.

The health history should begin by assessing current symptoms. Common endocrine symptoms, such as unexplained weight changes; fatigue; mood swings; and changes in appetite, thirst, or urine output, can provide valuable clues to potential endocrine disorders. Additionally, menstrual irregularities and reproductive disorders can indicate endocrine abnormalities. It is important to also note the client's current and past medications, especially those affecting hormones (e.g., steroids, birth control pills), that can influence endocrine function. Finally, exposure to substances that can disrupt normal endocrine function should be examined. Examples of endocrine disruptors include occupational exposure to chemicals or pesticides, fabrics treated with flame retardants, and ingestion of soy-based products containing phytoestrogens.[16]

Physical Assessment

Conducting a thorough examination of each body system provides the nurse with cues regarding potential endocrine disorders. Early identification of abnormal findings and notification of the health care provider can lead to

16. Endocrine Society. (n.d.). *Hormones and endocrine disrupting chemicals: What you need to know* [Handout]. https://www.endocrine.org/-/media/endocrine/files/patient-engagement/hormones-and-series/hormones_and_edcs_what_you_need_to_know.pdf

prompt intervention. Table 7.3 summarizes abnormal findings in each body system that can potentially be related to the endocrine system.

Table 7.3. Abnormal Findings by Body System Potentially Related to the Endocrine System[17,18]

Body System	Endocrine Abnormal Finding
General	Goiter (enlarged thyroid gland), thyroid nodules, increased thirst, fluid retention, or cold or heat intolerance
Cardiovascular	Abnormal heart rate or blood pressure, heart palpitations, fatigue/weakness, or edema
Gastrointestinal	Constipation or diarrhea, increased hunger, or unintended weight loss or weight gain
Reproductive	Irregular menstrual cycles, gynecomastia (enlarged breasts in men), erectile dysfunction, or infertility
Skeletal	Bone density loss, joint pain, or stiffness
Neurological	Nervousness, anxiety, tremors, memory problems or confusion, peripheral neuropathy (nerve damage), sleep disturbances, mood swings, or emotional changes
Integumentary	Change in skin texture or pigmentation or change in hair or nail growth
Genitourinary	Increased urination

Life Span Considerations

Nurses consider characteristics of pediatric clients and older adults when performing an assessment.[19,20]

17. Crafa, A., Condorelli, R. A., Cannarella, R., Aversa, A., Calogero, A. E., & La Vignera, S. (2022). Physical examination for endocrine diseases: Does it still play a role? *Journal of Clinical Medicine, 11*(9), 2598. https://doi.org/10.3390/jcm11092598

18. National Institute of Diabetes and Digestive and Kidney Diseases. (n.d.). *Endocrine diseases*. National Institutes of Health. https://www.niddk.nih.gov/health-information/endocrine-diseases

19. Flint, B. & Tadi, P. (2023). *Physiology, Aging*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK556106/

20. Queensland Pediatric Emergency Care. (2022). *How children are different – Anatomical and physiological differences*.

PEDIATRIC CONSIDERATIONS

- Pediatric clients are at higher risk for some endocrine disorders, such as congenital hypothyroidism, congenital adrenal hyperplasia, growth disorders, and type 1 diabetes mellitus.
- Dynamic changes occur during pediatric growth and development. Growth hormone, insulin-like growth factor 1, and thyroid hormones are vital during childhood and adolescence.
- Sex hormones (gonadotropins, estrogen, testosterone) are integral during adolescence to develop secondary sexual characteristics.
- During infancy and adolescence, growth hormone secretion supports rapid growth with responsive hormone fluctuation.
- Childhood obesity challenges insulin and glucose regulation, which can result in type 2 diabetes mellitus.
- Neonates, infants, and children have increased glucose requirements with poor glycogen stores and can rapidly develop hypoglycemia and muscle fatigue.

OLDER ADULT CONSIDERATIONS

- Hypothyroidism should be considered when older adults present with lethargy, slow thought processes, and lack of enthusiasm, and not simply attributed to dementia.
- The development of diabetes mellitus is more likely in older adults due to alterations in glucose metabolism and insulin secretion.
- Older adults are prone to hypoglycemia and are likely to experience dramatic symptoms of hypoglycemia.
- “Tight” glycemic control may not be an appropriate goal for older adults because severe hypoglycemia may precipitate myocardial infarction, angina, stroke or seizures.
- Physical limitations may impact exercising by older adults with diabetes mellitus. Nurses should stress safe alternatives like walking, swimming, or

https://www.childrens.health.qld.gov.au/__data/assets/pdf_file/0031/179725/how-children-are-different-anatomical-and-physiological-differences.pdf

stationary bicycle riding to assist with blood sugar control.
- Overall metabolic activity decreases in older adults due to decline in thyroxin and triiodothyronine secretion.
- Older women experience menopause, along with an increased risk of cardiovascular disease, loss of bone mass, and atrophy of estrogen-responsive tissue.

Laboratory and Diagnostic Testing

The aim of diagnostic testing is to identify abnormalities or dysfunction related to endocrine gland functioning and the release of hormones. Health care providers order diagnostic tests based on signs and symptoms exhibited that reflect potential endocrine disorders.

LABORATORY STUDIES

One of the most definitive signs of an endocrine dysfunction is an abnormal hormone level in blood tests. Read more about specific hormone blood tests under each endocrine system alteration discussed later in this chapter.

IMAGING STUDIES

Imaging studies such as an ultrasound, CT scan, MRI, and nuclear medicine scan may be used to visualize the endocrine glands and identify structural abnormalities or tumors.

7.4 Endocrine Disorders

Disorders in endocrine gland function can result in alterations to metabolism, growth, stress response, moods, blood sugar regulation, fluid balance, immune system response, bone health, and reproductive function. Three major endocrine glands are the pancreas, thyroid, and adrenal glands. Endocrine alterations discussed in this chapter include diabetes mellitus, hyperthyroidism, hypothyroidism, Cushing's disease and syndrome, and Addison's disease.

7.5 Diabetes Mellitus

Diabetes mellitus (DM) is a chronic medical condition marked by persistently elevated blood glucose levels, a condition called **hyperglycemia**. This occurs as a result of the body's inability to properly regulate blood glucose due to issues with insulin secretion by the pancreas, cellular insulin resistance, or both.

Pathophysiology

The pathophysiology of diabetes mellitus is related to dysfunction of the islet cells of the pancreas. As previously discussed in the "Review of Anatomy and Physiology of the Endocrine System" section, the islet cells regulate the secretion of insulin and glucagon to balance blood glucose levels.

During **type 1 diabetes**, the immune system mistakenly attacks and destroys beta islet cells, leading to an absolute deficiency of insulin. During **type 2 diabetes**, the body's cells become resistant to the effects of insulin and/or the pancreas does not produce sufficient insulin to meet the body's needs. **Gestational diabetes** occurs during pregnancy and typically resolves after the baby is born. However, gestational diabetes increases the mother's risk of developing type 2 diabetes later in life. **Latent autoimmune diabetes in adults (LADA)** is a type of diabetes that starts in adulthood and slowly gets worse over time. Like type 1 diabetes, LADA occurs when the pancreas stops making insulin because an autoimmune process is damaging islet cells in the pancreas. However, unlike type 1 diabetes, in LADA the process happens slowly so people often don't need to take insulin right away.[1]

The development of type 1 DM is influenced by genetics, autoimmune factors, and/or viral infections. Autoimmune factors and viral infections can

1. Mayo Clinic. (2023). *Latent autoimmune diabetes in adults – What is it?* https://www.mayoclinic.org/diseases-conditions/type-1-diabetes/expert-answers/lada-diabetes/faq-20057880

destroy the islet cells of the pancreas, rendering them incapable of producing insulin.

The development of DM type 2 is influenced by a combination of genetic, lifestyle, and environmental factors. Risk often increases as individuals age, with greater onset occurring after age 45. Family history, obesity, metabolic syndrome, and lifestyle factors such as lack of physical activity increase risk for the development of DM type 2. **Metabolic syndrome** is a group of conditions that increase the risk of coronary heart disease, diabetes, and stroke. The conditions include elevated blood pressure, blood glucose, and triglyceride levels, as well as increased waist circumference.[2] Women who experienced gestational diabetes during pregnancy are also at greater risk for developing DM type 2. Additionally, certain ethnic groups, including African Americans, Hispanics, Native Americans, and Pacific Islanders, also have increased genetic risk for developing DM type 2.[3]

> See a free risk test for type 2 diabetes from the American Diabetes Association: 60-Second Type 2 Diabetes Risk Test.

Potential Long-Term Complications

In all types of diabetes, insulin does not effectively facilitate the uptake of glucose by the body's cells. Elevated blood sugar levels damage blood vessels

2. National Heart, Lung, and Blood Institute. (2022). *What Is metabolic syndrome?* National Institutes of Health. https://www.nhlbi.nih.gov/health/metabolic-syndrome

3. Robertson, R. P. (2023). Type 2 diabetes mellitus: Prevalence and risk factors. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

and nerves and can lead to long-term, serious complications. Examples of complications related to DM include the following[4]:

- **Cardiovascular Disease:** Damage to blood vessels due elevated blood sugar can result in arteriosclerosis, atherosclerosis, coronary artery disease, and heart attacks.
- **Hypertension:** DM damages the lumen of blood vessels and can lead to rigidity and development or exacerbation of high blood pressure, which further increases the risk of heart disease.
- **Kidney Failure:** DM is a leading cause of kidney disease, referred to as **diabetic nephropathy**. Over time, DM can cause kidney failure, which may necessitate renal dialysis or kidney transplantation.
- **Blindness:** Damage to the blood vessels in the eyes causes diabetic retinopathy and reduced vision. If left untreated, vision impairment and eventually blindness can occur.
- **Stroke:** DM increases the risk of stroke due to its impact on cerebral blood vessels, making them susceptible to clot formation or rupture, which can result in a stroke.
- **Neuropathy:** DM causes nerve damage, often affecting the legs and feet. Symptoms include pain, tingling, and numbness called **paresthesia**.
- **Peripheral Vascular Disease:** DM may cause circulatory problems in the lower extremities, which can result in foot ulcerations and nonhealing foot wounds that can result in amputation.
- **Infection and Sepsis:** DM increases the risk of severe infection that can cause early death.

Acute Complications: Hypoglycemia and Hyperglycemia

Clients with diabetes mellitus can develop acute complications called

4. Inzucchi, S. E., & Lupsa, B. (2022). Glycemic control and vascular complications in type 2 diabetes mellitus. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

hypoglycemia (low blood glucose levels) and extreme hyperglycemia (high blood glucose levels).

Hypoglycemia

Hypoglycemia is defined as blood glucose levels below 70 mg/dL. Hypoglycemia is a common side effect of medications used to lower blood sugar, especially insulin or oral medications that affect the release of insulin (e.g., sulfonylureas and biguanides). Common causes of hypoglycemia in clients taking diabetic medications include the following[5]:

- Too much insulin administered or too high of dose of oral medication
- Excessive physical activity
- Mismatch of medication administration and meal administration or delayed or missed meals
- Excessive alcohol consumption

Initial signs and symptoms of hypoglycemia include confusion, hunger, shakiness or tremors, sweating, tachycardia, anxiety and irritability, weakness or fatigue, dizziness or lightheadedness, and blurred vision. A low blood glucose level triggers the release of epinephrine (the "fight or flight" hormone) that causes symptoms such as tachycardia, sweating, tingling, and anxiety. Left untreated, hypoglycemia can cause serious neurological effects, such as loss of consciousness, seizures, coma, and death due to lack of glucose delivery to brain cells.[6]

Hypoglycemia may be difficult to recognize in the elderly and in people who are taking beta-adrenergic blocking drugs.

5. American Diabetes Association. (n.d.). *Hypoglycemia (low blood glucose).* https://diabetes.org/living-with-diabetes/treatment-care/hypoglycemia

6. American Diabetes Association. (n.d.). *Hypoglycemia (low blood glucose).* https://diabetes.org/living-with-diabetes/treatment-care/hypoglycemia

Nurses must monitor clients diagnosed with diabetes mellitus very closely for signs and symptoms of hypoglycemia and provide rapid treatment. A general rule used by the American Diabetes Association is the **15-15 Rule**, which suggests consuming or administering 15 grams of a carbohydrate, followed by a 15-minute wait and then remeasurement of blood glucose level to assess if blood glucose has returned to normal levels. These steps are repeated until blood glucose is at least 70 mg/dL.[7] Most agencies have a "Hypoglycemia Protocol" for immediate treatment without the need to first notify the provider. See the following box for an example of a hypoglycemia protocol, but always follow agency policy.

Sample Hypoglycemia Protocol[8,9]

Mild Hypoglycemia (Blood glucose less than 70 mg/dL but greater than 40 mg/dL):

- Provide 10-15 grams of a simple, fasting-acting carbohydrate to immediately raise blood glucose levels, such as:

7. American Diabetes Association. (n.d.). *Hypoglycemia (low blood glucose).* https://diabetes.org/living-with-diabetes/treatment-care/hypoglycemia

8. Mathew, P., & Thoppil, D. (2022). *Hypoglycemia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534841/

9. American Diabetes Association. (n.d.). *Hypoglycemia*. https://diabetes.org/living-with-diabetes/treatment-care/hypoglycemia#:~:text=Treatment%E2%80%94The%20%2215%2D15,at%20least%2070%20mg%2FdL

    - ½ cup of fruit juice
    - ½ cup of regular soft drink
    - 8 oz. of skim milk
    - 3 graham crackers

- If food is not available or appropriate to administer to the client, some agency protocols advise administering a glucose tablet or gel.
- After administering 10-15 grams of carbohydrate, recheck the bedside glucose level in 15 minutes to ensure it has risen.
- A meal tray or complex carbohydrates may be provided if appropriate and the client is able to swallow.
- If symptoms persist and the blood glucose level remains below 70 mg/dL, repeat administration of 10-15 grams of carbohydrate and recheck the bedside blood glucose level every 15 minutes until it is above 70 mg/dL.
- Notify the provider of the hypoglycemic event.

Moderate Hypoglycemia (Blood glucose less than 40 mg/dL but greater than 20 mg/dL):

- Moderate hypoglycemia may manifest with symptoms like cold, clammy skin, rapid pulse, and drowsiness.
- Administer 15-30 grams of carbohydrates, if the client is able to safely swallow.
- A meal tray or complex carbohydrates may be provided if appropriate and the client is able to swallow.
- Encourage ingestion of additional food items with protein, such as low-fat milk or cheese, 10-15 minutes after the carbohydrate ingestion.
- Recheck the bedside glucose level in 15 minutes after

carbohydrate administration.

- If symptoms persist and the blood glucose level remains below 70 mg/dL, repeat administration of 10-15 grams of carbohydrate and recheck the bedside blood glucose every 15 minutes until it is above 70 mg/dL.
- Notify the provider of the hypoglycemic event.

Severe Hypoglycemia (Blood glucose less than 20 mg/dL):

- Severe hypoglycemia can be life-threatening and is characterized by the inability to swallow, unconsciousness, or convulsions. It is imperative to call for emergency assistance according to agency protocol.
- Administer glucagon nasal spray, glucagon injection, or D50 IV push per agency protocol.
- If the person remains unconscious after ten minutes, administer a second dose.
- Notify the individual's health care provider and follow their instructions.
- If the person remains unconscious, transport them to the Emergency Department (ED) for further evaluation.
- After the person regains consciousness and is no longer nauseated, offer a small meal to stabilize blood sugar levels.

Hyperglycemia

Hyperglycemia occurs when a fasting blood glucose level is above 126 mg/dL, and severe hyperglycemia is generally defined as greater than 250 mg/dL. Hyperglycemia can cause acute complications called diabetic ketoacidosis (DKA) or hyperosmolar hyperglycemic state (HHS):

- **Diabetic Ketoacidosis (DKA)** occurs during severe hyperglycemia

episodes if the client's pancreas is no longer producing insulin. It most commonly occurs in clients with type 1 DM, but it can also occur in clients with type 2 diabetes if their pancreas is no longer producing insulin. Because of the lack of insulin available to transport glucose into cells, the body breaks down fatty acids for energy, and ketones are created. Ketones cause metabolic acidosis, which can be a life-threatening condition. DKA is often triggered by a combination of factors, including uncontrolled high blood sugar and increased stress on the body, such as infection or trauma. In some cases, individuals are not aware they have type 1 DM until they are hospitalized with DKA and the diagnosis of diabetes mellitus is established. DKA is also associated with elevated potassium levels that can cause life-threatening cardiac arrhythmias. DKA is typically treated with insulin drips, IV fluids, and medications to restore normal electrolyte and pH balance.

- **Hyperosmolar Hyperglycemic State (HHS)** is an extremely severe hyperglycemia that occurs in individuals with type 2 DM. Because the pancreas of an individual with DM type 2 is still producing some insulin that moves glucose into cells, fatty acids are not broken down into ketones, so DKA does not occur. However, the blood glucose level becomes so abnormally elevated that severe cellular dehydration occurs, resulting in life-threatening hypotension and elevated serum sodium levels. HHS is typically triggered by prolonged periods of extremely high blood sugar, often due to illness, infection, or inadequate management of DM. HHS is treated with IV fluids, insulin drips, and medications to restore electrolyte balance.[10,11] See Table 7.5a comparing the signs and symptoms of hypoglycemia and hyperglycemia.

10. Hughes, E. K., Brady, M. F., & Rawla, P. (2023). *Acanthosis Nigricans*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK431057/

11. Robertson, R. P. (2023). Type 2 diabetes mellitus: Prevalence and risk factors. *UpToDate*. https://www.wolterskluwer.com/en/solutions/uptodate

Table 7.5a. Signs and Symptoms DKA and HHS[12,13]

Condition	Signs and Symptoms
Diabetic Ketoacidosis (DKA)	Elevated blood glucose levels greater than 250 with glucose and ketones in the urine, excessive thirst, frequent urination, abdominal pain, nausea and vomiting, deep and labored breathing (Kussmaul respirations), confusion and altered mental status, fruity breath odor, and hyperkalemia.
Hyperosmolar Hyperglycemic State (HHS)	Elevated blood sugar levels, extreme dehydration with elevated serum sodium levels, excessive thirst, altered mental status, confusion and weakness, and coma.

Assessment

Clinical manifestations of diabetes mellitus are related to chronically elevated blood sugar levels, resulting in damage to blood vessels, nerves, and tissues. See Table 7.5b for a summary of potential assessment findings across body systems and organs for clients with diabetes mellitus.

Table 7.5b. Clinical Manifestations of Diabetes Mellitus and Potential Complications[14,15]

12. Gosmanov, A. R., Gosmanova, E. O., & Kitabchi, A. E. (2021). *Hyperglycemic Crises: Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar State*. Endotext [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK279052/

13. Centers for Disease Control and Prevention. (2022). *Low blood sugar*. https://www.cdc.gov/diabetes/basics/low-blood-sugar.html

14. Hughes, E. K., Brady, M. F., & Rawla, P. (2023). *Acanthosis Nigricans.* StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK431057/

15. Robertson, R. P. (2023). Type 2 diabetes mellitus: Prevalence and risk factors. *UpToDate*. www.uptodate.com

Body System or Organ	Clinical Manifestations
Cardiovascular	Hypertension (high blood pressure), elevated cholesterol and triglycerides levels, and increased risk of heart disease and stroke
Nervous	Neuropathy (nerve damage) and paresthesia
Eyes	Diabetic retinopathy, vision changes, and potential blindness
Kidneys	Diabetic nephropathy (kidney damage), proteinuria (excess protein in urine), and renal failure
Gastrointestinal/ Genitourinary	**Polydipsia** (excessive thirst), **polyphagia** (excessive hunger), **polyuria** (excessive urination), **gastroparesis** (delayed stomach emptying), nausea, and vomiting
Skin	**Acanthosis nigricans** (hyperpigmentation of the skin often found in the axilla, groin, and folds of the neck), **sudomotor neuropathy** (absence of sweating in the extremities that causes dry skin and can lead to foot ulcerations), slow wound healing, and skin infections
Musculoskeletal	Diabetic **myopathy** (muscle weakness) and **charcot joint** (joint damage)
Reproductive	Polycystic ovary syndrome (PCOS) in women and erectile dysfunction in men
Respiratory	Increased risk of obstructive sleep apnea
Immune	Increased susceptibility to infections and slower healing

Diagnostic Testing

Diagnostic testing related to DM includes several tests to identify the presence of elevated blood glucose or glucose in the urine. The most common tests used to diagnose type 2 DM are fasting blood glucose, hemoglobin A1C, and glucose tolerance test. See Figure 7.8[16] for an infographic from the Centers for Disease Control and Prevention comparing lab results for normal, prediabetes, and type 2 diabetes.

16. "CDC_Diabetes_Social_Ad_Concept_A2_Facebook" by unknown author for Centers for Disease Control and Prevention is licensed in the Public Domain. Access for free at https://www.cdc.gov/diabetes/basics/getting-tested.html.

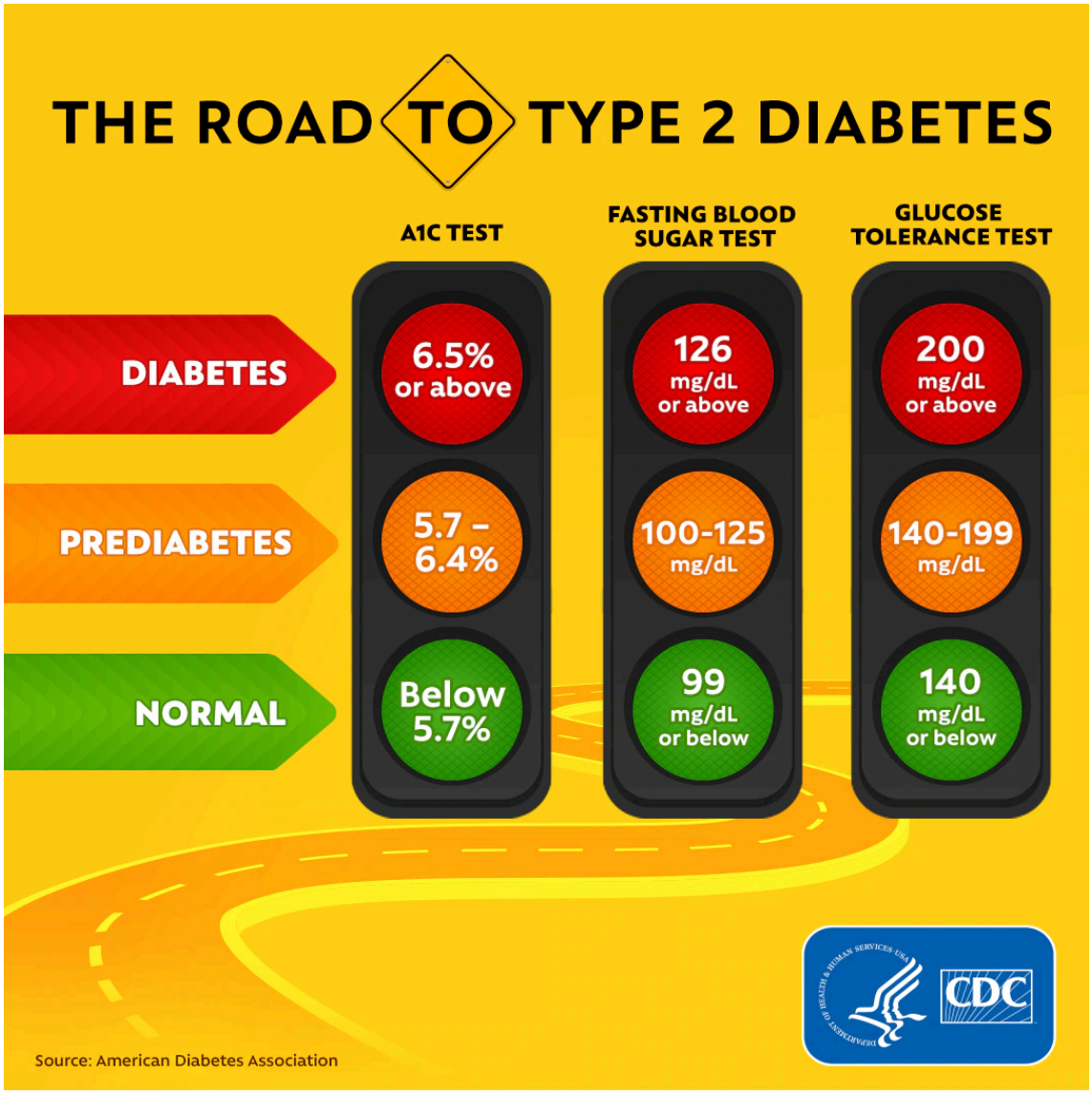


Figure 7.8 Normal, Prediabetes, and Type 2 Diabetes

Common diagnostic tests for DM include the following[17,18]:

17. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/basics/getting-tested.html

18. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

- **Fasting blood glucose (FBG):** FBG assesses an individual's blood glucose level when they have had no caloric intake for at least eight hours (although water intake is permitted). The blood sample must be collected before food, insulin, or oral antidiabetic agents have been administered. Normal fasting blood glucose range is between 70-100 mg/dL. Diabetes mellitus is diagnosed when fasting blood glucose levels consistently measure 126 mg/dL or higher on two separate tests. **Impaired fasting glucose** is identified in levels that range between 100 to 125 milligrams per deciliter (mg/dL), which means blood glucose levels are elevated, but not high enough to be classified as diabetes.[19,20]
- **Random blood glucose:** Random blood glucose measures the level of glucose in the blood at any given time, without the requirement for fasting. This test is often used for quick assessments of blood sugar levels, especially during emergency or urgent care settings. The normal range for random plasma glucose levels is typically less than 140 mg/dL.[21,22] Random blood sugar greater than 200 mg/dL can be a sign of diabetes mellitus.
- **Hemoglobin A1C (HbA1C):** Hemoglobin A1C assesses an individual's

19. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/l

20. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

21. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/

22. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

average blood glucose levels over the preceding two to three months. HbA1C is a form of hemoglobin, a protein found in red blood cells. When glucose is in the bloodstream, it attaches to hemoglobin, forming glycated hemoglobin. The percentage of hemoglobin that is glycated is directly proportional to the average blood glucose levels during the red blood cells' life spans, which is approximately 120 days. The normal range for HbA1C is typically less than 5.7%. An HbA1C level between 5.7% and 6.4% (or 39-47 mmol/mol) is indicative of prediabetes, which means that blood glucose levels are higher than normal but not yet in the diabetic range. An HbA1C level of 6.5% (or 48 mmol/mol) or higher is diagnostic of diabetes mellitus.[23,24]

- **Oral glucose tolerance tests (GTT):** GTT evaluates the body's ability to regulate blood glucose levels, especially after consuming a high dose of glucose. The results are typically reported as blood glucose levels measured at different time points (such as fasting, 1 hour post-glucose consumption, and 2 hours post-glucose consumption). These are the normal results by time frame:
  - Fasting blood glucose (FBG): Less than 100 mg/dL
  - 1-hour post-glucose load: Less than 200 mg/dL
  - 2-hour post-glucose load: Less than 140 mg/dL

23. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/

24. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

Elevated blood glucose levels at any of these time points may indicate impaired glucose tolerance and diabetes mellitus.[25,26]

A Closer Look at GTT[27,28]

Preparation: Before the test, the individual is required to fast overnight (usually for at least eight hours) to ensure a stable baseline blood glucose level. During this fasting period, the person should avoid eating or drinking anything except for water.

Initial Blood Sample: A baseline fasting blood sample is collected to measure the individual's fasting blood glucose level.

Glucose Solution: After the fasting sample is taken, the person is given a glucose solution to drink. This solution contains a

25. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/

26. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

27. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/

28. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

standardized amount of glucose (usually 75 grams), which is typically dissolved in water.

Blood Samples: Blood samples are collected at specified intervals after the glucose solution is consumed. The most common time points for these samples are at one hour and two hours after drinking the glucose solution. In some cases, a sample may also be taken at three hours.

- **C-peptide:** C-peptide is generally found in amounts in the blood equal to the amount of insulin because insulin and C-peptide are linked when they are first produced by the pancreas. Therefore, the level of C-peptide is an indirect measure of the amount of insulin being produced by the pancreas. A C-peptide test may be ordered when diabetes mellitus has been initially diagnosed to determine if type 1 or type 2 diabetes mellitus (DM) is present. Type 1 DM is diagnosed when the pancreas does not make any insulin, so the level of C-peptide is also low. In type 2 DM, the pancreas continues to produce insulin, so C-peptide levels are normal or high. Fasting C-peptide levels are typically around 0.5 to 2.0 ng/mL.[29,30]
- **Urine Tests for Ketones or Glucose**
  - **Ketones:** Ketones are metabolic byproducts of fatty acid metabolism, typically produced in the liver. In healthy individuals, ketones are efficiently metabolized, and only minimal amounts appear in the urine. However, under specific circumstances in clients with DM type

29. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/

30. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

1, such as lack of food intake when ill or the development of DKA, elevated ketone levels in the urine indicate the body is using fat as the major source of energy. Ketones may be monitored using urine ketone strips for clients with blood glucose levels over 240 mg/dL to watch for DKA and determine the need for prompt follow-up.
- **Glucose:** Normally, there is very little or no glucose in urine. When blood glucose levels are very high in the blood, such as in uncontrolled diabetes, the glucose spills over into the urine. Glucose can also be found in urine when the kidneys are damaged or diseased. In the first part of the renal tubule, called the proximal tubule, glucose is reabsorbed from the filtrate into the bloodstream. The proximal tubule can only reabsorb a limited amount of glucose. Therefore, if the blood glucose level exceeds about 160 – 180 mg/dL, the proximal tubule becomes overwhelmed and begins to excrete glucose in the urine.[31,32]

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing priorities for clients with diabetes mellitus revolve around managing blood glucose levels, preventing complications, providing health teaching, and promoting self-management of this chronic disease at home.

Nursing diagnoses for clients with diabetes are crafted based on a thorough assessment of the client's condition, medical history, and their unique

31. Centers for Disease Control & Prevention. (2023). *Diabetes tests*. https://www.cdc.gov/diabetes/diabetes-testing/

32. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Diabetes tests and diagnosis*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/tests-diagnosis

requirements. Common nursing diagnoses related to DM are the following[33]:

- Readiness for Enhanced Knowledge
- Imbalanced Nutrition
- Impaired Skin Integrity
- Ineffective Coping
- Ineffective Health Maintenance
- Risk for Infection

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with DM include the following:

- *The client will achieve and maintain stable blood glucose levels within the target range*.
- *The client will demonstrate understanding of diabetes self-management strategies following the health teaching sessions, including accurate monitoring of blood glucose levels and administration of medications*.
- *The client will achieve and maintain healthy weight*.
- *The client will demonstrate healthy skin integrity with no skin ulcers*.

Interventions

Medical Interventions

Medical interventions for DM are designed to help individuals manage their blood glucose levels within a target range, prevent the development of

33. Goyal, R., Singhal, M., Jialal, I., et al. (2023). *Type 2 Diabetes (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568737/

complications, and improve their overall health and well-being. Specific interventions can vary based on the type of diabetes, the individual's needs, and the health care provider's recommendations. Medical interventions typically include medication therapy, blood glucose monitoring, dietary counseling, and weight management.

MEDICATION THERAPY

Medication therapy may include oral antidiabetic medications, insulin, or other injectable medication.

Non-Insulin Antidiabetic Medications

Non-insulin antidiabetic medications are prescribed for clients with type 2 DM. They may be used alone or in combination with insulin. See Table 7.5c for an overview of common non-insulin antidiabetic medications, their mechanisms of action, and nursing considerations.

Table 7.5c. Non-Insulin Antidiabetic Medications

Medication	Examples	Mechanism of Action	Nursing Considerations
Biguanides	Metformin	Decrease the amount of glucose produced by the liver and increase the sensitivity of muscle cells to insulin. It also slows the absorption of glucose from the digestive tract.	Administer with meals to and renal function tests discontinued in clients u of risk of acute renal func and chills. Low blood pre
Sulfonylureas	Glipizide, glyburide, and glimepiride	Stimulate the pancreas to release more insulin when there is still some insulin production by the pancreas.	Should be administered liver function tests, and v reaction.[36,37]
Dipeptidyl peptidase-4 (DPP-4) inhibitors	Sitagliptin and saxagliptin	Block the DPP-4 enzyme that inactivates incretin hormones, thus increasing the level of incretin. Incretins stimulate the release of insulin and reduce the production of glucagon.[38]	Monitor for hypoglycemi filtration rate. Report hyp severe arthralgia, and up
GLP-1 receptor agonists	Dulaglutide, exenatide, and liraglutide	Mimic the action of GLP-1, a naturally occurring hormone in the body that regulates blood sugar levels. GLP-1 is released from the intestines in response to food intake and stimulates the release of insulin from the pancreas, suppresses the release of glucagon, and promotes feelings of fullness, which can lead to reduced food intake.[39]	Injected subcutaneously side effects of nausea an each week. Contraindicated for clien
Alpha-glucosidase inhibitors	Acarbose	Block gastrointestinal alpha-glucosidase enzymes in the gastrointestinal system that digest the starch, thus inhibiting the metabolism of sucrose to glucose.[41,42]	Monitor serum creatinin
Thiazolidinediones	Pioglitazone	Increase cellular insulin sensitivity and cellular uptake of glucose.[45,46]	Monitor for signs of hear periodic ophthalmologic
Sodium-glucose co-transporter 2 SLT-2 inhibitors	Canagliflozin	Act on the kidneys to reduce the reabsorption of glucose and promote urinary glucose excretion.[49]	Monitor renal function a

34. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

35. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

36. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

37. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

38. American Diabetes Association. (n.d.). *What are my options for type 2 diabetes medications?* https://diabetes.org/health-wellness/medication/oral-other-injectable-diabetes-medications

39. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Insulin, medicines, & other diabetes treatment.* National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/insulin-medicines-treatments

40. Collins, L., & Costello, R. A. (2024). *Glucagon-Like Peptide-1 Receptor Agonists*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK551568/

41. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

Insulin Therapy

Insulin therapy is used for individuals with type 1 DM and in some cases of type 2 DM when insufficient insulin is being produced by the pancreas or tight glycemic control is warranted in the hospital. The primary purpose of insulin therapy is to regulate and normalize blood glucose levels by supplementing or replacing the body's natural insulin production.[52,53] Client

42. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

43. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

44. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

45. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

46. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

47. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e.* Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

48. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

49. Padda, I. S., Mahtani, A. U., & Parmar, M. (2023). *Sodium-Glucose Transport Protein 2 (SGLT2) Inhibitors*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK576405/

50. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

51. Ganesan, K., Rana, M. B. M., & Sultan, S. (2023). *Oral Hypoglycemic Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482386/

52. American Diabetes Association. (n.d.). *What are my options for type 2 diabetes medications?* https://diabetes.org/health-wellness/medication/oral-other-injectable-diabetes-medications

53. National Institute of Diabetes and Digestive and Kidney Diseases. (2022, March). *Insulin, medicines, & other diabetes treatment*. National Institutes of

goals are to maintain their serum blood glucose in normal range and achieve their individualized target level of A1C (often 7%). See Figure 7.9[54] for an image of an insulin vial and the orange-capped syringe specifically used to administer insulin.



Figure 7.9 Insulin Vial and Insulin Syringes

Health. https://www.niddk.nih.gov/health-information/diabetes/overview/insulin-medicines-treatments

54. "4973474372_691d2b2391_h.jpg" by Brian J. Matis is licensed under CC BY-NC-SA 2.0

There are many different types of insulin with different times of onset, peak, and duration. Table 7.5d summarizes insulin classes as well as glucagon.[55,56]

Table 7.5d. Insulins and Glucagon Medication Grid

55. Ernstmeyer, K., & Christman, E. (Eds.). (2023). Nursing pharmacology – 2e. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

56. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Insulin, medicines, & other diabetes treatment*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diabetes/overview/insulin-medicines-treatments

Class	Generic/Brand Name	Onset/Peak/Duration	Nursing Considerations
Rapid-Acting Insulin	Insulin lispro (Humalog) Insulin aspart (Novolog)	Onset: 15-30 minutes Peak effect: 1-3 hours Duration: 3-5 hours	Commonly prescribed to cover mealtime spikes in blood sugar levels. Administer within 15 minutes before a meal or immediately after a meal. Afrezza, an inhaled insulin, is contraindicated in clients with asthma or COPD.
Short-Acting Insulin	Regular insulin (Humulin R or Novolin R)	Onset: 30 minutes Peak effect: 3 hours Duration: 8 hours	Commonly prescribed to control blood sugar between meals and at night. Administer 30 minutes before a meal.
Intermediate-Acting Insulin	Isophane insulin or NPH (Humulin N or Novolin N)	Onset: 1-2 hours Peak effect: 6 hours (range 2.8-13 hours) Duration: Up to 24 hours	Commonly prescribed in combination with other insulins to provide basal insulin coverage. Administer once or twice daily. Gently roll or invert vial/pen several times to resuspend the insulin before administration.
Combination: Intermediate-Acting/ Rapid-Acting	Humalog Mix 50/50 Humalog Mix 75/25 Novolog Mix 70/30 *The first number is % of intermediate-acting insulin; second number is % of rapid-acting insulin	Onset: 15-30 minutes Peak effect of Humalog 50/50: 1-5 hours Duration: 11-22 hours	Administer twice daily, 15 minutes before a meal or immediately after a meal. Only administer subcutaneously. Gently roll or invert vial/pen several times to resuspend the insulin before administration.
Combination: Intermediate-Acting/ Short-Acting	Humulin Mix 70/30 Novolin Mix 70/30 *The first number is % of intermediate-acting insulin; second number is % of short-acting insulin	Onset: 30-90 minutes Peak effect: 1.5-6.5 hours Duration: 18-24 hours	Administer twice daily, 30-45 minutes before a meal. Only administer subcutaneously. Gently roll or invert vial/pen several times to resuspend the insulin before administration. Do not mix with other insulin.
Long-Acting Insulin	Glargine (Lantus) Detemir (Levemir)	Onset: 3-4 hours Peak effect: None Duration: >24 hours	Prescribed to provide consistent blood glucose levels with less variability throughout the day. Administer once daily (sometimes dose is split and administered twice daily). Only administer subcutaneously. Do not mix with other insulin.
Anti-Hypoglycemic	Glucagon	May be administered subcutaneously, IM, or IV Supplementary carbohydrate should be given as soon as possible, especially to a pediatric client	Used to reverse hypoglycemic episode if NPO administration is not appropriate

Many types of insulins are available in prefilled pens with a dial to select the

number of units to be administered. These pens are helpful for clients in self-administration of insulin. See Figure 7.10[57] for an image of a prefilled syringe.



Figure 7.10 Prefilled Insulin Syringe

Insulin pumps are small, programmable devices that deliver a continuous supply of insulin into the body, mimicking the function of a healthy pancreas. Bolus doses of insulin can also be self-administered to cover meals or correct high blood sugar levels.

The pump's settings are programmable, allowing users to customize basal rates, insulin-to-carbohydrate ratios, and correction factors to match variations in daily activities, diet, and metabolism for clients. The pump contains a reservoir filled with rapid-acting insulin, which is connected to the body via small, flexible tubing. There are also patch pumps without tubing. The insulin is delivered subcutaneously, typically in the fatty tissue beneath the skin. Insulin pumps and patch pumps are often integrated with continuous glucose monitoring sensors that allow real-time monitoring of blood glucose levels with automated adjustments to insulin delivery, enhancing overall blood sugar control. Insulin pumps can contribute to better blood sugar management by reducing the risk of hypoglycemia (low blood sugar) and offering more precise control over insulin dosage. The pump offers greater flexibility in terms of lifestyle and meal timing, as users can adjust insulin delivery based on their daily routines. This can lead to a more

57. "Human_insulin_100_IU-1ml_pen_yellow_background_%2802%29.jpg" by Wesalius is licensed under CC BY 4.0

convenient and adaptable approach. See Figure 7.11[58] for an image of an individual with an insulin pump and continuous glucose monitoring system.

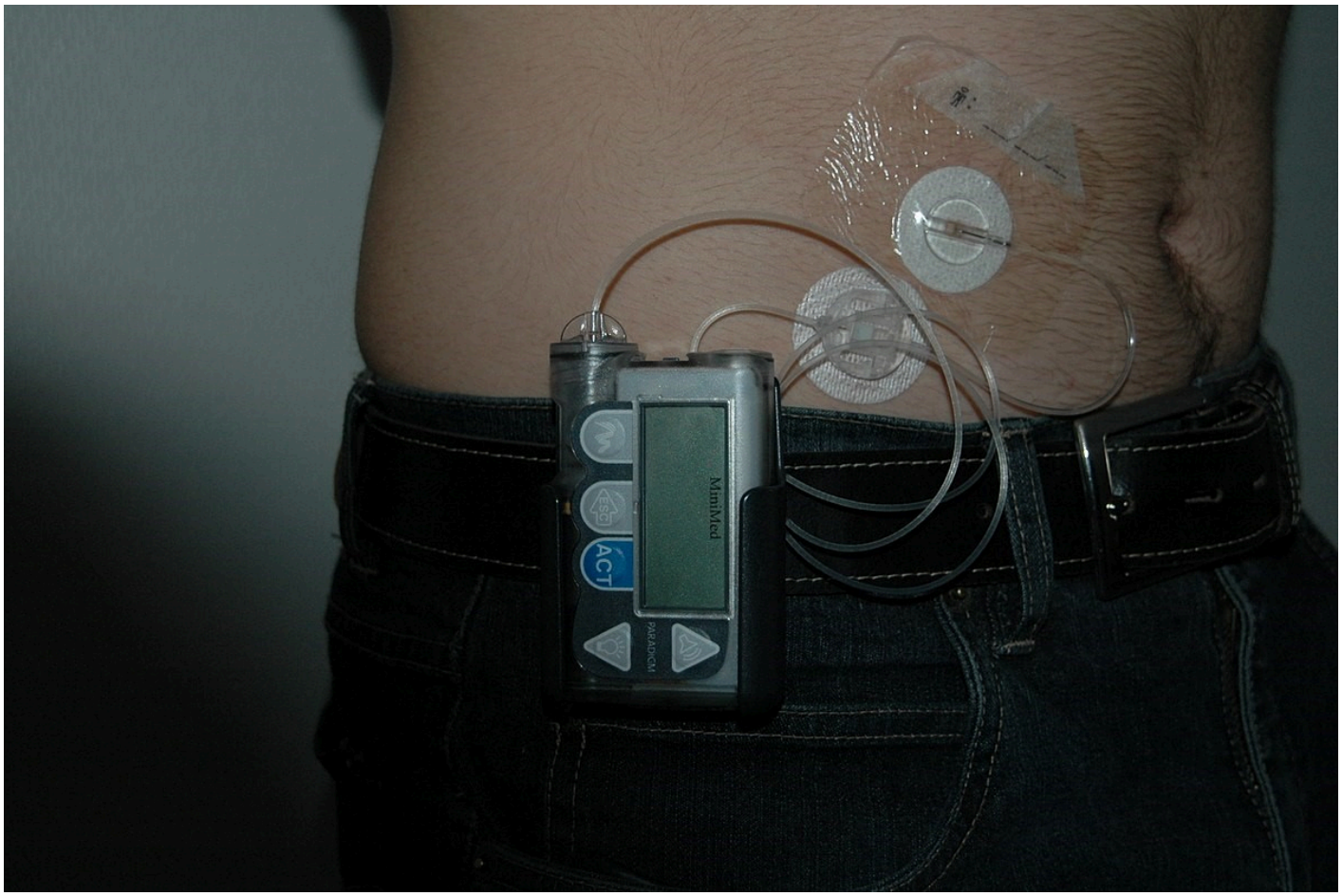


Figure 7.11 Insulin Pump and Continuous Glucose Monitoring System

> Review additional information about medication classes used to treat diabetes mellitus in the "Antidiabetics" section of the "Endocrine" chapter in Open RN *Nursing Pharmacology, 2e*.

58. "Wearing_pump.JPG" by Bjorn Heller is licensed under CC BY-SA 2.0 DE LIZENZVERTRAG

BLOOD GLUCOSE MONITORING

Routine monitoring of blood glucose levels is a common component of diabetes management for clients with type 1 DM and for some clients with type 2 DM depending upon their prescribed medication therapy. Individuals typically check their blood glucose levels before meals and at bedtime and may administer additional insulin based on their glucose level before eating. See Figure 7.12[59] for an image of a blood glucose monitoring device.



Figure 7.12 Blood Glucose Monitoring Device

A **continuous glucose sensor (CGS)** is a medical device designed to monitor and track blood glucose levels in the interstitial fluid. The sensor transmits real-time data to a display device, often a dedicated receiver or a smartphone app. This allows individuals with diabetes, as well as their health care providers, to observe trends and patterns in glucose levels. The sensor has customizable alarms and alerts to notify users of high or low glucose levels. This feature helps individuals take prompt action to address potential issues and maintain better control over their blood sugar. Some advanced CGS

59. "5585751341_affc34fe84_e.jpg" by Bradley Johnson is licensed under CC BY-NC-ND 2.0

integrate with insulin pumps, creating a closed-loop system. This allows for automated adjustments to insulin delivery based on real-time glucose data, contributing to more precise and responsive diabetes management. See Figure 7.13[60] for an image of a continuous glucose sensor.

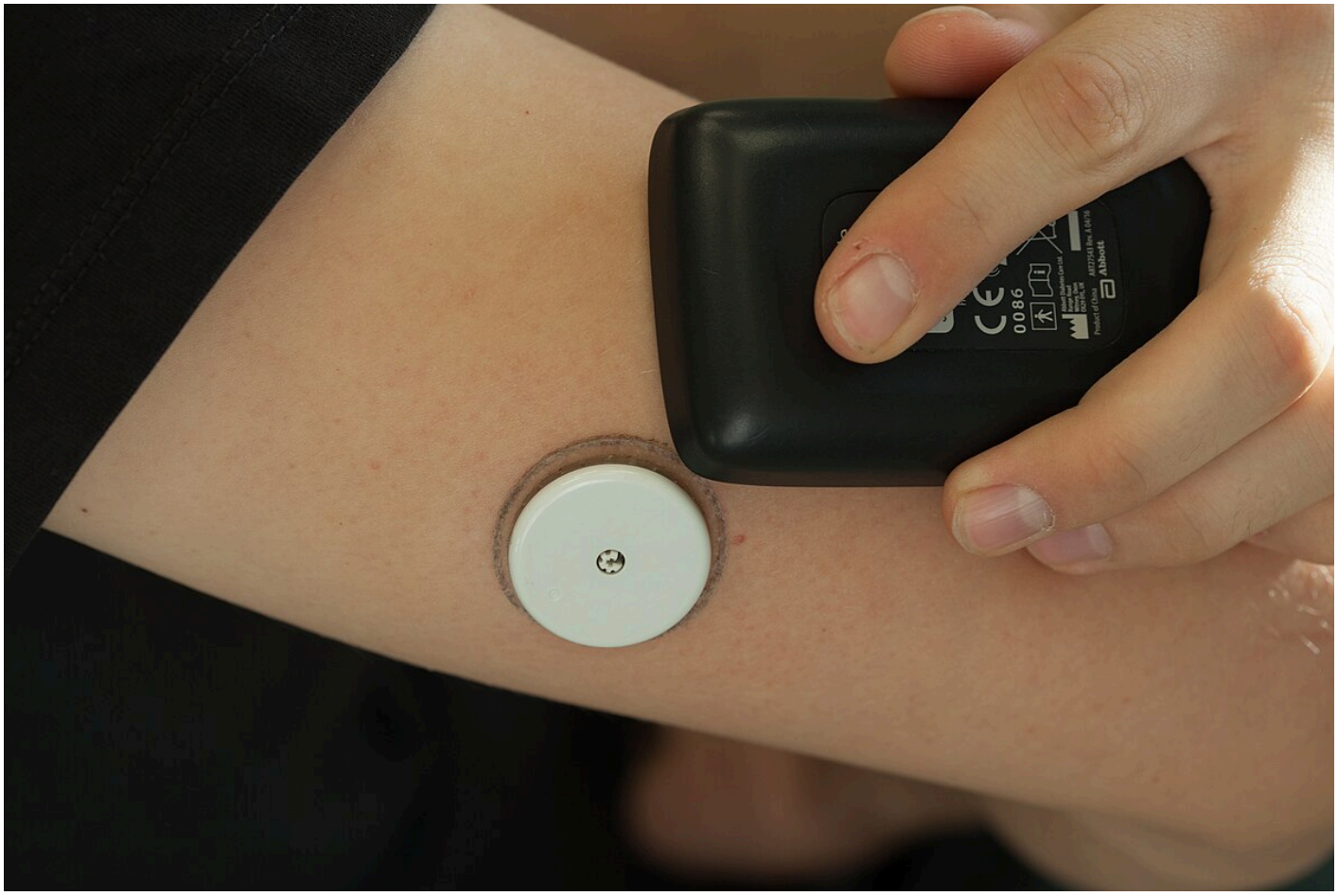


Figure 7.13 Continuous Glucose Sensor

DIETARY COUNSELING

Referrals are made to registered dieticians to assist with blood glucose management through dietary modifications and carbohydrate counting. Controlling carbohydrate intake, portion sizes, and choosing foods with a low glycemic index can help stabilize blood sugar levels. Diabetic education is

60. "FreeStyle_libre_am_Oberarm_und_Auslesegerät-5.JPG" by Thirunavukkarasye-Raveendran is licensed under CC BY 4.0

multifaceted and successful when individualizing for each client. Dietary counseling principles are described in the following box.

Dietary Counseling Principles[61]

Nutrition plays a crucial role in managing diabetes; therefore, meal planning is an essential part. To create an effective and sustainable meal plan, it is important to consider various factors, such as culture, socioeconomic status, and lifestyle, while also adhering to these specific dietary guidelines:

- **Realistic and Flexible Meal Planning:** Meal planning for diabetes should be realistic and flexible to fit the individual's preferences, daily schedule, and dietary restrictions. It's important to create a plan that can be maintained over the long-term.
- **Consider Cultural Preferences:** Cultural background can greatly influence food choices and eating habits. When creating a meal plan, it's important to consider cultural preferences and adapt recipes to make them more diabetes-friendly while still honoring traditional dishes.
- **Socioeconomic Status:** Economic factors can impact access to certain foods. It's essential to choose cost-effective, nutritious options and provide guidance on making healthy choices within a limited budget.

61. Lin, C.-L., Huang, L.-C., Chang, Y. T., Chen, R.-Y., & Yang, S.-H. (2021). Effectiveness of health coaching in diabetes control and lifestyle improvement: A randomized-controlled trial. *Nutrients, 13*(11), 3878. https://doi.org/10.3390/nu13113878

- **Carbohydrates:** Carbohydrates are a crucial component of meal planning for individuals with diabetes. Carbohydrates are "counted" for each meal to help quantify insulin for meal-time dosing. Individuals with diabetes maintain best glycemic control by distributing carbohydrates evenly throughout the day and adhering to controlled portion sizes. The glycemic index of simple and complex carbohydrates must also be considered when making food choices. The glycemic index indicates how quickly a carbohydrate-containing food raises blood sugar. Choosing low-glycemic index foods can help prevent rapid spikes in blood glucose levels.

- **Protein:** Protein should constitute 15%-20% of total daily calories. Lean sources of protein, such as poultry, fish, tofu, legumes, and low-fat dairy, are excellent choices. They can help stabilize blood sugar levels and promote a feeling of fullness.

- **Fat and Cholesterol:** Saturated fat intake should be less than 7% of total daily calories. Saturated fats can raise cholesterol levels and increase the risk of heart disease. Choose healthier fats like those found in nuts, seeds, avocados, and olive oil.

Minimize intake of trans fats, which are often found in processed and fried foods. Trans fats can have a negative impact on heart health.

- **Fiber:** Fiber is beneficial for improving carbohydrate metabolism and lowering cholesterol levels. The American Heart Association (AHA) recommends a daily fiber intake of at least 25 grams. Incorporate fiber-rich foods like whole grains, fruits, vegetables, and legumes into the diet.

- **Sweeteners:** Artificial sweeteners can be included in a meal plan as long as they are used mindfully and not in excess.
- **Alcohol:** Alcohol consumption can affect blood glucose levels. While moderate alcohol use may not significantly impact blood sugar, it's important to be cautious, as excessive alcohol intake can lead to hypoglycemia (low blood sugar). If alcohol is consumed, it should be done in moderation, and individuals with diabetes should monitor their blood sugar levels carefully.

Meal planning is a critical aspect of diabetes management, and there are various strategies to help individuals with diabetes maintain stable blood glucose levels. Two popular meal planning approaches are the exchange system and carbohydrate counting. These methods provide structure and flexibility to create balanced meals while helping individuals manage their blood sugar effectively.

Exchange System

The **exchange system** is a meal planning method that categorizes foods into three main groups: carbohydrates (CHO), meat and meat substitutes, and fats. This approach simplifies meal planning by assigning specific portion sizes to each food group, allowing for the substitution of foods within the same group without significantly affecting blood glucose levels.[62]

- **Carbohydrates (CHO):** This group includes foods like bread, rice, pasta, cereal, fruits, and starchy vegetables. In the exchange system, CHO foods are categorized into serving sizes with approximately equal carbohydrate

62. Delahanty, L. (2023). Nutritional considerations in type 2 diabetes mellitus. *UpToDate*. www.uptodate.com

content, making it easier to control blood sugar.

- **Meat and Meat Substitutes:** This group comprises sources of protein, such as lean meats, poultry, fish, tofu, legumes, and dairy products. These are essential for building and repairing body tissues.
- **Fats:** The fats group includes sources of dietary fat like oils, nuts, seeds, and butter. While fats don't directly impact blood glucose, managing their intake is important for overall health and weight control.

Using the exchange system, individuals can create balanced meals by selecting a certain number of servings from each food group, providing predictability in blood glucose responses. This system is particularly helpful for those who prefer structured meal planning.

Carbohydrate Counting

Carbohydrate counting is a flexible and individualized approach to meal planning for people with diabetes. It focuses primarily on carbohydrates because they have the most significant impact on blood glucose levels. With carbohydrate counting, individuals keep track of the total grams of carbohydrates they consume in a meal, regardless of the food source. One carbohydrate choice is equal to 15 grams of carbohydrate. This method allows for more variety in food choices, as long as the total carbohydrate intake is consistent.[63,64]

Carbohydrate counting involves these steps:

- Identifying carbohydrate-containing foods in a meal.

63. American Diabetes Association. (n.d.). *Carb counting and diabetes.* https://diabetes.org/food-nutrition/understanding-carbs/carb-counting-and-diabetes

64. Delahanty, L. (2023). Nutritional considerations in type 2 diabetes mellitus. *UpToDate.* www.uptodate.com

- Estimating the total grams of carbohydrates in each food item.
- Keeping track of the cumulative carbohydrate intake for the entire meal.

By understanding how different foods affect blood sugar and monitoring carbohydrate intake, individuals can better control their post-meal blood glucose levels. Carbohydrate counting is particularly useful for those who want more flexibility in their food choices and are willing to track carbohydrate intake accurately.[65]

Insulin may be administered after meals based on carbohydrate intake. See an example of this process in the following box.

Example of Carbohydrate Counting

Provider Order: Administer 2 units Humalog insulin for each carbohydrate choice eaten at breakfast, lunch, and dinner

Meal Ticket: Lunch

- 1 Turkey sandwich (30 grams)
- 0.5 cup quinoa (15 grams)
- 1 cup yogurt (15 grams)

How many units of insulin should be administered following the lunch meal?

(Remember 15 grams carbohydrate = 1 carb choice)

Total grams of carbohydrate eaten: 60 grams

60 grams/15 grams = 4 carbohydrate choices

65. American Diabetes Association. (n.d.). *Carb counting and diabetes*. https://diabetes.org/food-nutrition/understanding-carbs/carb-counting-and-diabetes

4 carb choices X 2 units of Humalog insulin per carb choice = 8 units Humalog insulin administered

WEIGHT MANAGEMENT & EXERCISE

Maintaining a healthy weight can improve blood glucose control, particularly in type 2 diabetes. Regular exercise can promote weight loss. Exercise increases cellular sensitivity to insulin and promotes the uptake of glucose from the bloodstream, thus helping to regulate blood glucose levels.

Exercise can also prevent common complications of diabetes, such as heart disease, peripheral arterial disease, kidney disease, and stroke. It also has a positive impact on mental health, reducing stress and anxiety, which can contribute to improved self-management of diabetes. See the following box for exercise guidelines for individuals with diabetes.[66]

Exercise Guidelines[67]

When implementing an exercise program for diabetes management, it is important to consider the following guidelines:

- Avoid exercising in extreme temperatures to avoid dehydration.

66. Centers for Disease Control & Prevention. (n.d.). *Get active!* https://www.cdc.gov/diabetes/living-with/physical-activity.html)

67. Centers for Disease Control & Prevention. (n.d.). *Get active!* https://www.cdc.gov/diabetes/living-with/physical-activity.html)

- Aim to exercise five to six days a week. Do not go more than 48 hours between exercise sessions. Logging workouts can help keep track of weekly exercise.
- Exercise about an hour after a meal to ensure adequate blood glucose levels.
- Regularly monitor blood glucose levels before, during, and after exercise. This helps individuals understand how physical activity affects their blood sugar.
- Educate individuals about the risk of hypoglycemia (low blood sugar) during and after exercise. They should know the symptoms and the strategies to prevent and manage hypoglycemia by having a source of fast-acting carbohydrates on hand.
- The type and duration of exercise can vary depending on individual preferences and physical capabilities. It can include aerobic exercises, strength training, and flexibility exercises. Aim for at least 150 minutes of moderate-intensity aerobic activity per week, as recommended by health guidelines.
- Exercise plans should be individualized to meet the specific needs and goals of each person with diabetes.

Nursing Interventions

Nursing interventions for diabetes management are essential in providing holistic care and support to individuals with diabetes. These interventions aim to help clients effectively manage their condition, prevent complications, and improve their overall quality of life. Nursing interventions include blood glucose level monitoring, medication management, health teaching, foot care, and health screening.

BLOOD GLUCOSE LEVEL MONITORING

During inpatient care, provider orders often indicate bedside blood glucose monitoring before every meal and bedtime. If insulin is prescribed, there is often a "sliding scale" component, where rapid-acting insulin is administered based on the blood glucose level. This sliding scale corrects for the blood sugar level before the meal. Added to this amount are units of insulin for the amount of carbohydrates consumed. Addressing both the blood sugar and quantity of carbohydrates consumed helps maintain tight glycemic control. See a common sliding scale insulin order in the following box.

Example of Sliding Scale Insulin Order

Obtain bedside blood glucose level before meals and bedtime. Use the following scale to administer Humalog insulin based on the blood glucose level:

- 150-199: 2 units
- 200-249: 4 units
- 250-299: 6 units
- 300-349: 8 units
- 350 – 399: 10 units
- 400 or over: Call the provider

MEDICATION MANAGEMENT

Nurses administer prescribed antidiabetic medications during inpatient care and provide health teaching regarding the purpose of the medications, dosages, timing, and potential side effects. It is vital for clients to understand the onset, peak, and duration of insulin, as well as the importance of timing insulin administration with meal intake and carbohydrates consumed to prevent hypoglycemia. Nurses also teach clients how to self-administer insulin with return demonstration to ensure understanding.

Nurses also collaborate with health care providers to adjust medication prescriptions based on clients' changing needs, responses to treatment, and potential barriers for medication therapy at home.

FOOT CARE

Clients with diabetes are at high risk for foot ulcers and injuries due to decreased blood flow and sensation of the lower extremities. Good foot care is vital for clients to keep their feet healthy. Nurses teach clients about proper foot care such as inspecting the feet daily (including between the toes), wearing appropriate footwear at all times, and avoiding walking barefoot. If individuals trim their toenails at home, they should do so carefully and immediately report any nonhealing breaks in the skin to their health care provider. During inpatient or long-term care, only podiatrists or specially trained nurses should trim toenails of diabetic clients to prevent unintended injury and potential infection. Annual podiatrist visits are recommended with immediate care for injuries or ulcers to prevent infection and potential amputation. See Figure 7.14[68] for an infographic from the Centers for Disease Control and Prevention on tips for healthy feet.

68. "337438-A_FootCare_Infographic_3.10_final" by unknown author for Centers for Disease Control and Prevention is licensed in the Public Domain. Access for free at https://www.cdc.gov/diabetes/library/socialmedia/infographics/feet-healthy.html.



Figure 7.14 Tips for Healthy Feet

HEALTH TEACHING

Nurses provide comprehensive health teaching to individuals with diabetes and their family members. In many institutions, diabetic nurse educators provide extensive teaching on topics such as the nature of diabetes, blood glucose monitoring, medication management, and lifestyle modifications. However, all nurses continue to reinforce this information during every encounter to help promote effective self-management of this chronic condition. Return demonstration of skills related to blood glucose monitoring and administration of injections are vital to ensure client understanding.

Common health topics include the following:

- Monitoring their blood glucose levels using glucometers or continuous glucose monitoring systems.
- Interpreting blood glucose readings and making necessary adjustments to their treatment plan.
- Recognizing and managing episodes of low blood sugar (hypoglycemia) and high blood sugar (hyperglycemia) and when to notify the provider.

- Performing good foot care.
- Participating in routine care to prevent diabetic complications, such as annual eye and podiatrist exams.
- Understanding the importance of regular exercise and nutritional eating to reduce the risk of atherosclerosis and arteriosclerosis.
- Empowering clients to take an active role in their care by understanding the disease, treatment plan, and appropriate self-management.
- Preparing for sick days to keep blood glucose in target range. See the following box on general teaching to provider about planning for sick days.

Planning for Sick Days

Although a client's food intake may decrease when ill, their blood glucose can become elevated due to the effects of cortisol that is released as part of the immune response. Clients with diabetes are also at risk for becoming seriously ill from colds or other respiratory viruses. Nurses should teach clients the following sick day guidelines[69]:

- Check your blood glucose at least every four hours and modify your insulin administration according to the results and the instructions provided by your health care provider. Notify your health care provider if your blood glucose is greater than 240 mg/dL.
- Drink plenty of fluids to prevent dehydration. If having difficulty keeping fluids down, try to sip fluids every 15

69. American Diabetes Association. (n.d.). *Diabetes and planning for sick days*. https://diabetes.org/getting-sick-with-diabetes/sick-days

minutes.

- Eat simple carbohydrates like regular soda, Jell-O, or popsicles to keep your blood glucose up if you are having difficulty eating and are at risk for hypoglycemia.
- If your body does not have enough insulin, it creates ketones, placing you at risk for diabetic ketoacidosis (DKA). If you are at risk, test your urine for ketones every four to six hours or as directed by your health care provider.
- If you are vomiting or have diarrhea more than three times over 24 hours or have a fever over 101° F for 24 hours, call your health care provider.
- Be cautious with using over-the-counter cold medications because they can affect your blood glucose or your prescribed medication.
- Create an action plan with your health care team to use on sick days.

Read more information about planning for sick days from the American Diabetes Association at https://diabetes.org/getting-sick-with-diabetes/sick-days

HEALTH SCREENINGS

Nurses promote routine health screenings for clients with diabetes, including annual eye exams and routine kidney function tests, lipid profiles, and blood pressure monitoring. Kidney function tests often include microalbumin, an early detection of kidney dysfunction. Nurses also coordinate referrals to specialists, such as ophthalmologists, podiatrists, or endocrinologists.

Evaluation

Evaluation focuses on the effectiveness of the nursing interventions by reviewing the client's expected outcomes to determine if they were met by the time frames indicated. During the evaluation phase, nurses use critical

thinking to analyze reassessment data and determine if a client's expected outcomes have been met, partially met, or not met by the time frames established. If outcomes are not met or only partially met by the time frame indicated, the care plan should be revised. Reassessment should occur every time the nurse interacts with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with others on the interprofessional team.

Nurses refer to the previously identified outcome statements and perform reassessments to determine if they have been met by the current nursing care plan or if additional interventions are required. For example, the nurse would perform assessments related to the previously established outcome criteria and determine if they were "met" or if additional interventions are required.



RN Recap: Diabetes Type 2

View a brief YouTube video of diabetes mellitus type 2[70]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=1960#oembed-1

70. Open RN Project. (2024, April 19). *Health Alterations – Chapter 7 Endocrine – Diabetes mellitus type 2* [Video]. YouTube.*CC BY-NC 4.0https://youtu.be/d8rPuWVscTk*

7.6 Thyroid Disorders

The thyroid gland is a butterfly-shaped organ located in the front of the neck and plays a vital role in regulating various metabolic processes in the body by producing and releasing thyroid hormones. When the thyroid gland does not function correctly, it can lead to a range of thyroid disorders, with the most common being hypothyroidism (underactive thyroid) and hyperthyroidism (overactive thyroid). These disorders can result in a variety of symptoms and health complications, affecting energy levels, weight, vital signs, and overall well-being.[1]

Hypothyroidism

Hypothyroidism is a medical condition characterized by an underactive thyroid gland that causes reduced production of thyroid hormones. When the thyroid gland fails to produce sufficient levels of thyroxine (T4) and triiodothyronine (T3), the body's metabolic rate decreases. **Goiter**, a swelling or nodularity of the thyroid, is a sign of both hypothyroidism and hyperthyroidism. See Figure 7.15[2] for an image of a goiter.

1. Ross, D. S. (2022). Thyroid hormone synthesis and physiology. *UpToDate*. www.uptodate.com

2. "Goiter.JPG" by Dr. J.S. Bhandari, India is licensed under CC BY-SA 3.0



Figure 7.15 Goiter

A Closer Look...Myxedema Coma

Myxedema coma is a severe form of hypothyroidism. It is a rare condition that requires immediate medical attention. *Myxedema* means "swelling of the skin and underlying tissues." With extremely low levels of thyroid hormones, multisystem organ failure can develop. Hypothermia is a hallmark sign of myxedema coma. Other classic signs and symptoms of myxedema coma include severe bradycardia,

hypotension, and impaired cardiac contractility that can result in cardiac failure. Breathing can become shallow, resulting in hypoxia and hypercapnia. Impaired cognitive function with decreased levels of consciousness and extreme confusion can progress to complete lack of responsiveness or coma. To prevent myxedema coma, it is crucial for individuals diagnosed with hypothyroidism to adhere to their prescribed treatment regimen by taking thyroid hormone replacement medication as directed and attending regular follow-up appointments with their health care provider to monitor their condition with lab work.[3,4]

Pathophysiology

Hypothyroidism can be caused by a variety of factors, including autoimmune disease, thyroid surgery, radiation therapy, medications, iodine deficiency, or congenital thyroid disease. The most common cause of hypothyroidism is an autoimmune disease called **Hashimoto's thyroiditis**, a condition in which the immune system mistakenly attacks the thyroid gland, resulting in inflammation and damage.[5]

3. Ross, D. S. (2023). Treatment of primary hypothyroidism in adults. *UpToDate*. www.uptodate.com

4. Surks, M. I. (2022). Clinical manifestations of hypothyroidism. *UpToDate*. www.uptodate.com

5. Surks, M. I. (2022). Clinical manifestations of hypothyroidism. *UpToDate*. www.uptodate.com

Assessment of Hypothyroidism

Common signs and symptoms of untreated or inadequately controlled hypothyroidism can be viewed in the following Table 7.6a.

Table 7.6a. Common Manifestations of Hypothyroidism[6]

Body System	Common Manifestations
General	Fatigue and weakness, cold intolerance, weight gain, hoarseness associated with goiter, or myxedema (generalized edema)
Cardiovascular	Bradycardia and hypotension
Respiratory	Slow, shallow breathing
Gastrointestinal	Constipation, abdominal bloating and pain, or anorexia
Musculoskeletal	Muscle weakness and aches, joint pain and stiffness, or muscle cramps
Neurological	Cognitive impairment (i.e., memory problems, poor concentration), depression, slow mental processing, or paresthesia (tingling or numbness in extremities)
Integumentary	Dry, pale, cool, itchy skin; dry, coarse, brittle hair or hair loss; or thinning, brittle, ridged nails
Reproductive	Menstrual irregularities (heavier or more frequent periods), infertility (in some cases), or low libido (decreased sexual desire)

DIAGNOSTIC TESTING

Diagnostic testing for hypothyroidism assesses the underactivity of the thyroid gland. It typically involves measuring the blood levels of thyroid hormones, especially T3 (triiodothyronine), T4 (thyroxine), and TSH (thyroid-stimulating hormone)[7,8]:

- **Thyroid-Stimulating Hormone (TSH):** TSH is produced by the pituitary gland. Recall that TSH is part of a negative feedback loop for regulating

6. Surks, M. I. (2022). Clinical manifestations of hypothyroidism. *UpToDate*. www.uptodate.com

7. National Institute of Diabetes and Digestive and Kidney Disease. (2017). *Thyroid tests.* National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/thyroid

8. MedlinePlus [Internet]. (2023). *Thyroid tests*. https://medlineplus.gov/tendinitis.html

thyroid hormones by the hypothalamus and pituitary. In hypothyroidism, where the thyroid gland is underactive and not producing enough thyroid hormones, the pituitary gland increases its production of TSH to stimulate the thyroid gland to produce more thyroid hormones. Therefore, in hypothyroidism, the TSH level is typically elevated.[9]

- **Thyroxine (T4):** T4 is produced and secreted by the thyroid gland. T4 is a prohormone and is relatively inactive on its own. However, it serves as a precursor to the more active thyroid hormone triiodothyronine (T3). Low T4 levels indicate hypothyroidism.[10]
- **Triiodothyronine (T3):** T3 is the active form of thyroid hormone. It directly impacts the body's metabolic rate by affecting the function of cells throughout the body. T3 helps regulate how the body uses energy, including the consumption of oxygen and the burning of calories. This, in turn, impacts body temperature, heart rate, and the rate of chemical reactions in the body.[11]

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing diagnoses for clients with hypothyroidism guide nursing care and address the specific needs of these individuals.

Common nursing diagnoses include the following:

9. Ross, D. S. (2022). Diagnosis and screening for hypothyroidism in nonpregnant adults. *UpToDate*. www.uptodate.com
10. Ross, D. S. (2022). Diagnosis and screening for hypothyroidism in nonpregnant adults. *UpToDate*. www.uptodate.com
11. Ross, D. S. (2022). Diagnosis and screening for hypothyroidism in nonpregnant adults. *UpToDate*. www.uptodate.com

- Fatigue
- Imbalanced Nutrition
- Impaired Thermoregulation
- Constipation

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

- *The client will verbalize an understanding of energy conservation techniques.*
- *The client will achieve and maintain a stable, healthy body weight within the recommended range.*
- *The client will verbalize an understanding of strategies to prevent constipation, such as increased fiber and physical activity.*

Interventions for Hypothyroidism

MEDICAL INTERVENTIONS

Medical interventions for hypothyroidism focus on hormone replacement therapy, hormone level monitoring, and dietary modifications. Adherence to prescribed medical therapy and appropriate monitoring are critical for managing this chronic disease.

Medication Therapy

Levothyroxine is a synthetic T4 hormone and is the classic treatment for hypothyroidism. It is usually taken orally as a daily medication. The goal of treatment is to achieve and maintain a stable TSH level within the normal range, indicating adequate thyroid hormone replacement.

Review additional information about thyroid replacement medications in the "Thyroid Medications" section of the "Endocrine" chapter of Open RN *Nursing Pharmacology, 2e*.

TSH Monitoring

After beginning thyroid hormone replacement therapy, TSH levels must be routinely monitored to assess thyroid function and ensure thyroid hormones are within the target range. Adjustments to a client's medication dosage may be necessary based on the test results and the client's clinical response to the medication.

Dietary Modifications

Maintaining a well-balanced diet that includes iodine (a crucial component of thyroid hormones) is important. Clients may benefit from dietary modifications to prevent constipation, such as increased fluids, fiber, and physical activity. It may also be helpful to avoid excessive consumption of foods that can interfere with thyroid function such as cruciferous vegetables, soy products, peaches, and strawberries.[12]

NURSING INTERVENTIONS

Nursing interventions for hypothyroidism focus on medication management and symptom management to promote client comfort.

12. Ross, D. S. (2022). Diagnosis and screening for hypothyroidism in nonpregnant adults. *UpToDate*. www.uptodate.com

Medication Management

Nurses teach the importance of taking thyroid medication at the same time each day, preferably on an empty stomach, to maximize absorption. They explain that levothyroxine is prescribed at a low dose and then titrated to achieve therapeutic blood levels of TSH, requiring repeated blood draws. Nurses teach clients to avoid taking thyroid medication with certain foods, beverages, and supplements that can interfere with absorption (e.g., calcium supplements, iron, and soy) and emphasize the importance of not changing the brand of thyroid medication without consulting their health care provider.

Nurses are aware that clients with hypothyroidism must use sedatives and opioids with caution because of the increased effects of sedation and respiratory depression effects of these medications.

Symptom Management

Nurses teach clients how to manage symptoms, such as fatigue, weight gain, and cold intolerance, until thyroid hormone levels are normalized. They encourage the client to maintain a nutritious diet and engage in regular physical activity, but also teach energy conservation techniques to combat fatigue. Nurses discuss the client's comfort level with temperature regulation, especially regarding cold intolerance, and encourage the use of appropriate clothing and heating devices to stay warm. Review energy management strategies in the "Nursing Interventions" subsection of "Iron-Deficiency Anemia" in the "Hematological Alterations" chapter.

Hyperthyroidism

Hyperthyroidism is characterized by the excess secretion of thyroxine (T4) and triiodothyronine (T3) from the thyroid gland. Hyperthyroidism can be a chronic or temporary condition, depending upon the underlying cause.

Pathophysiology

Common causes of hyperthyroidism include Graves' disease (an autoimmune

disorder), toxic nodular goiter, and thyroiditis. **Graves' disease** is typically a long-lasting or permanent condition resulting from autoimmune destruction of the thyroid gland, whereas other forms of hyperthyroidism, such as thyroiditis, can be temporary and resolve on their own.

Recall the negative feedback loop used to regulate the secretion of thyroid hormones. In hyperthyroidism there is a failure of negative feedback control mechanisms. The thyroid gland becomes overactive, producing excessive levels of thyroid hormones regardless of the body's actual need.

Thyroid storm is a severe state of hyperthyroidism that is a life-threatening medical condition. It occurs when hyperthyroidism is untreated, poorly controlled, or when the client is under severe physical or emotional stress, or if antithyroid medication is abruptly stopped. It can also occur during surgery when the thyroid is manipulated. Thyroid storm is most commonly associated with Graves' disease, which causes the thyroid gland to produce excessive amounts of thyroid hormones.[13] Review additional information about thyroid storm in the following box.

A Closer Look at a Thyroid Storm[14,15]

Thyroid storm is a severe manifestation of hyperthyroidism in which excessive release of thyroid hormones causes a range of life-threatening symptoms.

Manifestations of thyroid storm are as follows:

13. Ross, D. S. (2022). Overview of the clinical manifestations of hyperthyroidism in adults. *UpToDate*. www.uptodate.com

14. Ross, D. S. (2022). Overview of the clinical manifestations of hyperthyroidism in adults. *UpToDate*.www.uptodate.com

15. Ross, D. S. (2023). Thyroid storm. *UpToDate*. www.uptodate.com

- Fever: Clients with thyroid storm often have hyperthermia, an extremely high body temperature.
- Tachycardia: The heart rate becomes excessively fast, which can strain the cardiovascular system.
- Hypertension: Blood pressure may rise to dangerous levels, putting significant stress on the heart and blood vessels.

Thyroid storm is a medical emergency that requires immediate hospitalization and intensive medical management. Treatment typically includes medications to control the production and effects of thyroid hormones, as well as supportive care to manage symptoms and complications. Prompt recognition and treatment of thyroid storm are crucial to improving the chances of a successful outcome for individuals experiencing thyroid storm.

Assessment of Hyperthyroidism

Common signs and symptoms of hyperthyroidism are summarized in Table 7.6b.

Table 7.6b. Common Manifestations of Hyperthyroidism[16]

16. Ross, D. S. (2022). Overview of the clinical manifestations of hyperthyroidism in adults. *UpToDate*. www.uptodate.com

Body System	Clinical Manifestations and Findings
Cardiovascular	Tachycardia, palpitations, hypertension, chest pain or angina, and arrhythmias
Nervous	Nervousness and anxiety, restlessness and irritability, tremors, heat intolerance, excessive sweating, insomnia and sleep disturbances, and difficulty concentrating or memory problems
Gastrointestinal	Increased appetite and weight loss, frequent bowel movements and diarrhea, nausea and vomiting, and hepatomegaly
Musculoskeletal	Muscle weakness, fatigue, and osteoporosis (bone density loss)
Endocrine	Goiter (enlargement of the thyroid gland)
Dermatological	Warm, moist skin; fine, soft hair and hair loss; and **onycholysis** (separation of fingernails from the nail bed)
Reproductive	Menstrual irregularities and **amenorrhea** (absence of menstrual periods) in some female clients
Ocular	Eye-related symptoms such as double vision, photophobia, and **exophthalmos** (bulging eyes) (See Figure 7.16[17] for an image of exophthalmos.)
Respiratory	Shortness of breath and tachypnea (due to increased oxygen demand)
Psychological	Emotional lability (rapid shifts in mood)



Figure 7.16 Exophthalmos

Figure 7.16 Exophthalmos

Diagnostic Testing

Diagnostic testing for hyperthyroidism includes measuring blood levels of T3 (triiodothyronine) and T4 (thyroxine). Excessive T3 and T4 levels cause the symptoms and metabolic changes seen in hyperthyroidism. In response, the TSH (thyroid-stimulating hormone) level is typically decreased as the pituitary decreases stimulation of the thyroid to regulate T3 and T4 levels. Review

17. "Proptosis_and_lid_retraction_from_Graves%27_Disease.jpg" by Jonathan Trobe, M.D. – University of Michigan Kellogg Eye Center is licensed under CC BY 3.0

information about these diagnostic tests under the “Diagnostic Testing” subsection for “Hypothyroidism.”

Nursing Diagnoses

Nursing diagnoses for clients with hyperthyroidism can help guide nursing care and address the specific needs of these individuals.

Common nursing diagnoses include the following:

- Ineffective Thermoregulation
- Anxiety
- Imbalanced Nutrition

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client’s specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

- *The client will demonstrate effective self-regulation of body temperature.*
- *The client will engage in relaxation techniques and stress-reduction activities.*
- *The client will achieve and maintain a stable weight.*

Interventions for Hyperthyroidism

MEDICAL INTERVENTIONS

Medical interventions for hyperthyroidism aim to control the overproduction of thyroid hormones and manage the associated symptoms. Medication therapy, radioactive iodine, thyroidectomy, and radiofrequency ablation are common treatments for hyperthyroidism. The choice of treatment depends

on the underlying cause of hyperthyroidism, the severity of the condition, and the client's individual health factors.

Medication Therapy

Common medications used to treat hyperthyroidism and/or associated symptoms include antithyroid medications and beta-blockers.

- **Antithyroid Medications:** These medications work by blocking the production of thyroid hormones in the thyroid gland. They are often used to temporarily control hyperthyroidism, especially in Graves' disease. Examples include methimazole and propylthiouracil (PTU).[18]
- **Beta-Blockers:** Beta-blockers are prescribed to manage the symptoms of hyperthyroidism, such as rapid heartbeat, tremors, and anxiety. They do not affect thyroid hormone levels but help alleviate some of the uncomfortable symptoms. Examples include propranolol and atenolol.[19]

> Review additional information about these medication classes in the "Thyroid Medications" section of the "Endocrine" chapter in Open RN *Nursing Pharmacology, 2e*.

Radioactive Iodine (RAI) Therapy

Radioactive iodine (RAI) therapy is a common treatment for hyperthyroidism

18. Ross, D. S. (2023). Patient education: Antithyroid drugs (Beyond the basics). *UpToDate*. www.uptodate.com

19. Ross, D. S. (2023). Beta blockers in the treatment of hyperthyroidism. *UpToDate*. www.uptodate.com

in conditions like Graves' disease. It involves the oral ingestion of a radioactive form of iodine, which is selectively taken up by the overactive thyroid cells. The RAI gradually shrinks the thyroid and reduces hormone production. However, this treatment can result in hypothyroidism, which may require lifelong thyroid hormone replacement therapy.[20] Clients who undergo radioactive iodine therapy will give off radiation for some time after treatment. They are taught radiation precautions, including how to protect others through social distancing, and to avoid contact with anyone who is pregnant or trying to get pregnant.[21]

Thyroidectomy

In some cases, surgical removal of part or all of the thyroid gland may be necessary, particularly when other treatments are not suitable or effective. A **total thyroidectomy** removes the entire thyroid gland, while a **subtotal thyroidectomy** removes a portion of the thyroid gland. Clients who undergo thyroid surgery require lifelong thyroid hormone replacement because this surgery typically results in hypothyroidism.[22] Although a thyroidectomy is a common surgical procedure, there are a number of complications that can occur. See Table 7.6c for an overview of potential postoperative complications after a thyroidectomy.

20. Ross, D. S., & Sugg, S. L. (2023). Surgical management of hyperthyroidism. *UpToDate*. www.uptodate.com

21. American Cancer Society. (2023). *Radiation therapy safety.* https://www.cancer.org/cancer/managing-cancer/treatment-types/radiation/safety.html

22. Ross, D. S., & Sugg, S. L. (2023). Surgical management of hyperthyroidism. *UpToDate*. www.uptodate.com

Table 7.6c. Potential Complications After a Thyroidectomy[23]

Potential Complication	Cause	Signs and Symptoms	Treatment/Nursing Interventions
Airway compromise	Can occur due to hemorrhage, swelling, or **tetany** (involuntary contraction or spasm of muscles, associated with low calcium levels)	Difficulty breathing, neck swelling, stridor, low oxygen levels, difficulty swallowing, or drooling	Client may have to return to operating room in case of hemorrhage Ensure tracheostomy tray is nearby Monitor surgical dressing for excessive bleeding (note that blood may pool to back of dressing) Keep neck in neutral position to prevent stress on suture line Monitor respiratory status Provide humidified air if possible to reduce tissue swelling
Hypoparathyroidism	Can occur due to unintended removal of or trauma to parathyroid glands during surgery	Low serum calcium levels, numbness, tingling, muscle cramping, Chvostek's and Trousseau's signs, changes in EKG readings, or seizures	Supplement with calcium and vitamin D Monitor for signs and symptoms of low calcium Monitor levels of serum calcium Educate on food sources that are high in calcium and vitamin D
Laryngeal nerve injury	Superior and recurrent laryngeal nerves run through the thyroid and are at risk for injury during thyroid removal	Hoarse sounding voice, changes in the pitch of voice, or aspiration. May be transitory or permanent	Assess voice before and after surgery Encourage resting of the voice Provide alternative means to communicate if necessary Monitor for signs of aspiration

Radiofrequency Ablation

Radiofrequency ablation (RFA) is a minimally invasive procedure that uses radiofrequency energy to heat and destroy thyroid nodules or hyperactive

23. Biello, A., Kinberg, E. C., Menon, G., et al. (2024). *Thyroidectomy*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK563279/

tissue. This technique is typically employed for clients with toxic thyroid nodules or small areas of overactivity.[24]

NURSING INTERVENTIONS

Nursing interventions for hyperthyroidism focus on medication management, nutritional support and hydration, and symptom management to promote client comfort.

Medication Compliance

Nurses administer antithyroid medications as prescribed and provide health teaching about the medication and potential side effects. Education is also provided regarding the importance of regular follow-up appointments and blood tests to monitor thyroid hormone levels.

Nutritional Support and Hydration

Nurses encourage a high-calorie diet to support the increased metabolic rate associated with hyperthyroidism. The client's weight and nutritional status are monitored. Adequate fluid intake is also promoted because hyperthyroidism can lead to increased thirst and sweating.

Symptom Management

Clients with exophthalmos are typically prescribed eye drops to alleviate discomfort. Additional eye care may be required.

If the client is experiencing symptoms of anxiety and agitation as a result of elevated T3 and T4 levels, nurses encourage rest and a calm environment.

24. Ross, D. S., & Sugg, S. L. (2023). Surgical management of hyperthyroidism. *UpToDate*. www.uptodate.com

Evaluation

Evaluation focuses on the effectiveness of the nursing interventions by reviewing the client's expected outcomes to determine if they were met by the time frames indicated. For thyroid disorders, evaluation focuses on the normalization of thyroid panel results and the resolution of associated symptoms. During the evaluation phase, nurses use critical thinking to analyze reassessment data and determine if a client's expected outcomes have been met, partially met, or not met by the time frames established. If outcomes are not met or only partially met by the time frame indicated, the care plan should be revised. Reassessment should occur every time the nurse interacts with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with others on the interprofessional team.

Comparison of Hypothyroidism and Hyperthyroidism

The clinical manifestations of hypothyroidism and hyperthyroidism can be easily remembered by recalling the opposite effects of "not enough" thyroid hormones versus "too much" thyroid hormones on various body systems. See Figure 7.17 [25] for an illustration comparing the manifestations of hypothyroidism and hyperthyroidism.

25. "Hyperthyroidism and Hypothyroidism" by Meredith Pomietlo is licensed by CC BY-NC 4.0.

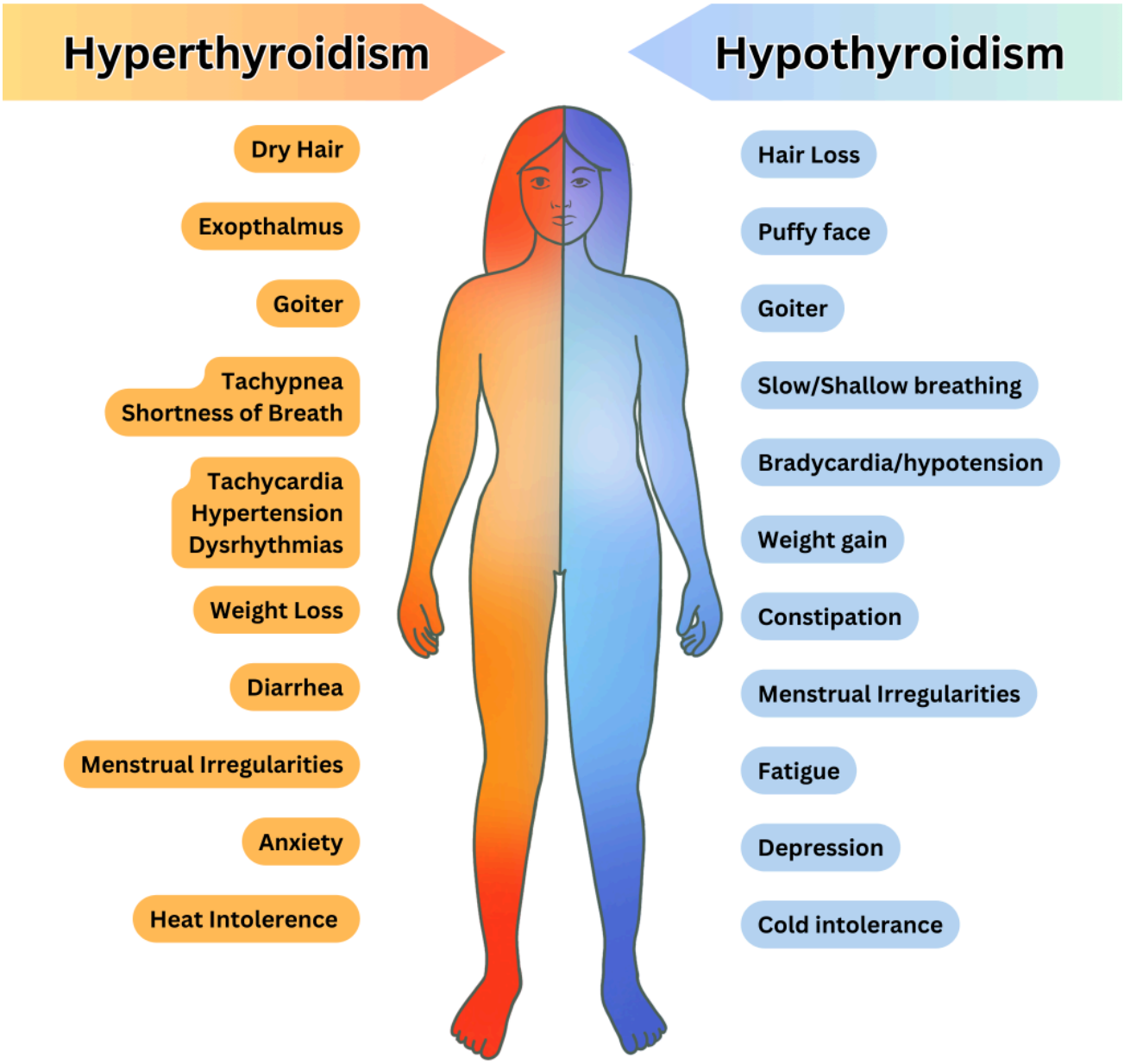


Figure 7.17 Comparison of the Clinical Manifestations of Hyperthyroidism and Hypothyroidism

View a supplementary YouTube video[26] from Nurse Mike on hypothyroidism/hyperthyroidism: Hyperthyroidism vs. Hypothyroid RN LPN NCLEX.



RN Recap: Hypothyroidism and Hyperthyroidism

View a brief YouTube video overview of hypothyroidism and hyperthyroidism[27]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2038#oembed-1

26. Simple Nursing. (2019, August 21). *Hyperthyroidism vs. hypothyroid RN LPN NCLEX* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=YyHM9xQyyas

27. Open RN Project. (2024, June 23). *Health Alterations – Chapter 7 – Hypothyroidism & hyperthyroidism* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/s3H4sc-3OFQ?si=l7aClnLjARPP8tTz

7.7 Adrenal Disorders

The adrenal glands are a pair of small, triangular-shaped glands located on top of each kidney. See Figure 7.18[1] for an illustration of the location of the adrenal glands.

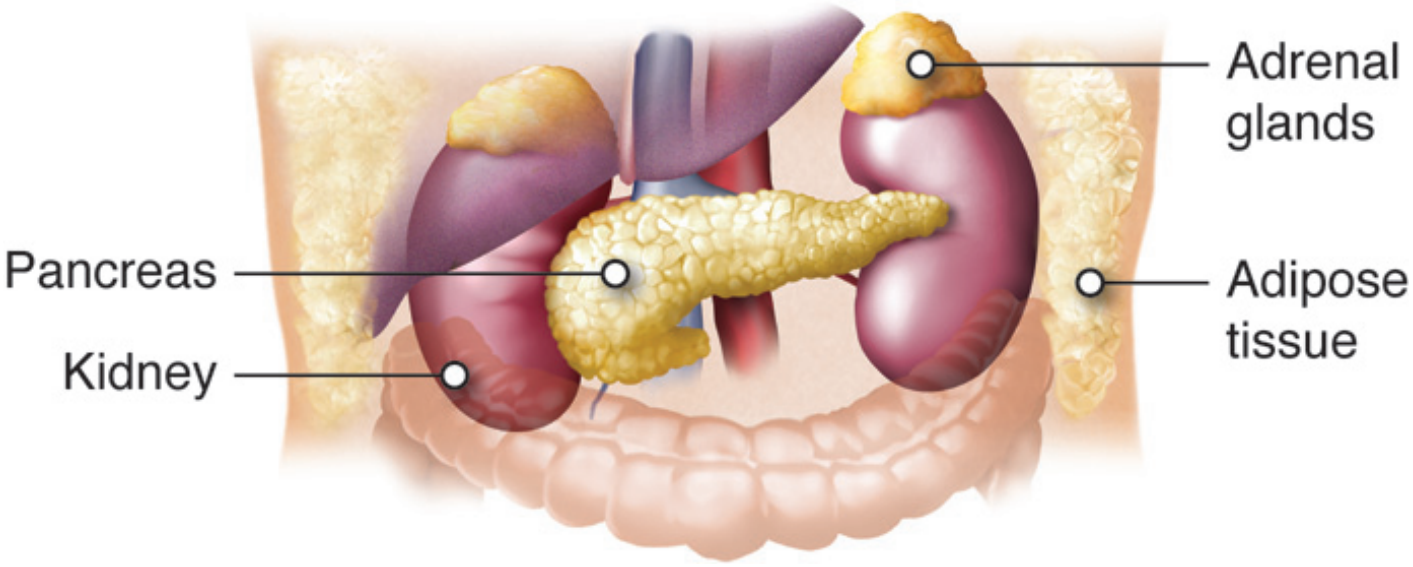


Figure 7.18 Location of Adrenal Glands

The adrenal glands are responsible for producing several hormones that are essential for maintaining overall health and regulating various body functions. The two primary parts of the adrenal glands are the adrenal cortex and the adrenal medulla, each of which produces different hormones. See Figure 7.19[2] for an illustration of adrenal cortex and adrenal medulla.

1. "E_M1_13.jpg" by SBCCOE is licensed under a CC BY-NC-SA 4.0. Access for free at https://pressbooks.ccconline.org/bio106/chapter/endocrine-structures-and-functions/.
2. "E_M1_14a.jpg" by SBCCOE is licensed under a CC BY-NC-SA 4.0. Access for free at https://pressbooks.ccconline.org/bio106/chapter/endocrine-structures-and-functions/.

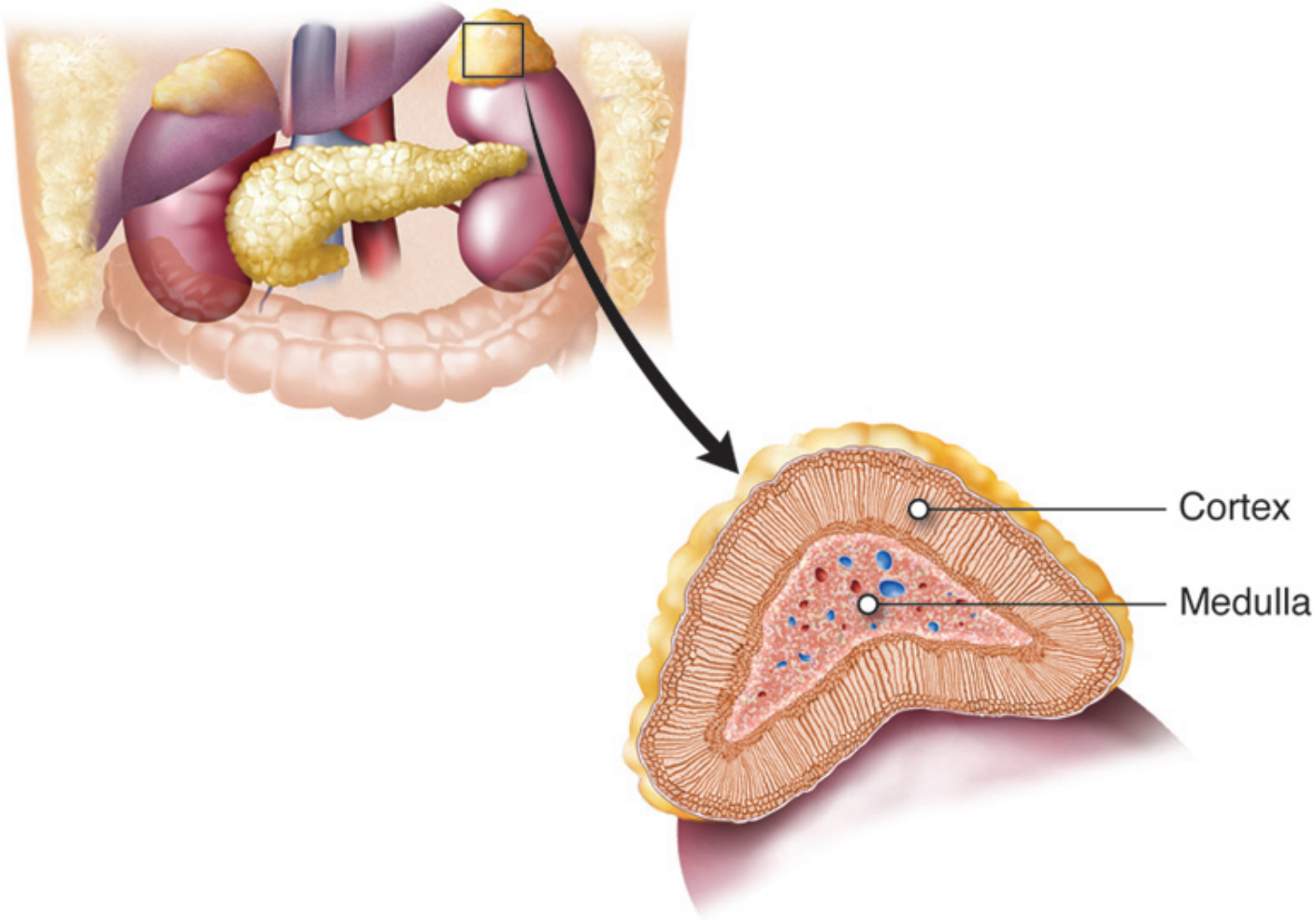


Figure 7.19 Adrenal Cortex and Adrenal Medulla

The adrenal cortex produces corticosteroids, including cortisol and aldosterone, which help to regulate metabolism, immune response, and salt and water balance. **Cortisol** is a glucocorticoid hormone produced by the adrenal glands that regulates physiological processes in the body. It is referred to as the "stress hormone" due to its involvement in the body's stress response. **Aldosterone** is a mineralocorticoid hormone produced by the adrenal gland that regulates the salt and water balance of the body in the kidneys by increasing the retention of sodium and water and excreting potassium.

The adrenal medulla produces catecholamines, including **epinephrine** and **norepinephrine**. These hormones help induce the fight-or-flight response

and play a critical role in elevating heart rate and blood pressure to prepare the body in times of stress or danger.[3]

Adrenal Insufficiency: Addison's Disease

Addison's disease refers to a specific type of adrenal gland insufficiency, resulting in inadequate production of cortisol and aldosterone. Addison's disease is often the result of an autoimmune response and destruction of the adrenal glands. It can also occur as the result of tuberculosis; infection; or the sudden cessation of long-term, high-dose glucocorticoid treatment.[4]

Addisonian crisis is a life-threatening medical emergency that occurs when the body's need for the hormones cortisol and aldosterone exceeds the available supply. This crisis is a severe complication of Addison's disease, a condition in which the adrenal glands do not produce enough of these critical hormones. The crisis often occurs in response to a stressful event, such as an infection, surgery, trauma, or a significant physical or emotional stressor.[5,6] Read additional information about Addisonian crisis in the following box.

3. Roman, S., & Wu, L. (2022). Surgical anatomy of the adrenal glands. *UpToDate*. www.uptodate.com

4. Niema, L., & DeSantis, A. (2023). Determining the etiology of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

5. Niema, L., & DeSantis, A. (2023). Determining the etiology of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

6. Nieman, L., & DeSantis, A. (2023). Treatment of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

A Closer Look: Emergency Care of Client in Addisonian Crisis[7]

An Addisonian crisis is a life-threatening situation, and prompt medical attention is crucial. In an Addisonian crisis there is a rapid shift in electrolytes. Sodium (Na) levels fall, leading to hyponatremia, while potassium (K) levels rise, causing hyperkalemia. These electrolyte imbalances can result in various life-threatening complications, including cardiac arrhythmias. Low blood pressure is another hallmark sign of an Addisonian crisis. It occurs due to the loss of aldosterone, which subsequently impairs the body's ability to retain sodium.

Prompt intervention requires administration of intravenous fluids with saline to rapidly correct the dehydration, raise blood pressure, and correct electrolyte imbalances. These fluids help raise blood pressure and restore blood volume. Intravenous corticosteroids, such as hydrocortisone, are administered to rapidly replace the deficient cortisol. If hyperkalemia is present, medications may be given to lower potassium levels and reduce the risk of life-threatening cardiac arrhythmias.

Assessment of Adrenal Insufficiency

Common assessment findings for adrenal insufficiency can be seen in Table 7.7a.

7. Nieman, L., & DeSantis, A. (2023). Treatment of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

Table 7.7a. Common Manifestations of Adrenal Insufficiency[8]

Body System	Clinical Manifestations
General	Fatigue, weakness, weight loss, and salt cravings
Cardiovascular	Hypotension, dizziness, and fainting episodes
Gastrointestinal	Abdominal pain, diarrhea, nausea and vomiting, and anorexia (loss of appetite)
Musculoskeletal	Muscle weakness, joint pain and stiffness, and muscle and joint aches
Endocrine	Hypoglycemia, loss of pubic and axillary hair, amenorrhea (absence of menstrual periods in women), reduced libido and sexual dysfunction, infertility, and **oligomenorrhea** (infrequent or irregular menstrual periods)
Dermatological	**Hyperpigmentation** (darkening of the skin, especially in sun-exposed areas), skin thinning, easy bruising, **vitiligo** (loss of skin pigmentation), **hyperhidrosis** (excessive sweating), and slow wound healing
Neurological	Lethargy and apathy, depression and mood changes, difficulty concentrating, confusion and cognitive changes, headache, and irritability

See Figure 7.20[9] for an illustration of the clinical manifestations of adrenal insufficiency.

8. Nieman, L. K. (2022). Clinical manifestations of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

9. "Adrenal Insufficiency" by Meredith Pomietlo is licensed under CC BY-NC 4.0

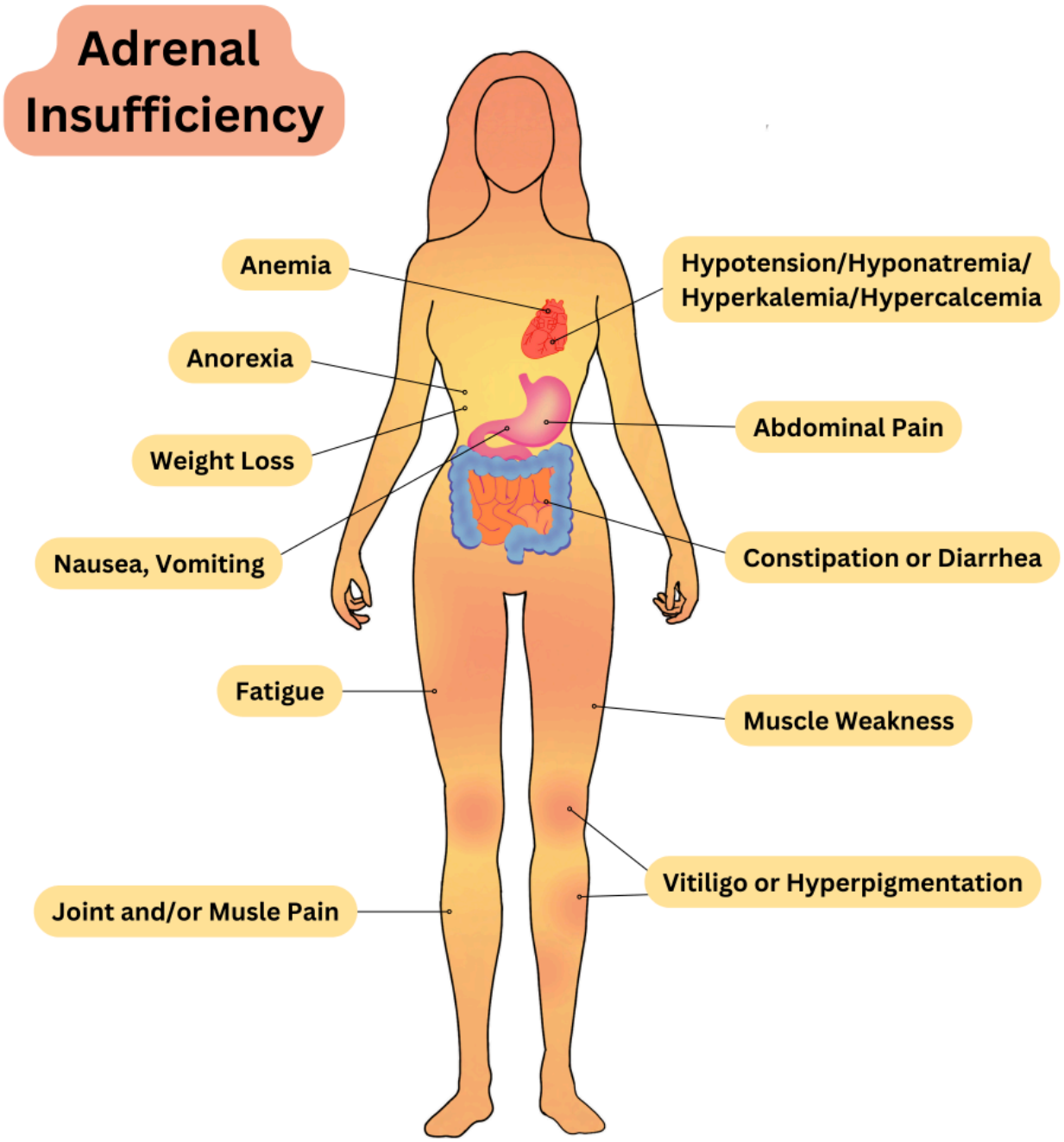


Figure 7.20 Clinical Manifestations of Adrenal Insufficiency

DIAGNOSTIC TESTING

Diagnosing Addison's disease involves a combination of clinical assessment, laboratory tests, and specialized tests to confirm adrenal insufficiency. Addison's disease is characterized by the insufficient production of cortisol and often aldosterone by the adrenal glands, so serum cortisol and aldosterone levels are abnormally low. Additionally, as a result of abnormally

low aldosterone levels, electrolyte imbalances can also be found, including **hyponatremia** (low sodium) and **hyperkalemia** (elevated potassium).[10] Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing diagnoses for clients with adrenal gland hypofunction can help guide nursing care and address the specific needs of these individuals.

Common nursing diagnoses include the following:

- Risk for Imbalanced Fluid Volume
- Impaired Skin Integrity
- Fatigue
- Imbalanced Nutrition: Less Than Body Requirements

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

- *The client will maintain adequate fluid balance as evidenced by stable vital signs and absence of signs and symptoms of dehydration or fluid overload.*
- *The client will exhibit intact skin without any signs of breakdown, ulceration, or infection.*
- *The client will demonstrate improved ability to perform activities of daily living without excessive fatigue.*

10. Nieman, L., & DeSantis, A. (2023). Treatment of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

- *The client will achieve and maintain a stable and appropriate body weight.*

Interventions for Adrenal Insufficiency

MEDICAL INTERVENTIONS

Medical interventions for adrenal insufficiency focus on medication therapy to replace the deficient hormones and effectively manage the condition to prevent adrenal crisis.

Medication Therapy

Clients with Addison's disease are typically prescribed oral glucocorticoid medications, such as hydrocortisone, prednisone, or dexamethasone, to replace deficient cortisol levels. The dose is often divided into multiple daily doses to mimic the body's natural cortisol release pattern.

Clients may also require mineralocorticoid replacement with medications like fludrocortisone to replace aldosterone and regulate salt and water balances in the body.

Clients with adrenal insufficiency often have abnormal electrolyte levels. Those presenting with hyperkalemia require urgent treatment to lower their potassium levels, along with close cardiac monitoring.

> Review information about treatment of abnormal electrolyte levels in the "Electrolytes" section of the "Fluids and Electrolytes" chapter in Open RN *Nursing Fundamentals, 2e.*

Hormone Monitoring

Periodic blood tests are conducted to assess hormone levels and adjust

medication doses as needed. Clients are educated about the need to increase their glucocorticoid medication during times of illness, injury, or stress to prevent an adrenal crisis.

Lifestyle Changes

Clients are advised to maintain a well-balanced diet and avoid excessive stress, which can exacerbate symptoms.[11]

NURSING INTERVENTIONS

Nursing interventions for adrenal insufficiency focus on medication management, health teaching, and nutritional support.

Medication Management

Nurses administer prescribed glucocorticoid and mineralocorticoid replacement medications during inpatient care according to the health care provider's orders. Health teaching is provided about proper medication administration techniques and adherence to the medication schedule.

Health Teaching

Nurses provide health teaching about several topics to clients with adrenal insufficiency:

- The disease process and the importance of medication adherence.
- Signs and symptoms of adrenal crises and when to immediately notify the health care provider. Additional doses of medications may be required during illness and stressful situations.

11. Nieman, L., & DeSantis, A. (2023). Treatment of adrenal insufficiency in adults. *UpToDate*. www.uptodate.com

- Wearing a medical alert bracelet or necklace to inform health care professionals of their diagnosis if an emergency should occur.

Nutritional Support

Nurses advocate for multidisciplinary treatment with a registered dietician to develop a well-balanced diet plan and to ensure adequate sodium intake for clients on mineralocorticoid replacement therapy. The nurse also monitors the client's dietary intake and hydration status.

Evaluation

Evaluation focuses on the effectiveness of the nursing interventions by reviewing the client's expected outcomes to determine if they were met by the time frames indicated. During the evaluation phase, nurses use critical thinking to analyze reassessment data and determine if a client's expected outcomes have been met, partially met, or not met by the time frames established. If outcomes are not met or only partially met by the time frame indicated, the care plan should be revised. Reassessment should occur every time the nurse interacts with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with others on the interprofessional team.

Nurses refer to the previously identified outcome statements and perform reassessments to determine if they have been met by the current nursing care plan or if additional interventions are required. For example, the nurse would perform assessments related to the previously established outcome criteria and determine if they were "met" or if additional interventions are required.

Cushing's Disease & Cushing's Syndrome

Excessive amounts of adrenal hormones, including glucocorticoids (cortisol), mineralocorticoids (aldosterone), and/or catecholamines (epinephrine and norepinephrine), can be caused by a medical condition or a side effect of

other medications. **Cushing's disease** is typically caused by a benign tumor in the adrenal gland that causes excess hormone production. **Cushing's syndrome** is caused by excess glucocorticoid blood levels caused by medication therapy for another medical problem, such as COPD or immunosuppressive therapy after an organ transplant. In both cases, excessive glucocorticoids can cause widespread issues throughout the body.[12]

Assessment of Cushing's Disease and Cushing's Syndrome

Common assessment findings for Cushing's disease and Cushing's syndrome are summarized in Table 7.7b.

Table 7.7b. Common Manifestations of Cushing's Disease and Cushing's Syndrome[13]

Body System	Clinical Manifestations
Endocrine	Elevated blood pressure, impaired glucose tolerance, and weight gain and obesity with classic signs such as a collection of fat on the back of the neck between the shoulder blades and a round face
Cardiovascular	Hypertension, palpitations, and rapid heart rate
Musculoskeletal	Muscle weakness and wasting and increased risk of fracture
Integumentary	Easy bruising and thinning of the skin and purple or red stretch marks (**striae**)
Gastrointestinal	Abdominal obesity and central weight gain, increased appetite, and overeating
Neurological	Mood changes, including anxiety and depression, irritability, headaches, and cognitive impairment
Immune	Increased susceptibility to infections, delayed wound healing, and poor scar formation
Reproductive	Irregular menstrual periods in women with PCOS, **hirsutism** (excessive hair growth) in women, and decreased libido and erectile dysfunction in men
Renal	Fluid retention and edema and increased urinary frequency and urgency
Ocular	Increased intraocular pressure and risk of glaucoma and visual disturbances, including blurry vision

12. Nieman, L. K. (2022). Causes and pathophysiology of Cushing syndrome. *UpToDate*. www.uptodate.com

13. Nieman, L. K. (2023). Epidemiology and clinical manifestations of Cushing syndrome. *UpToDate*. www.uptodate.com

See Figure 7.21 [14] by for an illustration of common clinical manifestations of Cushing's Disease and Cushing's Syndrome.

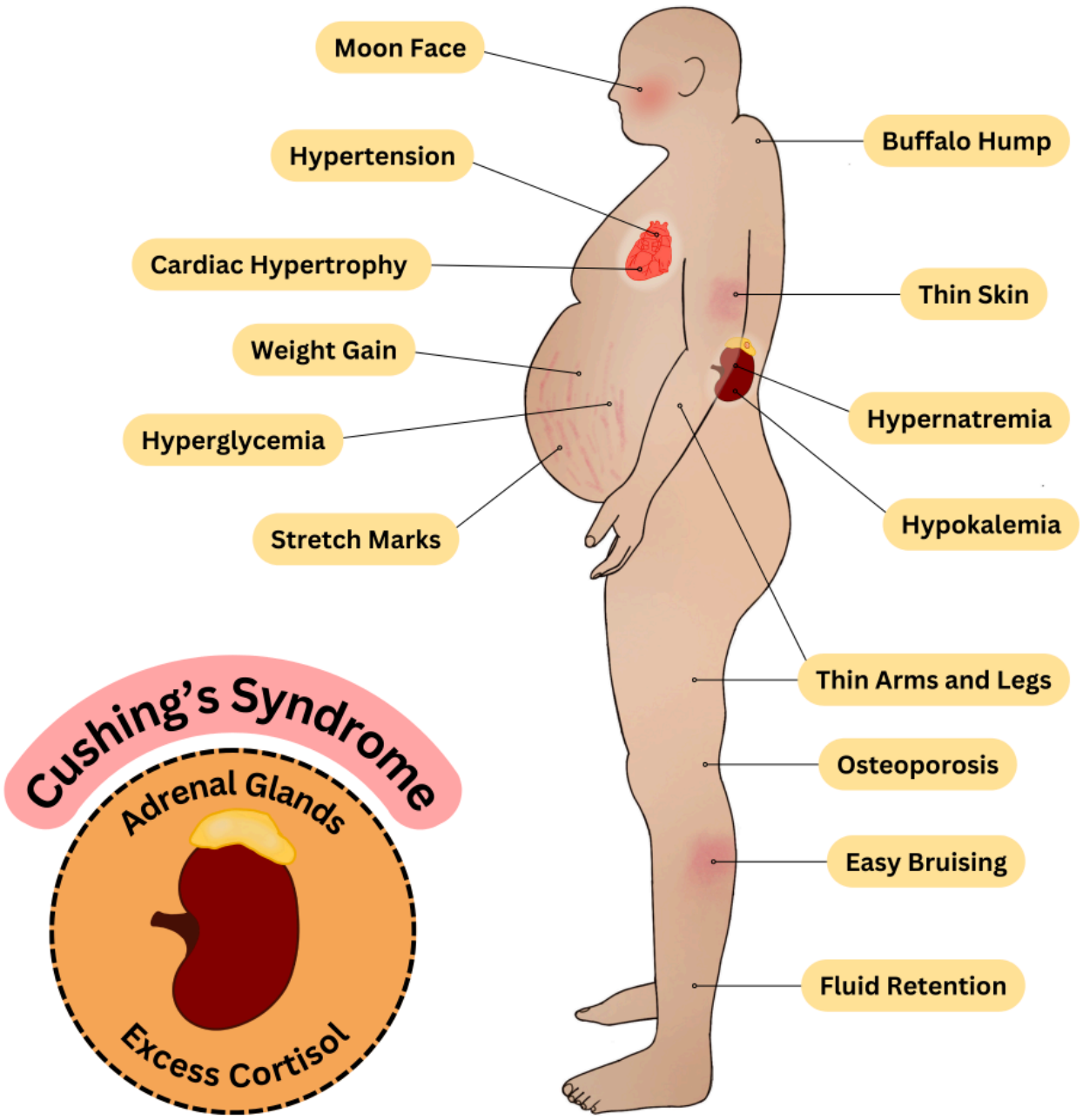


Figure 7.21 Common Manifestations of Cushing's Disease and Cushing's Syndrome

14. "Cushing's Syndrome by Meredith Pomietlo is licensed under CC BY-NC 4.0

DIAGNOSTIC TESTING

Diagnostic testing includes blood tests of cortisol and aldosterone levels. Review information about cortisol testing under diagnostic testing in the "Adrenal Insufficiency" subsection. Electrolytes are commonly monitored because excessive aldosterone levels can cause hypernatremia (elevated sodium) and hypokalemia (decreased potassium).[15]

Nursing Diagnoses

Nursing diagnoses for clients with excessive adrenal hormones guide nursing care and address the specific needs of these individuals. Common nursing diagnoses include the following:

- Fluid Volume Excess
- Imbalanced Nutrition: More Than Body Requirements
- Disturbed Body Image
- Impaired Skin Integrity
- Risk for Infection

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

- *The client will maintain optimal fluid balance as evidenced by normal blood pressure, no signs of edema, and balanced input and output within normal limits.*
- *The client will achieve and maintain a healthy body weight, with weight*

15. Nieman, L. K. (2023). Establishing the diagnosis of Cushing syndrome. *UpToDate*. www.uptodate.com

gain within recommended limits, while demonstrating knowledge of appropriate portion sizes and balanced dietary choices.

- *The client will exhibit improved body image and self-esteem, as evidenced by positive self-talk, engagement in activities they enjoy, and verbalization of self-acceptance.*
- *The client will maintain intact skin and prevent skin breakdown, as evidenced by the absence of skin lesions, regular skin assessments, and adherence to recommended skin care routines.*

Interventions for Cushing's Disease and Cushing's Syndrome

MEDICAL INTERVENTIONS

Medical interventions include surgery or radiation therapy, medication therapy, and lifestyle modifications.

Surgery/Radiation Therapy

Surgery may be used to remove a tumor or the affected area of the adrenal gland in cases of adrenal adenoma or pituitary adenoma. Radiation therapy may also be utilized following surgery.

Medication Therapy

If a client is experiencing Cushing's disease as a result of glucocorticoid therapy for another condition, the medication may be stopped or reduced, if possible. Medications, such as aminoglutethimide and ketoconazole, may be prescribed to suppress cortisol production. Mineralocorticoid receptor antagonists such as spironolactone may also be prescribed to help control blood pressure and manage electrolytes. Beta-blockers may also be prescribed to help manage blood pressure and heart rate.

Read additional information about spironolactone and beta-blockers in the "Cardiovascular & Renal Systems" chapter of Open RN *Nursing Pharmacology, 2e*.

Lifestyle Modifications

Dietary modifications may be necessary to address weight gain or changes in appetite. Clients may also be advised to reduce sodium intake in conditions of excess aldosterone. Regular exercise, stress management, and healthy lifestyle choices can help manage symptoms and improve overall well-being.[16]

NURSING INTERVENTIONS

Nursing interventions for Cushing's disease and Cushing's syndrome focus on promoting fluid and electrolyte balance, providing health teaching on diet and exercise, and psychological support.

Promoting Fluid and Electrolyte Balance

Nurses monitor for signs of electrolyte imbalances (e.g., potassium levels) and provide education on dietary changes and medications to address these imbalances. Health teaching about dietary sodium restrictions is provided, if necessary, to help manage fluid balance.

16. Nieman, L. K. (2023). Overview of the treatment of Cushing syndrome. *UpToDate*. www.uptodate.com

Health Teaching

Nurses provide health teaching to clients with Cushing's disease on balanced nutrition and weight management. In collaboration with dieticians, meal plans are developed, and clients are taught about portion control and healthy food choices. Clients are encouraged to participate in regular physical activity to improve muscle strength and overall well-being. Exercise routines are planned that are aligned with their energy level and physical capabilities.

Psychological Support

Nurses provide emotional support and encourage open communication to help clients cope with the chronic nature of their condition and any body image changes. Resources are provided for support groups and counseling, as indicated.

Evaluation

Evaluation focuses on the effectiveness of the nursing interventions by reviewing the client's expected outcomes to determine if they were met by the time frames indicated. During the evaluation phase, nurses use critical thinking to analyze reassessment data and determine if a client's expected outcomes have been met, partially met, or not met by the time frames established. If outcomes are not met or only partially met by the time frame indicated, the care plan should be revised. Reassessment should occur every time the nurse interacts with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with others on the interprofessional team.

Nurses refer to the previously identified outcome statements and perform reassessments to determine if they have been met by the current nursing care plan or if additional interventions are required. For example, the nurse would perform assessments related to the previously established outcome criteria and determine if they were "met" or if additional interventions are required.



RN Recap: Cushing's Disease and Cushing's Syndrome

View a brief YouTube video overview of Cushing's disease and Cushing's syndrome[17]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2120#oembed-1



RN Recap: Adrenal Insufficiency

View a brief YouTube video overview of adrenal insufficiency[18]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2120#oembed-2

17. Open RN Project. (2024, April 24). *Health Alterations – Chapter 7 Endocrine – Cushing's syndrome and Cushing's disease* [Video]. YouTube. CC BY-NC 4.0https://www.youtube.com/watch?v=u6To7kidkg0

18. Open RN Project. (2024, June 23). *Health Alterations – Chapter 7 – Adrenal insufficiency* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/dYw0vwib4QU?si=p_VNu76TDiM9nKU-

View a supplementary YouTube video[19] comparing Addison's disease and Cushing's disease:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2120#oembed-3

19. RegisteredNurseRN.(2016, April 15). *Cushings and Addisons nursing | Addison's disease vs Cushing's syndrome nursing | Endocrine NCLEX*. [Video]. YouTube. All rights reserved. Reused with permission. https://www.youtube.com/watch?v=w_I-8aKaq68

7.8 Parathyroid Disorders

The parathyroid glands are found around the thyroid. They regulate calcium excretion by secreting **parathyroid hormone (PTH)**. See Figure 7.22[1] for an illustration of the parathyroid glands.

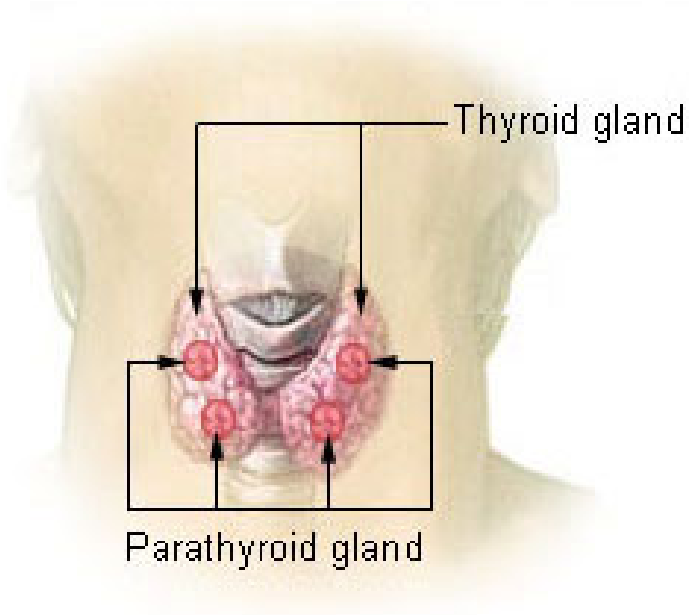


Figure 7.22 Parathyroid Glands

PTH secretion occurs as part of a negative feedback loop in response to low calcium levels in the blood. Calcium is reabsorbed in both the kidneys and intestine and released from the bones to increase serum calcium levels. Due to the inverse relationship of calcium and phosphorus, low calcium levels result in elevated phosphate levels in the blood.

Hypoparathyroidism

The primary cause of hypoparathyroidism is a complication of a thyroidectomy or head and neck surgery when the parathyroid glands are

1. "Illu_thyroid_parathyroid.jpg" by unknown author for National Cancer Institute is licensed in the Public Domain.

inadvertently removed, resulting in hypocalcemia. Signs and symptoms of hypocalcemia often impact the musculoskeletal, nervous, and cardiac systems. Hypocalcemia may result in numbness, paresthesia, muscle cramps, and cardiac dysrhythmias. If severe, hypocalcemia can cause laryngospasm, **tetany** (involuntary muscle contraction), and seizures. **Chvostek's sign** is a classic sign of acute hypocalcemia and is an involuntary twitching of facial muscles when the facial nerve is tapped. A second classic sign of acute hypocalcemia is **Trousseau's sign**, a hand spasm caused by inflating a blood pressure cuff to a level above systolic pressure for three minutes.[2]

Hypoparathyroidism is treated with calcium supplements and calcitriol (vitamin D). Dietary recommendations for clients with hypoparathyroidism include food sources that are high in calcium, vitamin D, and low in phosphorus. Phosphate binders may also be prescribed if phosphorus levels are elevated. Clients treated for hypoparathyroidism with calcium and calcitriol must have periodic blood tests performed for calcium, phosphorus, and renal function. The absence of PTH reduces the reabsorption of calcium in the kidneys, so they are also at risk for developing kidney stones as a result of calcium deposits building up in the kidney tissue.[3] This is especially common in conditions of chronic hypoparathyroidism. This risk can be minimized by titrating therapy to keep the serum calcium level in the low-normal range. In most cases, this will be sufficient to prevent muscle cramps and paresthesia yet limit the risk of kidney stones.[4]

2. Hans, S. K., & Levine, S. N. (2024). *Hypoparathyroidism*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441899/

3. Abdullah, A. (2021). *Chronic hypoparathyroidism linked to higher risk of kidney stones*. https://hypoparathyroidismnews.com/news/chronic-hypoparathyroidism-linked-significantly-higher-risk-kidney-stones-calcification-large-study/

4. Hans, S. K., & Levine, S. N. (2024). *Hypoparathyroidism*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441899/

Hyperparathyroidism

Hyperparathyroidism is overactivation of parathyroid glands causing excessive release of parathyroid hormone, resulting in hypercalcemia. Hypercalcemia results from PTH encouraging bone breakdown and increased absorption of calcium from intestines and kidneys. Signs and symptoms of hypercalcemia include nausea, vomiting, constipation, increased thirst and/or urination, dysrhythmias, bone pain, kidney stones, lethargy/fatigue, and skeletal muscle weakness. Other associated symptoms include nonspecific client complaints such as depression, memory loss, fatigue, sleep problems, bone or muscle pains, gastroesophageal reflux disease, and decreased concentration.[5]

Hyperparathyroidism is often diagnosed when elevated calcium levels are discovered on lab work that was prescribed for other medical reasons. The most common cause of hyperparathyroidism is a parathyroid tumor that is treated and cured with surgery. Additional interventions include administration of IV fluids, calcium chelators, and furosemide. Postoperatively, there is typically significant improvement in the previously reported nonspecific symptoms, resulting in improved quality of life. Potential postoperative complications include hematoma formation leading to airway obstruction, hypoparathyroidism/hypocalcemia, and laryngeal nerve injury. Postoperative hypocalcemia is treated with calcium and vitamin D supplementation.[6]

5. Madkhali, T., Alhefdhi, A., Chen, H., & Elfenbein, D. (2016). Primary hyperparathyroidism. *Ulusal Cerrahi Dergisi, 32*(1), 58-66. https://doi.org/10.5152/ucd.2015.3032

6. Madkhali, T., Alhefdhi, A., Chen, H., & Elfenbein, D. (2016). Primary hyperparathyroidism. *Ulusal Cerrahi Dergisi, 32*(1), 58-66. https://doi.org/10.5152/ucd.2015.3032



RN Recap: Hyperparathyroidism and Hypoparathyroidism

View a brief YouTube video overview of hyperparathyroidism and hypoparathyroidism[7]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2149#oembed-1

7. Open RN Project. (2024, June 23). *Health Alterations – Chapter 7 – Hyperparathyroidism & hypoparathyroidism* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/jPW7O4QB0_4?si=Rly_Fs0CIfqRkgwN

7.9 Learning Activities

Learning Activities

Diabetes Case Study

(Case Study answers are located in the Answer Key at the end of the book.)[1]

Daisy Hernandez is a 65-year-old woman presenting to the emergency department complaining of fatigue, excessive thirst, and frequent urination. She is from a low-income background and primarily speaks Spanish. Her medical history includes hypertension, and she has a family history of diabetes mellitus type 2. Daisy mentions she has not visited a doctor in the last year due to financial constraints and has not had blood work done in the past two years. Her vital signs are stable, with a blood pressure of 130/80 mmHg, a heart rate of 78 beats per minute, and a respiratory rate of 16 breaths per minute.

Assessment Findings

- General Appearance: Daisy appears tired and has a dry oral mucosa
- Skin: No apparent signs of infection or diabetic ulcers
- Heart and Lungs: Regular heart rate and rhythm, no murmurs or crackles

1. "Diabetes Study" by Open RN is licensed under CC BY-NC 4.0

- Abdomen: Soft, nontender, and nondistended
- Neurological: No signs of focal deficits, sensory disturbances, or motor impairments
- Extremities: No evidence of peripheral neuropathy or vascular compromise
- BMI: 30 kg/m^2 (Overweight)
- Waist circumference: 40 inches

Lab Results

- Blood glucose: 238 mg/dL (normal range: 70-110 mg/dL)
- Urine glucose: Positive
- Urine ketones: Negative

Provider Orders

Daisy's provider initiates fluid replacement to address her dehydration and starts insulin therapy to manage hyperglycemia. Daisy has also been prescribed metformin as an oral hypoglycemic agent and lisinopril for blood pressure control.

Questions

1. What cultural considerations should be taken into account when developing Daisy's care plan?
2. How would you assess Daisy's understanding of her diagnosis and treatment plan given her primary language is Spanish?
3. What lifestyle modifications would you suggest to Daisy, considering her socioeconomic background?
4. What community resources could be utilized to support Daisy's long-term management of diabetes?
5. How might Daisy's social and financial status impact her ability to access care and medications regularly?
6. How would you involve Daisy's family in her care plan to support her management of diabetes?

Hyperthyroidism vs. Hypothyroidism Case Studies

(Case Study answers are located in the Answer Key at the end of the book.)[2]

1. When the thyroid stimulating hormone (TSH) is released, what two thyroid hormones are released by the thyroid? What element is needed for the body to use these hormones?
2. The most common cause of hyperthyroidism is _____ disease.
3. Name two autoimmune diseases that affect thyroid function.
4. Describe signs/symptoms of a thyroid storm (thyrotoxicosis). What causes a thyroid storm?
5. The nurse is getting a new client with an admitting diagnosis of possible ("rule-out") myxedema coma.

   - What equipment should the nurse place in the room and why?
   - What are two risk factors for myxedema coma?

6. What are the signs/symptoms of hypothyroidism? What content should be included when teaching a client with hypothyroidism about diet and activity?
7. The nurse is preparing to administer levothyroxine orally.

   - What is the onset of action?
   - When should levothyroxine be administered and why?

2. "Hyperthyroidism vs. Hypothyroidism Case Studies" by Melissa Hauge is licensed under CC BY-NC 4.0

8. (TRUE or FALSE) Levothyroxine should not be taken during pregnancy.

Thyroid Case Study 1

Ms. Hype had a thyroidectomy three months ago for thyroid cancer and has been taking levothyroxine for thyroid hormone replacement. She is having difficulty sleeping at night and is losing weight even though she says she is eating "...all the time." She is wearing shorts and a t-shirt in January because she feels "so hot all the time." She is restless and frequently asking how long this appointment will take.

Vital Signs: Temperature 101.2 F, Pulse 112, Respirations 18, BP 162/94

9. What could be contributing to her symptoms?
10. What is the action of PTU (propylthiouracil)? What two side effects should be reported?
11. How does SSKI (potassium iodide) affect the thyroid?

Thyroid Case Study 2

A client with thyroid cancer has a scheduled thyroidectomy. The provider recently administered the capsule containing RAIU (radioactive iodine uptake).

12. Describe health teaching topics following their ingestion of this medication?
13. Describe nursing care following a thyroidectomy and identify two specific rationales for these nursing interventions.

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https://wtcs.pressbooks.pub/healthalts/?p=2152#h5p-27

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https://wtcs.pressbooks.pub/healthalts/?p=2152#h5p-28

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https://wtcs.pressbooks.pub/healthalts/?p=2152#h5p-29

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An interactive H5P element has been excluded from this version of the text. You can view it

online here:
https://wtcs.pressbooks.pub/healthalts/?p=2152#h5p-58

"Case Study: Diabetes Mellitus Type 1" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=2152#h5p-30

"Case Study: Symptoms of Dehydration – Head Injury Branching Scenario" by Kellea Ewen for Open RN is licensed under CC BY-NC 4.0

- Test your knowledge on diabetes using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[3]

3. "Diabetes – Level 2" by Angela Landry for OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on hypothyroidism using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[4]



- Test your knowledge on Cushing's disease using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[5]



- Test your knowledge on complications resulting from hyperthyroidism using this NCLEX Next Generation-style case study. You may reset and



4. "Hypothyroidism" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

5. "Cushing's Disease" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

resubmit your answers to this question an unlimited number of times.[6]

- Test your knowledge on endocrine conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[7]

- Test your knowledge on endocrine conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[8]

6. "Hyperthyroidism" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

7. "Endocrine Bowtie" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

8. "Pediatric Endocrine Bowtie" by Kellea Ewen, Jennifer Hinz and OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on managing diabetic ketoacidosis using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[9]

Telehealth Scenarios

Telehealth is an innovative technology that can bridge the gap between health care professionals and clients, especially for clients who live in remote areas. Telehealth not only makes health care more accessible but can also provide continuity of care and prevent unnecessary hospitalizations. Nurses who provide telehealth services become digital communicators and educators, merging clinical expertise with empathy and effective online communication.

Practice using effective telehealth communication in the following three scenarios with a 76-year-old African American female with type I diabetes and a recent hospitalization for a right below-knee amputation who is self-managing his condition at home[10]:

9. "Endocrine Case Study" by Travis Christman for OpenRN is licensed under CC BY-NC 4.0

10. Telehealth Simulations by Open RN and Codaptive Labs are licensed under CC BY-NC 4.0

- Marian Johnson, Telehealth Visit 1: Post-hospitalization Follow-Up
- Marian Johnson, Telehealth Visit 2: Identifying Learning Needs
- Marian Johnson, Telehealth Visit 3: Evaluating Health Teaching

VII Glossary

15-15 Rule: Suggests consuming or administering 15 grams of a carbohydrate, followed by a 15-minute wait and then remeasurement of blood glucose level to assess if blood glucose has returned to normal levels. (Chapter 7.5)

Acanthosis nigricans: Hyperpigmentation often found in the axilla, groin, and folds of the neck. (Chapter 7.5)

Addisonian crisis: Life-threatening medical emergency that occurs when the body's need for the hormones cortisol and aldosterone exceeds the available supply. (Chapter 7.7)

Adrenal cortex: Responsible for producing a group of steroid hormones known as corticosteroids. (Chapter 7.2)

Adrenal glands: Small glands located at the top of each kidney. (Chapter 7.2)

Adrenal medulla: Responsible for producing epinephrine and norepinephrine. (Chapter 7.2)

Adrenocorticotropic hormone (ACTH): Regulates the release of glucocorticoid hormone (cortisol) by the adrenal gland. (Chapter 7.2)

Aldosterone: A mineralocorticoid hormone produced by the adrenal gland that regulates the salt and water balance of the body in the kidneys by increasing the retention of sodium and water and excreting potassium. (Chapter 7.7)

Alpha cells: Secrete a hormone called glucagon. (Chapter 7.2)

Amenorrhea: Absence of menstrual periods. (Chapter 7.6)

Antidiuretic hormone (ADH): Regulates blood osmolarity by targeting the kidneys to increase water reabsorption. (Chapter 7.2)

Beta cells: Secrete insulin which facilitates the uptake of glucose by cells from the bloodstream. (Chapter 7.2)

Beta endorphin: Possesses morphine-like effects and plays a role in pain management and natural reward circuits such as feeding, drinking, sex, and maternal behavior. (Chapter 7.2)

Blood osmolarity: Concentration of solutes in the blood plasma. (Chapter 7.2)

Carbohydrate counting: Diabetic meal planning strategy in which

individuals keep track of the total grams of carbohydrates they consume in a meal, regardless of the food source. (Chapter 7.5)

Charcot joint: Chronic joint damage as the result of neuropathy. (Chapter 7.5)

Chvostek's sign: A classic sign of acute hypocalcemia and is an involuntary twitching of facial muscles when the facial nerve is tapped. (Chapter 7.8)

Continuous glucose sensor (CGS): A medical device designed to monitor and track blood glucose levels in the interstitial fluid. (Chapter 7.5)

Corticosteroids: Group of steroid hormones produced by the adrenal cortex; examples include mineralocorticoids, glucocorticoids, and androgens. (Chapter 7.2)

Cortisol: The most important glucocorticoid because it plays a crucial role in metabolism, immune response, and the body's response to stress. (Chapter 7.2, Chapter 7.7)

C-peptide: Generally found in amounts in the blood equal to the amount of insulin. (Chapter 7.5)

Cushing's disease: Typically caused by a benign tumor in the adrenal gland that causes excess hormone production. (Chapter 7.7)

Cushing's syndrome: Caused by excess glucocorticoid blood levels caused by medication therapy for another medical problem, such as COPD or immunosuppressive therapy after an organ transplant. (Chapter 7.7)

Delta cells: Secrete somatostatin. (Chapter 7.2)

Diabetes insipidus (DI): Rare medical condition characterized by excessive thirst and the excretion of large amounts of very dilute urine. (Chapter 7.2)

Diabetes mellitus (DM): A chronic medical condition marked by persistently elevated blood glucose levels. (Chapter 7.5)

Diabetes nephropathy: Kidney disease as the result of ongoing diabetes. (Chapter 7.5)

Diabetic ketoacidosis (DKA): Occurs during severe hyperglycemia episodes if the client's pancreas is no longer producing insulin. (Chapter 7.5)

Endocrine role: Refers to the production of glucagon and insulin by clusters of cells called islet cells to regulate blood glucose levels and keep them within a healthy range. (Chapter 7.2)

Epinephrine: A catecholamine produced by the adrenal medulla. (Chapter 7.7)

Estrogen: Hormone that promotes the development of breasts and the maturation of the uterus. (Chapter 7.2)

Exchange system: A meal planning method that categorizes foods into three main groups: carbohydrates (CHO), meat and meat substitutes, and fats, assigning specific portion sizes to each food group while allowing for the substitution of foods within the same group without significantly affecting blood glucose levels. (Chapter 7.5)

Exocrine role: Refers to the release of digestive enzymes called amylase and lipase that help to digest food. (Chapter 7.2)

Exophthalmos: Bulging eyes. (Chapter 7.6)

Fasting blood glucose (FBG): Assesses an individual's blood glucose level when they have had no caloric intake for at least eight hours (although water intake is permitted). (Chapter 7.5)

Follicle-stimulating hormone (FSH): Plays a role in sexual development and reproduction by affecting the function of the ovaries and testes. (Chapter 7.2)

Gastroparesis: Delayed stomach emptying, nausea, and vomiting. (Chapter 7.5)

Gestational diabetes: Elevated blood glucose occurs during pregnancy and typically resolves after the baby is born. (Chapter 7.5)

Glucagon: Hormone released in response to low blood glucose levels in order to raise blood glucose. (Chapter 7.2)

Gluconeogenesis: Stimulates the conversion of amino acids into glucose. (Chapter 7.2)

Glycogen: Glucose that is not immediately used by cells is stored in the liver and muscles. (Chapter 7.2)

Glycogenolysis: The conversion of glycogen stored in the liver into glucose and its release into the bloodstream. (Chapter 7.2)

Glycolysis: The first step in the breakdown of glucose to extract energy for cellular metabolism. (Chapter 7.2)

Goiter: A swelling or nodularity of the thyroid and a sign of both hypothyroidism and hyperthyroidism. (Chapter 7.6)

Graves' disease: A typically long-lasting or permanent condition resulting from autoimmune destruction of the thyroid gland. (Chapter 7.6)

Growth hormone (GH): Promotes growth in children, helps maintain normal body structure in adults, and plays a role in metabolism in both children and adults. (Chapter 7.2)

Hashimoto's thyroiditis: An autoimmune disease in which the immune system mistakenly attacks the thyroid gland, resulting in inflammation and damage. (Chapter 7.6)

Hemoglobin A1C (HbA1C): Assesses an individual's average blood glucose levels over the preceding two to three months. (Chapter 7.5)

Hirsutism: Excessive hair growth. (Chapter 7.7)

Homeostasis: The ability to maintain a stable state. (Chapter 7.2)

Hormone: A regulatory chemical substance produced by specialized cells or glands in the endocrine system that helps to regulate physiological processes. (Chapter 7.2)

Hyperglycemia: Occurs when a fasting blood glucose level is above 126 milligrams per deciliter (mg/dL) or a random blood glucose level exceeds 200 mg/dL. (Chapter 7.5)

Hyperhidrosis: Excessive sweating. (Chapter 7.7)

Hyperkalemia: Elevated potassium. (Chapter 7.7)

Hypernatremia: Elevated sodium. (Chapter 7.7)

Hyperosmolar hyperglycemic state (HHS): A severe hyperglycemic emergency, primarily seen in individuals with type 2 diabetes; often in older adults. (Chapter 7.5)

Hyperparathyroidism: Overactivation of parathyroid glands causing excessive release of parathyroid hormone, resulting in hypercalcemia. (Chapter 7.8)

Hyperpigmentation: Darkening of the skin, especially in sun-exposed areas. (Chapter 7.7)

Hypoglycemia: An abnormally low blood glucose level typically below 70 mg/dL. (Chapter 7.5)

Hypokalemia: Decreased potassium. (Chapter 7.7)

Hyponatremia: Low sodium. (Chapter 7.7)

Hypothalamus: Area of the brain which serves as the body's control center regulating temperature, heart rate, hunger, and mood. (Chapter 7.2)

Hypothalamus–pituitary complex: Coordinates the messages of the endocrine and nervous systems. (Chapter 7.2)

Hypothyroidism: A medical condition characterized by an underactive thyroid gland that causes reduced production of thyroid hormones. (Chapter 7.6)

Impaired fasting glucose: Identified in levels that range between 100 to 125 mg/dL. (Chapter 7.5)

Insulin: Facilitates the uptake of glucose by cells from the bloodstream, thus reducing blood glucose levels. (Chapter 7.2)

Insulin pumps: Small, programmable devices that deliver a continuous supply of insulin into the body, mimicking the function of a healthy pancreas. (Chapter 7.5)

Ketones: Metabolic byproducts of fatty acid metabolism, typically produced in the liver. (Chapter 7.5)

Latent autoimmune diabetes in adults (LADA): A type of diabetes that starts in adulthood and slowly gets worse over time. (Chapter 7.5)

Lipogenesis: A process in which excess glucose is synthesized into triglycerides. (Chapter 7.2)

Lipolysis: A process in which stored triglycerides are broken down into free fatty acids and glycerol. (Chapter 7.2)

Luteinizing hormone (LH): Plays a role in sexual development in children and in women and triggers ovulation (the release of an egg from the ovary) during the menstrual cycle. (Chapter 7.2)

Melatonin: Hormone that affects reproductive development and daily circadian rhythms. (Chapter 7.2)

Metabolic syndrome: A group of conditions that increase the risk of coronary heart disease, diabetes, and stroke. (Chapter 7.5)

Myopathy: Muscle weakness. (Chapter 7.5)

Myxedema coma: A severe, life-threatening emergency that represents the extreme end of the spectrum of hypothyroidism. (Chapter 7.6)

Negative feedback loop: A regulatory mechanism that serves to maintain

stability and homeostasis by counteracting changes in a physiological or environmental parameter. (Chapter 7.2)

Norepinephrine: A catecholamine produced by the adrenal medulla. (Chapter 7.7)

Oligomenorrhea: Infrequent or irregular menstrual periods. (Chapter 7.7)

Onycholysis: Separation of fingernails from the nail bed. (Chapter 7.6)

Oral glucose tolerance tests (GTT): Evaluates the body's ability to regulate blood glucose levels, especially after consuming a high dose of glucose. (Chapter 7.5)

Osmoreceptors: Specialized sensory neurons or cells that are responsible for detecting changes in osmotic pressure within the body. (Chapter 7.2)

Oxytocin: Stimulates labor contractions and lactation after delivery. (Chapter 7.2)

Pancreas: A long, flat gland that lies behind the stomach, responsible for both exocrine and endocrine functions. (Chapter 7.2)

Parathyroid glands: Four small masses of tissue are embedded on the surface of the thyroid gland. (Chapter 7.2)

Parathyroid hormone (PTH): Maintains homeostasis between calcium and phosphorus via a negative feedback loop. (Chapter 7.2, Chapter 7.8)

Paresthesia: Symptoms including pain, tingling, and numbness. (Chapter 7.5)

Pineal gland: A small cone-shaped structure that extends posteriorly from a ventricle of the brain. (Chapter 7.2)

Pituitary gland: Gland located at the base of the brain which makes, stores, and releases hormones. (Chapter 7.2)

Polydipsia: Excessive thirst. (Chapter 7.5)

Polyphagia: Excessive hunger. (Chapter 7.5)

Polyuria: Excessive urination. (Chapter 7.5)

Posterior pituitary gland: Gland which secretes two hormones produced by the hypothalamus called oxytocin and antidiuretic hormone (ADH). (Chapter 7.2)

Progesterone: Hormone that causes the uterine lining to thicken in preparation for pregnancy. (Chapter 7.2)

Prolactin: Stimulates breast development and milk production in females. (Chapter 7.2)

Radioactive iodine (RAI) therapy: A common treatment for hyperthyroidism in conditions like Graves' disease that utilizes radioactive iodine. (Chapter 7.6)

Radiofrequency ablation (RFA): A minimally invasive procedure that uses radiofrequency energy to heat and destroy thyroid nodules or hyperactive tissue. (Chapter 7.6)

Random blood glucose: Measures the level of glucose in the blood at any given time, without the requirement for fasting. (Chapter 7.5)

Somatostatin: Slows down the secretion of insulin and glucagon when needed to maintain blood glucose homeostasis. (Chapter 7.2)

Striae: Stretch marks. (Chapter 7.7)

Subtotal thyroidectomy: Surgical removal of a portion of the thyroid gland. (Chapter 7.6)

Sudomotor neuropathy: Absence of sweating in the extremities that causes dry skin and can lead to foot ulcerations. (Chapter 7.5)

Testosterone: Hormone that is responsible for the growth and development of the male reproductive structures, increased skeletal and muscular growth, enlargement of the larynx, and growth and distribution of body hair. (Chapter 7.2)

Tetany: Involuntary contraction or spasm of muscles. (Chapter 7.6, Chapter 7.8)

Thymus gland: Gland located in the mediastinum that is responsible for the production of T lymphocytes for the body's immune response. (Chapter 7.2)

Thyroid gland: A butterfly-shaped endocrine gland located in the neck, just below the larynx. (Chapter 7.2)

Thyroid-stimulating hormone (TSH): Stimulates thyroid hormone release by the thyroid gland. (Chapter 7.2, Chapter 7.6)

Thyroid storm: A severe state of hyperthyroidism that is a life-threatening medical condition. (Chapter 7.6)

Thyroxine (T4): A prohormone that is produced and secreted by the thyroid gland; serves as a precursor to triiodothyronine. (Chapter 7.6)

Total thyroidectomy: Surgical removal of the entire thyroid gland. (Chapter 7.6)

Triiodothyronine (T3): The active form of thyroid hormone, directly impacts the body's metabolic rate by affecting the function of cells throughout the body. (Chapter 7.6)

Tropic hormones: Turn on or off the function of other endocrine glands. (Chapter 7.2)

Trousseau's sign: A hand spasm caused by inflating a blood pressure cuff to a level above systolic pressure for three minutes. (Chapter 7.8)

Type 1 diabetes: The immune system mistakenly attacks and destroys beta cells, leading to an absolute deficiency of insulin. (Chapter 7.5)

Type 2 diabetes: The body either becomes resistant to the effects of insulin or does not produce sufficient insulin to meet the body's needs. (Chapter 7.5)

Vitiligo: Loss of skin pigmentation. (Chapter 7.7)

PART VIII

CHAPTER 8 RENAL AND URINARY SYSTEM ALTERATIONS

8.1 Renal Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with renal/urinary disorders
- Explain the pathophysiology of renal/urinary disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in caring for the client with renal/urinary disorders
- Integrate pharmacological and nonpharmacological measures for the client with renal/urinary disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=89#h5p-43

"Renal PreTest" by Kellea Ewen and Open RN is licensed under CC BY-NC 4.0

Renal alterations, encompassing a wide spectrum of renal and urinary

disorders, are a common yet complex area of focus for nursing professionals. Whether it's nephritis, nephrolithiasis, or renal failure, these conditions can profoundly impact the health and quality of life of clients. Understanding the pathophysiology of these disorders, incorporating evidence-based practice, and implementing a client-centered approach are crucial for delivering effective nursing care.

8.2 Review of Anatomy & Physiology of the Urinary System

The **urinary system**, also referred to as the renal system or urinary tract, consists of the kidneys, ureters, bladder, and urethra. The kidneys form urine, and the ureters carry the urine away from kidneys to the urinary bladder, where it is stored until it is expelled during urination. The urethra carries the urine from the urinary bladder to outside of the body during urination.[1] See Figure 8.1[2] for an illustration of the male urinary system.

1. National Institute of Diabetes and Digestive and Kidney Diseases. (2020). *The urinary tract & how it works.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-tract-how-it-works

2. "Urinary_System_(Male).png" by BruceBlaus is licensed under CC BY-SA 4.0

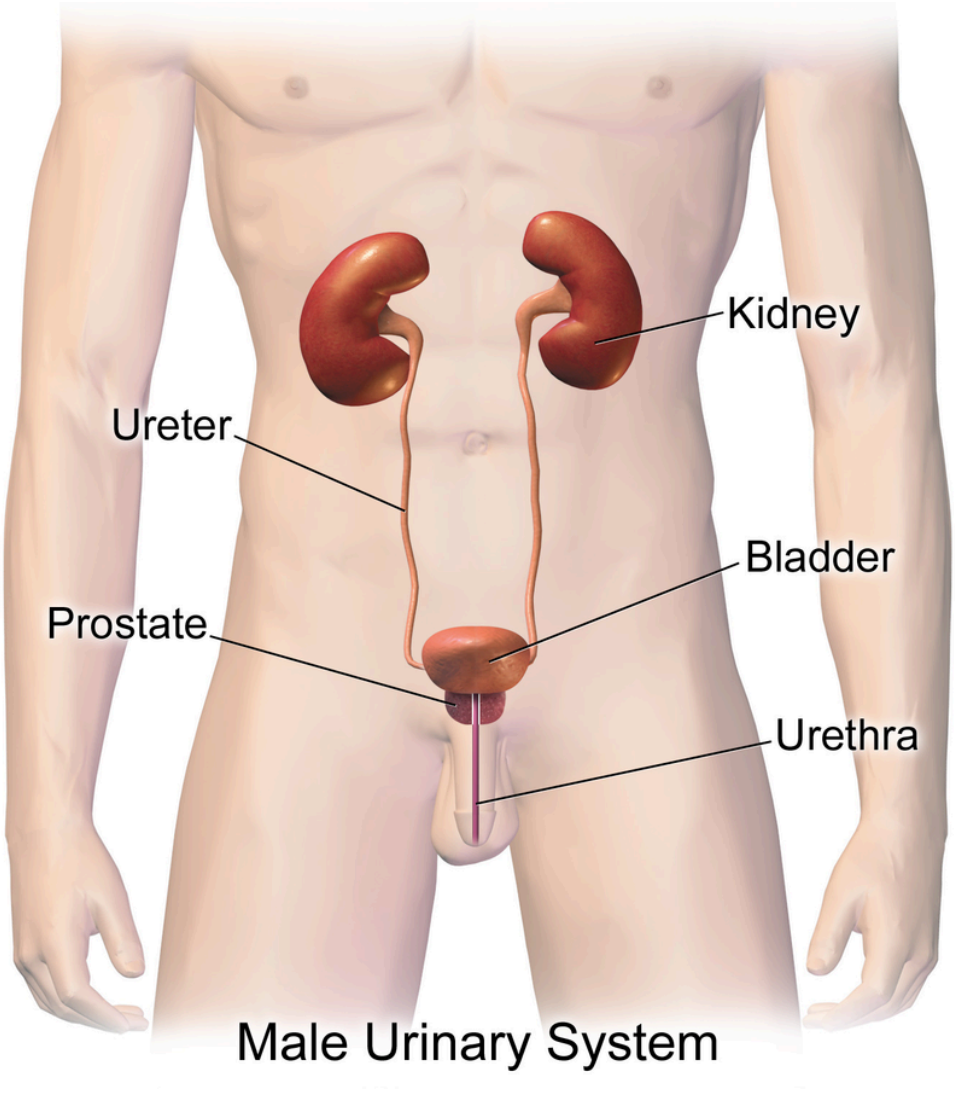


Figure 8.1 Male Urinary System

Kidneys

The **kidney** is an organ that filters waste from the blood and produces urine. Kidneys lie on either side of the spine behind the abdominal cavity, well-protected by muscle, fat, and ribs. Because they lie posterior to the peritoneum membrane, their location is described as retroperitoneal. They are roughly the size of your fist. The male kidney is typically a bit larger than the female kidney. The kidneys are well-vascularized, receiving about 25

percent of the blood pumped out of the heart with each heartbeat. Figure 8.2[3] displays the location of the kidneys.

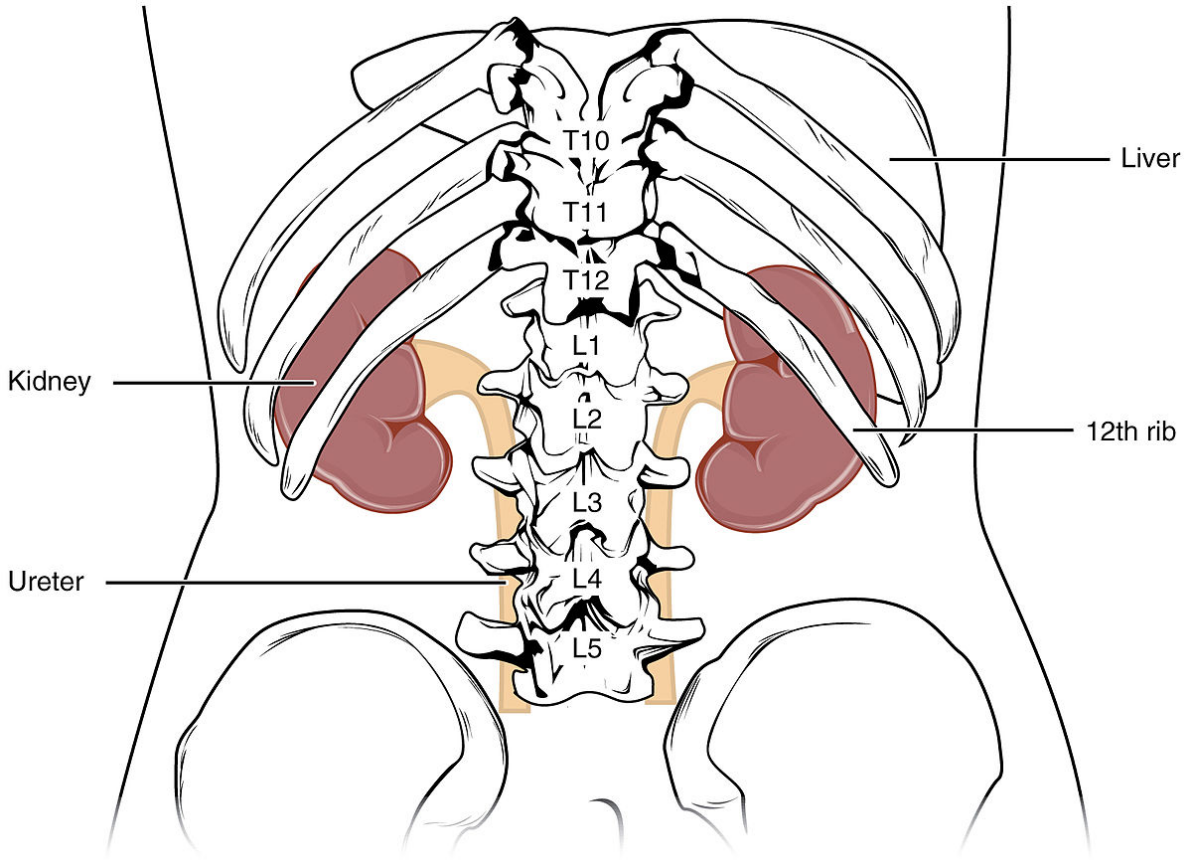


Figure 8.2 Kidneys

The outer region of the kidney is called the renal cortex, and the inner region is called the medulla. See Figure 8.3[4] for an illustration of the internal structures of the kidney. The renal hilum is the entry and exit site for vessels, nerves, and ureters. The renal arteries (colored red) come directly from the descending aorta, and the renal veins (colored blue) return filtered blood to the inferior vena cava.

3. "2608_Kidney_Position_in_Abdomen.jpg" by OpenStax College is licensed under CC BY 3.0

4. "2610_The_Kidney.jpg" by OpenStax College is licensed under CC BY 3.0

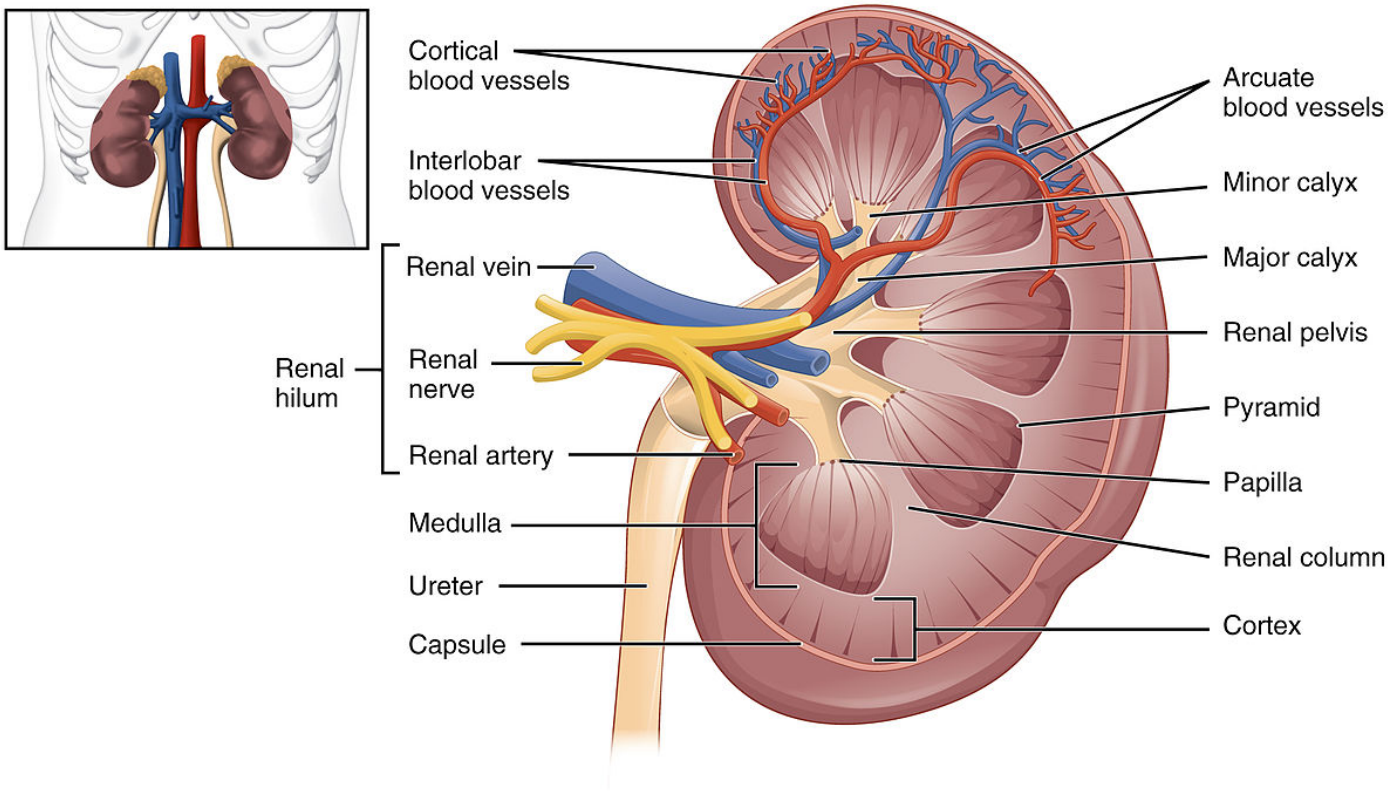


Figure 8.3 Internal Structures of the Kidney

Arterioles and Nephrons

The renal artery branches down into small arteries called afferent arterioles that bring blood to the nephron. Afferent arterioles service about 1.3 million nephrons in each kidney. See Figure 8.4[5] for an illustration of blood flow from the renal artery to the afferent arterioles to a nephron.

5. "2612_Blood_Flow_in_the_Kidneys.jpg" by OpenStax College is licensed under CC BY 3.0

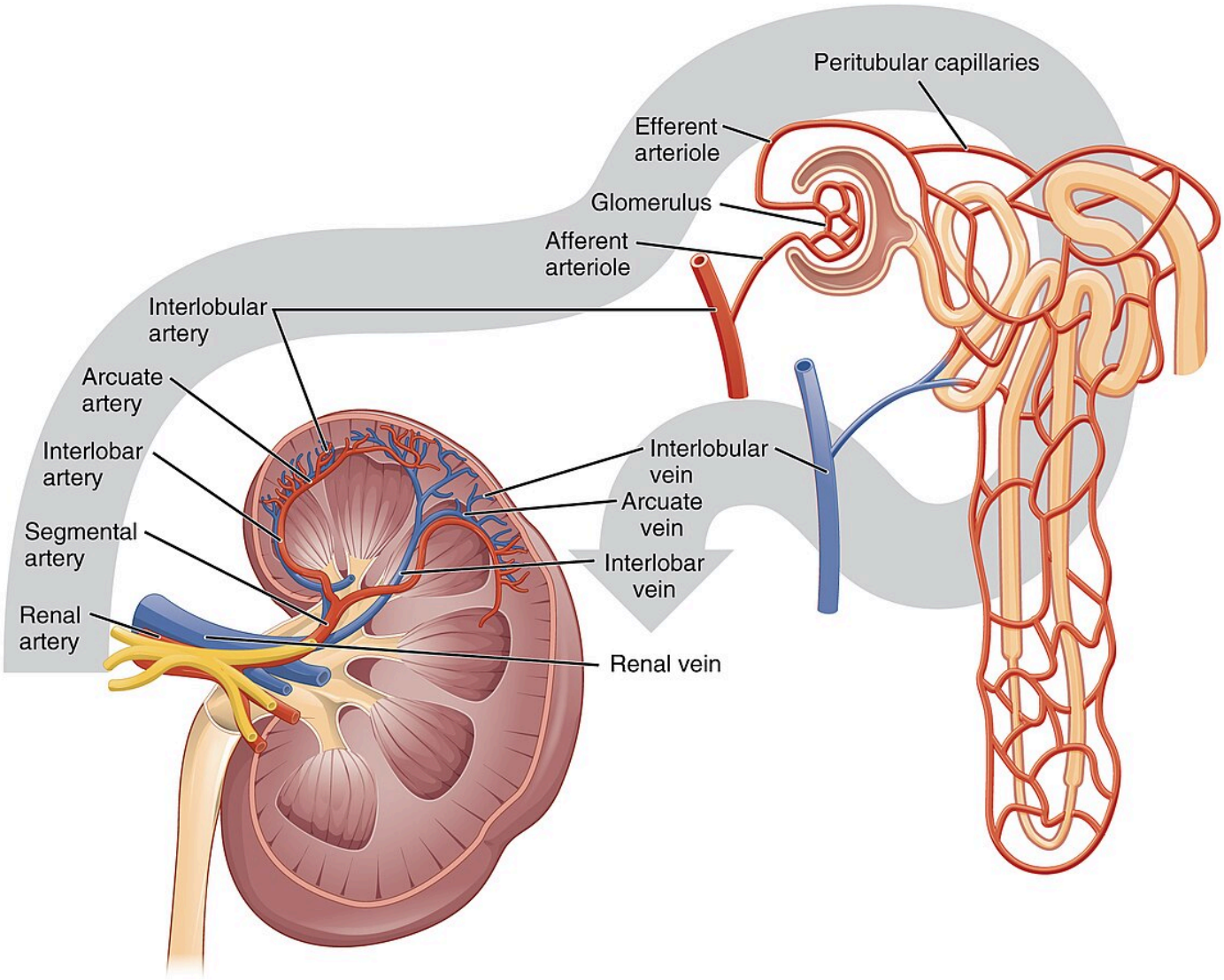


Figure 8.4 Blood Flow in the Kidneys

The **nephron** is the functional unit of the kidney and filters the blood, removes wastes, and balances fluid and electrolyte levels. A nephron has two parts called a renal corpuscle and a renal tubule. The renal corpuscle consists of a cluster of high-pressure capillaries called the **glomerulus**, surrounded by a glomerular capsule. An afferent arteriole leads into the renal corpuscle, and an efferent arteriole leaves the renal corpuscle. See Figure 8.5[6] for an

6. "2611_Blood_Flow_in_the_Nephron.jpg" by OpenStax College is licensed under CC BY 3.0

illustration of blood flow through the nephron. The capillaries in the glomerulus initially filter the blood based on particle size.

After blood is filtered by the glomerulus, it continues to pass through the renal tubule. Very thin and a little over an inch long, the renal tubule has three segments that the filtrate flows through called the proximal convoluted tubule, the loop of the nephron (referred to as the “loop of Henle”), and the distal convoluted tubule. Different portions of the renal tubule have different permeabilities for solutes and water, and efferent arterioles recover most of the water and electrolytes and return them back into the circulation. The remaining wastes pass as urine from the nephrons into collecting ducts and eventually into the ureters for elimination from the body. Within the renal tubule sodium, chloride, water, calcium, bicarbonate, glucose, protein, and blood components are typically reabsorbed whereas potassium, phosphorus, hydrogen, creatinine, and urea are typically excreted.

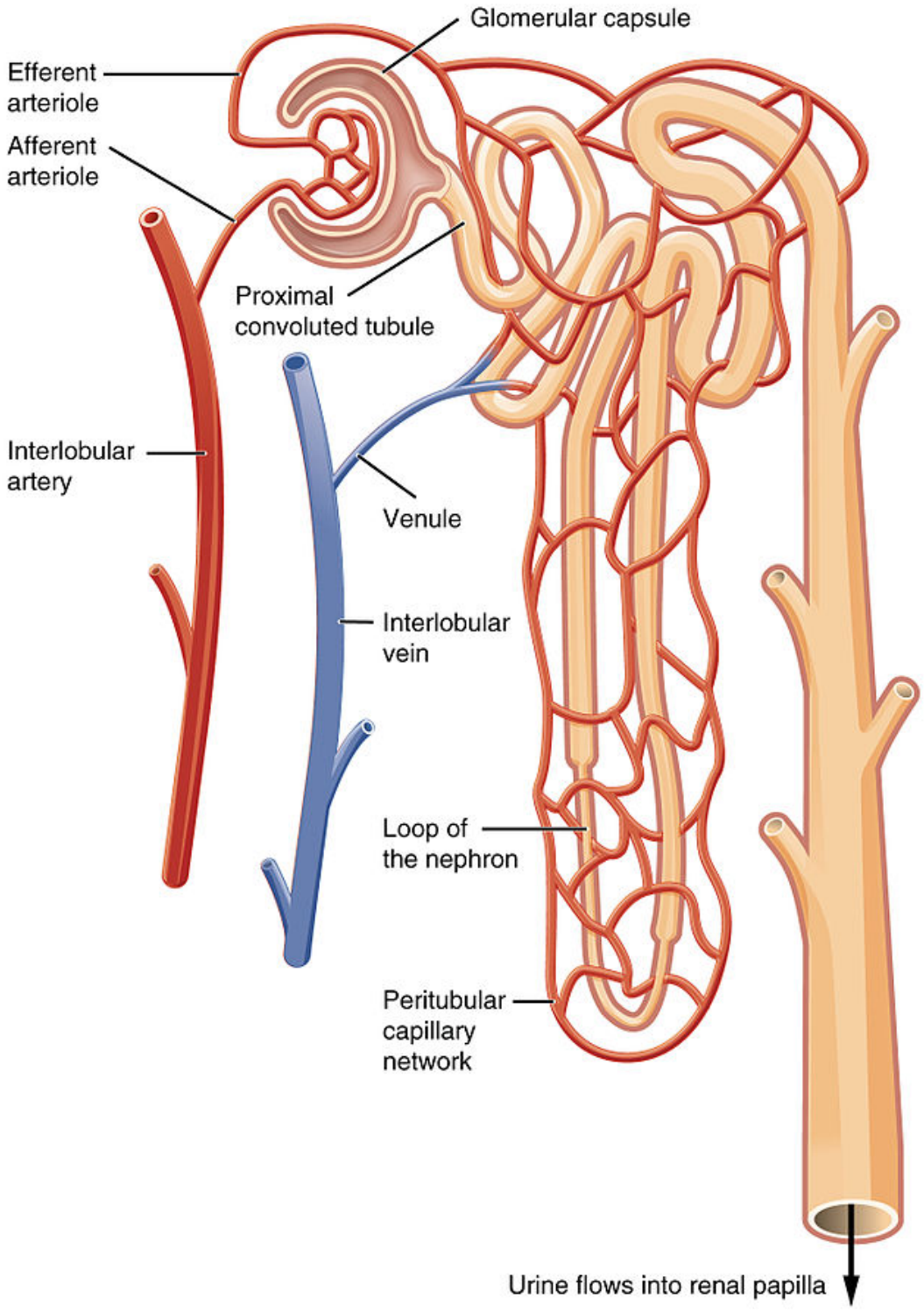


Figure 8.5 Blood Flow in the Nephron

Ureters

As urine is formed, it drains into the calyces of the kidney, which merge to form the funnel-shaped renal pelvis in the hilum of each kidney. The hilum

narrows to become the **ureter** of each kidney. As urine passes through the ureter, it does not passively drain into the bladder but rather is propelled by waves of peristalsis. The ureters are approximately 30 cm long. The muscular layer of the ureter creates the peristaltic contractions to move the urine into the bladder without the aid of gravity.

Bladder

The **bladder** collects urine from both ureters. View Figure 8.6[7] to see a cross-section of the bladder. The bladder lies anterior to the uterus in females, posterior to the pubic bone, and anterior to the rectum. During late pregnancy, its capacity is reduced due to compression by the enlarging uterus, resulting in increased frequency of urination. In males, the anatomy is similar, minus the uterus, with the addition of the prostate inferior to the bladder. The bladder is partially retroperitoneal (outside the peritoneal cavity) with its peritoneal-covered "dome" projecting into the abdomen when the bladder becomes **distended** (stretched out) with urine.

7. "2605_The_Bladder.jpg" by OpenStax College is licensed under CC BY 3.0

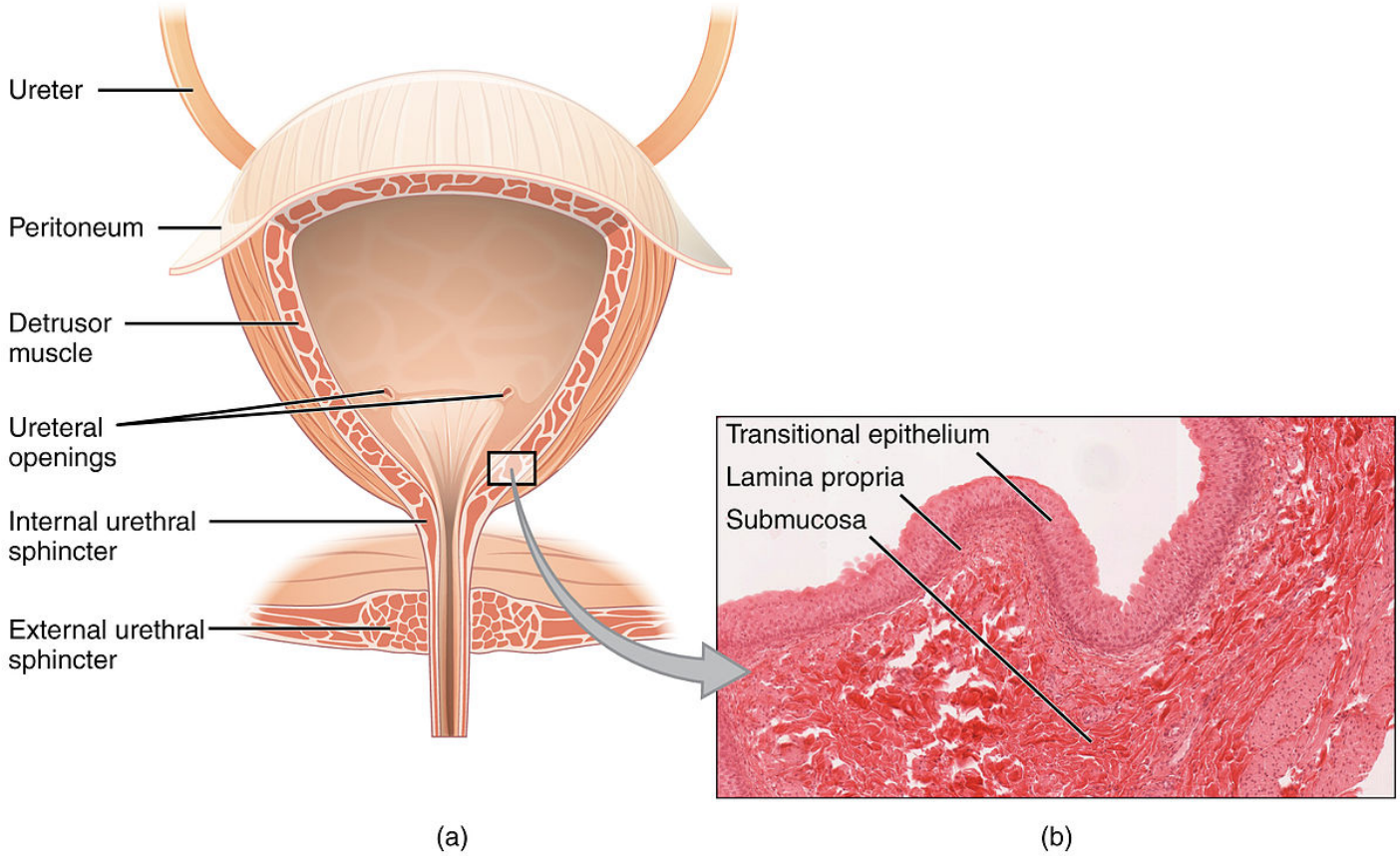


Figure 8.6 Bladder

Urethra

The **urethra** transports urine from the bladder to the outside of the body during urination. The urethra is the only urologic organ that is significantly different between males and females; all other urine transport structures are identical. In females, the urethra is shorter and closer to the rectum, which causes increased risk for urinary tract infections. See Figure 8.7[8] for a comparison of the female and male urethra.

8. "Female_and_Male_Urethra.jpg" by OpenStax College is licensed under CC BY 3.0

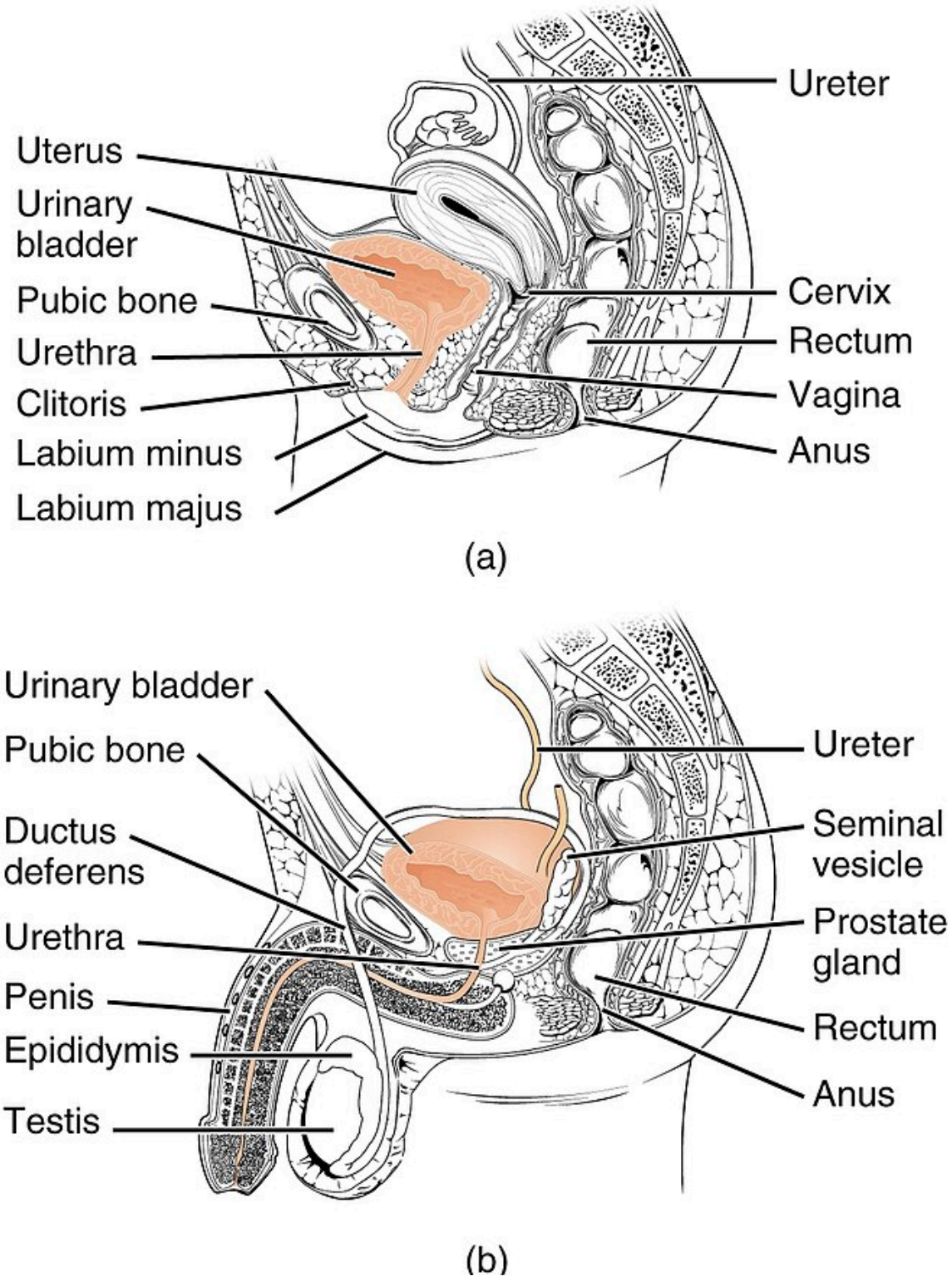


Figure 8.7 Female and Male Urethra

Physiology

Filtration, Reabsorption, and Secretion

The kidneys filter all the blood in your body every 30 minutes and create urine. They remove waste products and excess fluid and also regulate electrolytes and hormones that control blood pressure, stimulate production of red blood cells, and activate vitamin D to keep bones healthy.[9]

Blood enters the kidneys via the renal arteries and is filtered by nephrons, where many functions take place. Three principal functions of the nephron are filtration, reabsorption, and secretion. Secondary functions of the nephron include controlling blood pressure (via the production of renin), producing red blood cells (via the hormone erythropoietin), and vitamin D activation so calcium can be absorbed via the gastrointestinal tract.[10]

To produce urine, nephrons and collecting ducts carry out three basic functions: glomerular filtration, tubular reabsorption, and tubular secretion. The initial filtering of the blood takes place in the glomerulus, a cluster of capillaries surrounded by the glomerular capsule within the nephron. The renal tubule receives this filtered fluid, called glomerular filtrate, and electrolytes and water are reabsorbed in different parts of the renal tubule and returned to circulation. The final end product of the filtered fluid is urine.[11] These processes are discussed in more detail in the following subsections.

9. Centers for Disease Control and Prevention. (2022). *Chronic kidney disease basics*. https://www.cdc.gov/kidney-disease/about/

10. National Institute of Diabetes and Digestive and Kidney Diseases. (2020). *The urinary tract & how it works*. National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-tract-how-it-works

11. Colorado Community College System (CCCOnline). (n.d.). *Anatomy & Physiology*. https://pressbooks.ccconline.org/bio106/

FILTRATION

The first step in urine production is **glomerular filtration**. In this process, water and most of the solutes in the blood pass through the wall of glomerular capillaries into the glomerular capsule and then into the renal tubule. This process filters the blood and creates a filtrate that does not contain blood cells or large proteins, referred to as glomerular filtrate.

The volume of filtrate formed by both kidneys per minute is called the **glomerular filtration rate (GFR)**. GFR is used to assess how well the kidneys are functioning. The heart pumps about five liters of blood per minute when a person is resting, and approximately 20 percent of this (i.e., one liter) enters the kidneys to be filtered per minute. On average, this results in the production of about 115 mL/min of filtrate produced by the nephrons. However, 99 percent of this filtrate is returned to the circulation by reabsorption so that only about 1–2 liters of urine are produced per day.

GFR is influenced by hydrostatic pressure, osmotic pressure, and oncotic pressures. **Hydrostatic pressure** refers to the pressure produced by a fluid against a surface. Glomerular filtration occurs as hydrostatic pressure forces fluid and solutes through the semipermeable barrier of the glomerular capillary membrane. The movement of solutes out of the blood is limited by their size. Glomerular filtration occurs when glomerular capillary hydrostatic pressure exceeds the luminal hydrostatic pressure of glomerular capsule.

Another force, called osmotic pressure, also controls the movement of water. **Osmosis** refers to the movement of water across a semipermeable membrane that is impermeable to a solute. As long as the concentration of water differs on both sides, water will move in the direction of lower pressure until the osmotic pressure on both sides of the membrane is equal. For this reason, a proper concentration of solutes in the blood is important in maintaining osmotic pressure in the glomerulus, as well as systemically.

A third force, called **oncotic pressure**, is created by the protein content of the blood that helps hold water inside of capillaries. There are urinary system disorders in which too much protein passes through during filtration into the glomerular filtrate. This excess protein in the filtrate leads to a deficiency of circulating proteins in the blood. In turn, the presence of excess protein in the urine allows it to retain more water in the filtrate and results in an increase in

urine volume. Because there is less circulating protein in the blood (principally albumin), the osmotic pressure of the blood also falls. Less osmotic pressure tips the balance towards hydrostatic pressure, which causes water to be pushed out of the capillaries. The net effect is that water is lost from the circulation into interstitial tissues and cells. This "plumps up" the tissues and cells, a condition called **edema**.

See Figure 8.8[12] for an illustration of hydrostatic pressure and osmotic pressure in a capillary.

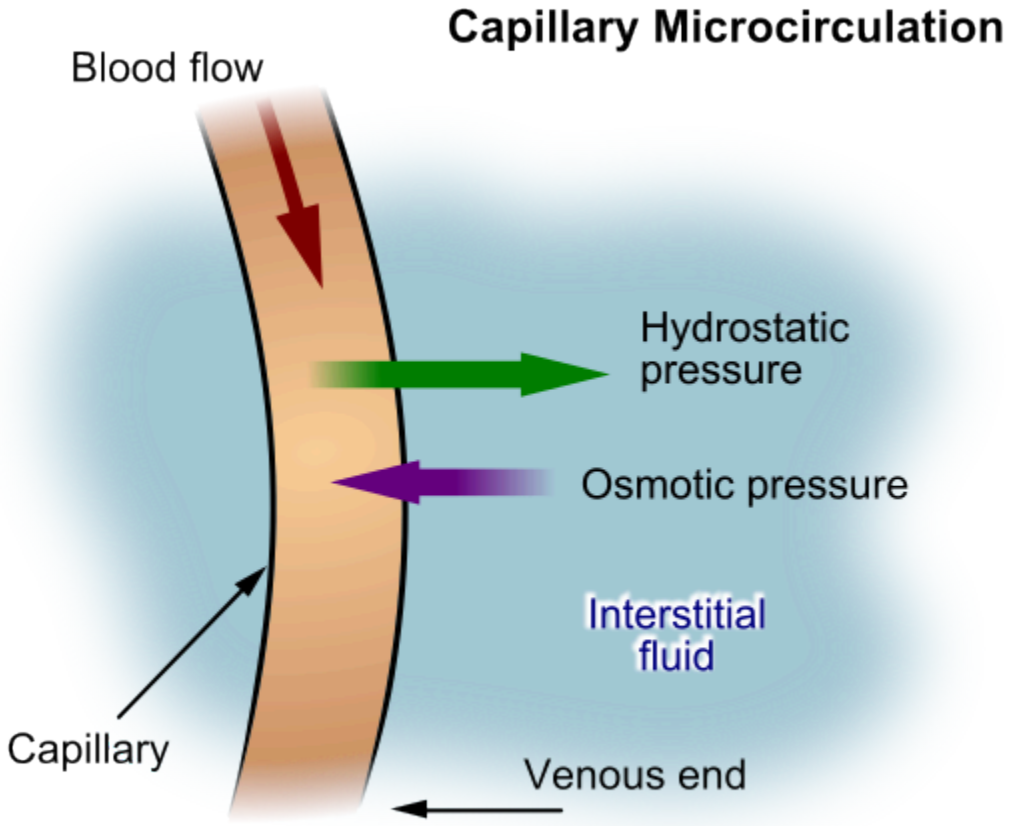


Figure 8.8 Hydrostatic and Osmotic Pressures in Capillaries

TUBULAR REABSORPTION AND SECRETION

After glomerular filtration, the filtrate continues to undergo modification through secretion and reabsorption in the renal tubules before urine is

12. "Capillary_microcirculation.jpg" by Kes47 is in the Public Domain

produced and collected in the collecting ducts. During this process, some substances are reabsorbed, whereas others are secreted. In fact, 99 percent of the water and most of the solutes that were filtered out during glomerular filtration are reabsorbed in the tubules. A blood vessel runs alongside the tubule. As the filtered fluid moves along the tubule, a blood vessel reabsorbs almost all of the water, along with minerals and nutrients the body needs, and returns them to the body via the renal vein. The remaining fluid and wastes in the tubule become urine.

See Figure 8.9[13] for an illustration of tubular reabsorption and secretion. The glomerulus (1) filters small solutes from the blood. The proximal tubule (2) reabsorbs 60-70% of the sodium and water back into the bloodstream. From the proximal tubule, the filtrate flows into the descending loop of Henle (3) and then into the ascending loop of Henle (4). Another 20-25% of sodium is reabsorbed in the ascending loop of Henle. Filtrate then enters the distal tubule (5), where sodium is actively filtered in exchange for potassium or hydrogen ions to maintain blood pH and electrolyte balance, a process regulated by the hormone aldosterone. The collecting duct (6) is the final pathway where antidiuretic hormone (ADH) acts to further reabsorb water and solutes back into the bloodstream, thereby preventing it from being eliminated in urine.

13. "Figure 41 03 04.jpg" by CNX OpenStax is licensed under CC BY 4.0

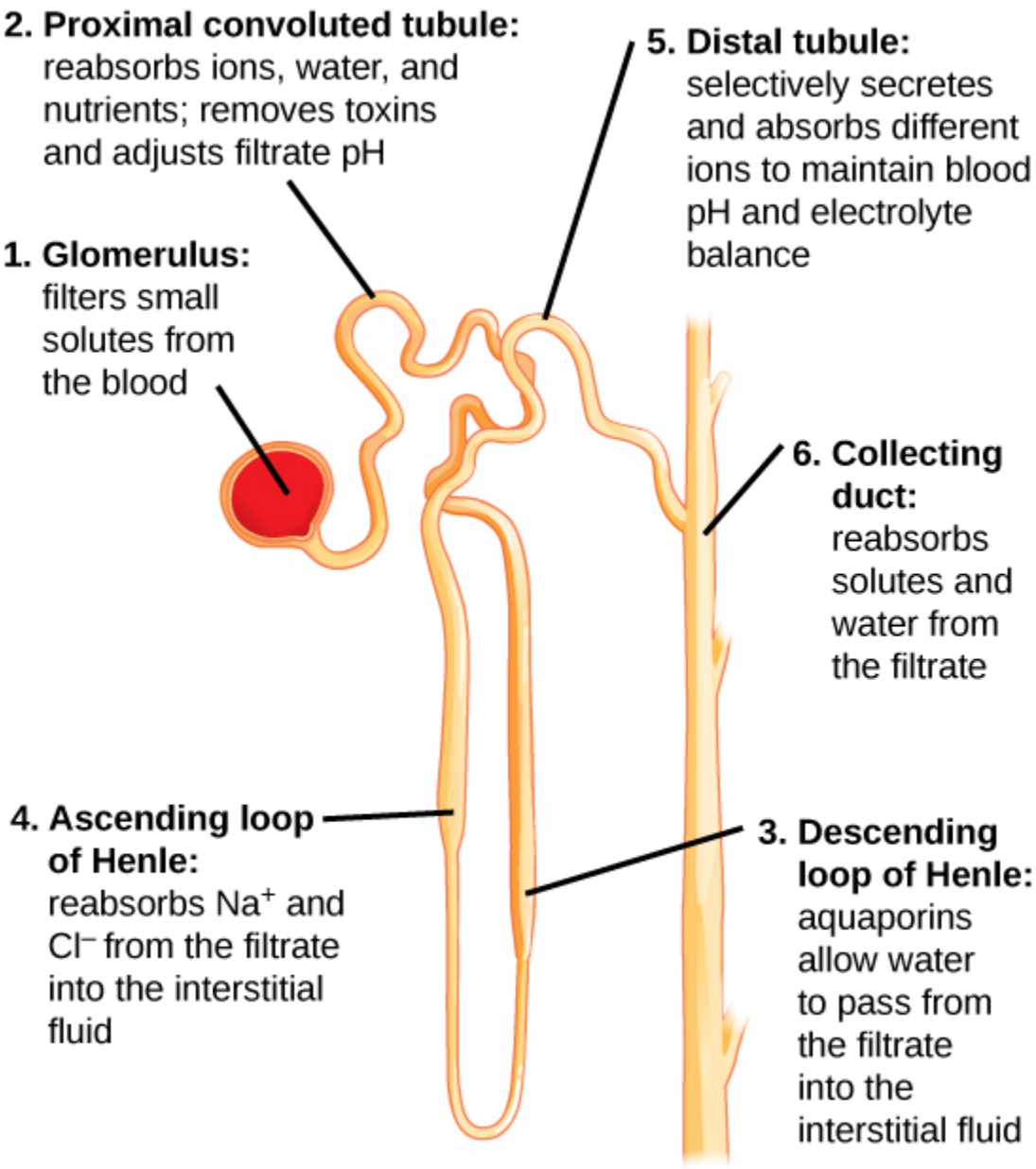


Figure 8.9 Nephron Structure

Urination

To **urinate** means passing urine out of the bladder, also referred as void or micturate. A healthy adult with normal functioning kidneys produces an average of 800-2,000 mL of urine per day, depending on their fluid intake and other physiological processes. The adult bladder typically holds about 360-480 mL of urine.

Urination is regulated by the internal and external urinary **sphincters**, circular muscles constricting an orifice. As the bladder fills and reaches about

150 mL (5 ounces), it sends signals to the brain to create an urge to urinate. The internal and external urinary sphincters work together to close off the urethra to keep urine in the bladder. The external urinary sphincter is under voluntary control and remains closed until the brain sends a signal it is time to urinate. As the bladder fills, subsequent urges become harder to ignore. If voluntary voiding does not occur and the bladder overfills, voluntary control fails, resulting in **urinary incontinence**.

Frequency of urination depends on how quickly the kidneys produce urine and how much urine a person's bladder can comfortably hold. Normal urine is typically clear or pale to light yellow in color and not foul-smelling. However, some foods or medications may change the smell or color of urine.[14]

In infants, the reflex to urinate is active, but as toddlers mature, they learn how to override the reflex and control the external sphincter, thus delaying voiding until it is appropriate to do so (commonly referred to as "potty training").

Urine

Urine volume varies considerably by individual, based on several factors such as fluid intake, perspiration, and disorders affecting the urinary system. The normal range of urine output for adults is one to two liters per day. The kidneys must produce a minimum urine volume of about 500 mL/day to adequately rid the body of wastes. Urine output below this level can be caused by severe dehydration or kidney disease.

Urine color and odor are affected by many conditions and even the food a person has eaten. For example, a urinary tract infection or kidney stone may cause bleeding, resulting in pink or even bright red urine. Dehydration

14. National Institute of Diabetes and Digestive and Kidney Diseases. (2020). *The urinary tract & how it works.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-tract-how-it-works

produces darker, concentrated urine. See Figure 8.10[15] for an illustration of the color of urine based on the client's hydration status. Additionally, about one in five people detect a distinctive odor in their urine after consuming asparagus; other foods such as onions, garlic, and fish can impart their own aromas. These food-caused odors are harmless.

15. "2601_Urine_Color_Chart.jpg" by OpenStax College is licensed under CC BY 3.0

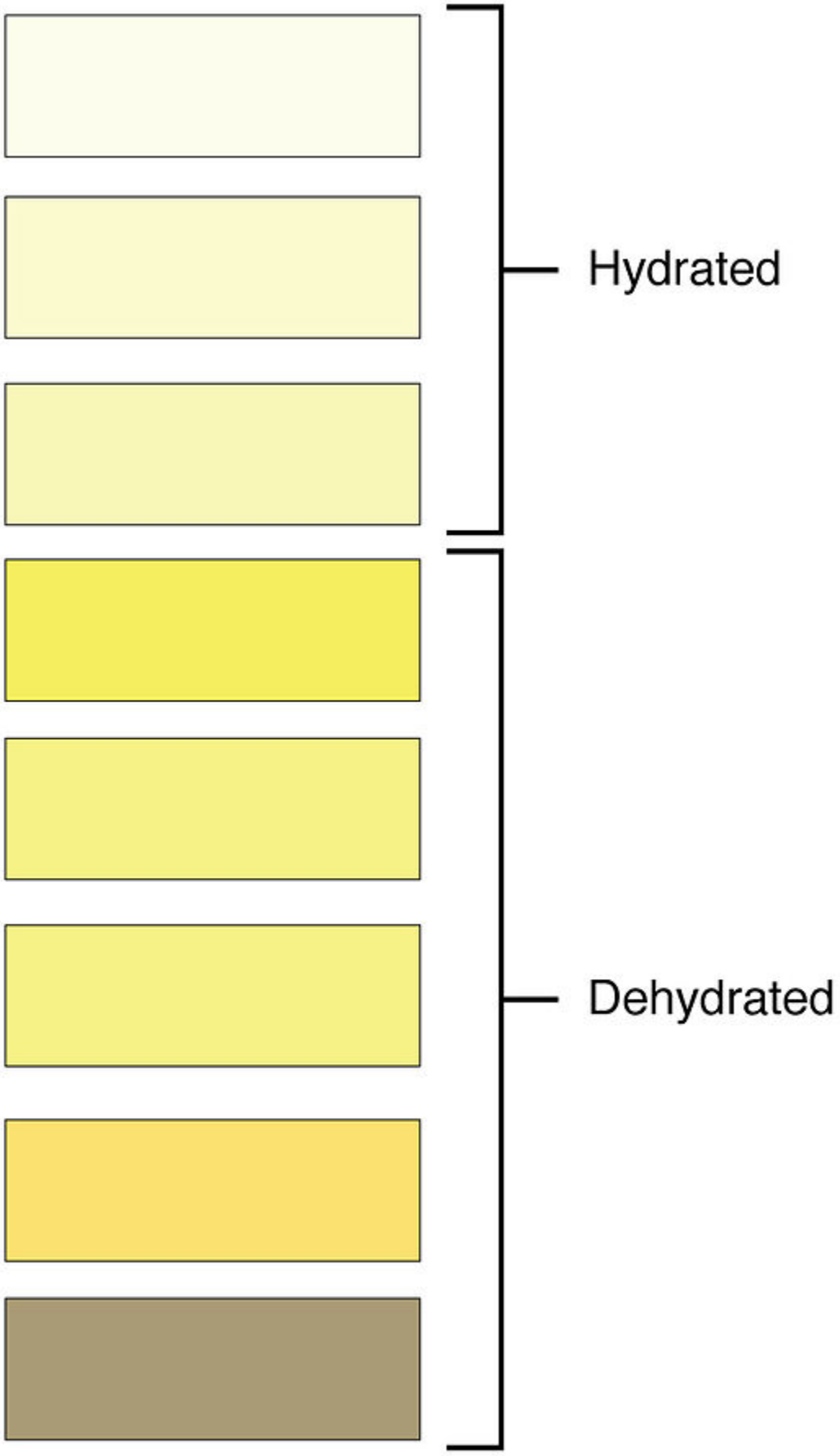


Figure 8.10 Urine Color Based on Hydration Status

Urea

Urea nitrogen is a waste product made when the liver breaks down protein into amino acids, and then **deamination** converts the amino acids into ammonia, urea, or uric acid. Urea is transported in the blood, filtered out by the kidneys, and eliminated from the body in urine. Urine primarily contains urea with small amounts of ammonia and uric acid. When damage occurs to the nephrons, urea is not filtered out as efficiently, and a buildup of urea in the blood can occur. For this reason, a diagnostic test called blood urea nitrogen (BUN) provides important information about kidney function.

Most of the ammonia produced from the breakdown of protein in the body is converted into urea by the liver, so the odor of ammonia is rarely detected in fresh urine.

Diuretics

A **diuretic** is a substance that increases urine production. Three common beverages contain diuretic compounds: coffee, tea, and alcohol. The caffeine in coffee and tea works by promoting vasodilation in the nephron, which increases GFR. Alcohol increases GFR by inhibiting ADH release from the posterior pituitary, resulting in less water recovery by the collecting duct. Medications called diuretics are prescribed to reduce blood volume and, thereby, reduce edema.

Acid-Base Imbalances Resulting From Nephron Damage

Several diseases and disorders can damage the kidneys and the nephrons. When nephrons are damaged, their ability to filter, reabsorb, and secrete substances is affected.

The kidneys and the lungs work together to balance acids and bases in the body. If an acid-base imbalance occurs due a respiratory disorder, the kidneys compensate by adjusting bicarbonate level of the blood (HCO_3). HCO_3 is a base that makes the blood more alkaline. As the kidneys sense an alteration in pH, they begin to retain or excrete HCO_3, depending on what is needed. If

the pH becomes acidic, the kidneys retain HCO3 to increase the amount of bases present in the blood to increase the pH. Conversely, if the pH becomes alkalotic, the kidneys excrete more HCO3, causing the pH to decrease.[16]

Metabolic Acidosis

Under normal conditions, the kidneys work to excrete acids through urine and neutralize excess acids by increasing bicarbonate (HCO3) reabsorption from the urine to maintain a normal pH. When the kidneys are not able to perform this buffering function to the level required to excrete and neutralize the excess acid, metabolic acidosis results. **Metabolic acidosis** is diagnosed by arterial blood gas (ABG) results indicating a pH level below 7.35 and an HCO3 level below 22.[17]

A common cause of metabolic acidosis is diabetic ketoacidosis, where acids called ketones build up in the blood. Another common cause of metabolic acidosis is lactic acidosis, which can be caused by impaired tissue oxygenation. Metabolic acidosis can also be caused from renal disease that causes decreased acid elimination.[18]

Nurses may first suspect that a client has metabolic acidosis due to rapid breathing that occurs as the lungs try to remove excess carbon dioxide in an attempt to resolve the acidosis. Other symptoms of metabolic acidosis include confusion, decreased level of consciousness, hypotension, and electrolyte disturbances that can progress to circulatory collapse and death if not treated promptly. It is important to promptly notify the provider of

16. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

17. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

18. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

suspected metabolic acidosis so that an ABG can be drawn, and treatment prescribed based on the cause.[19]

Metabolic Alkalosis

Metabolic alkalosis occurs when there is too much bicarbonate (HCO3) or an excessive loss of acid (H+ ions). Metabolic alkalosis is defined by ABG results indicating a pH above 7.45 and an HCO3 level above 26. One cause of metabolic alkalosis is excessive urine loss (due to diuretics or excessive mineralocorticoids) due to loss of hydrogen ions in the urine.[20] Prolonged vomiting and extensive nasogastric tube suctioning may also result in conditions of metabolic alkalosis.

A nurse may first suspect that a client has metabolic alkalosis due to a decreased respiratory rate (as the lungs try to retain additional CO2 to increase the acidity of the blood and resolve the alkalosis). The client may also be confused due to the altered pH level. The nurse should report signs of suspected metabolic alkalosis because uncorrected metabolic alkalosis can result in hypotension and cardiac dysfunction. Treatment is prescribed based on the ABG results and the suspected cause.[21]

- Review information about acid-base imbalance in the "Acid-

19. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/
20. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/
21. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Nursing fundamentals 2E*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/nursingfundamentals/

Base Balance" section of the "Fluids & Electrolytes" chapter of Open RN *Nursing Fundamentals, 2e*.

Other Terms Related to Urine and Urination

Terms commonly used to document conditions related to the urinary system are as follows:

- **Anuria:** Absence of urine output, typically found during kidney failure, defined as less than 50 mL of urine over a 24-hour period.
- **Diuresis:** Increased production of urine.
- **Dysuria:** Painful or difficult urination.
- **Enuresis:** Involuntary urination, especially by children.
- **Frequency:** The need to urinate several times during the day or night in normal or less-than-normal volumes. It may be accompanied by a feeling of urgency.[22]
- **Hematuria:** Blood in the urine, either visualized or found during microscopic analysis.
- **Incontinence:** Loss of bladder control.
- **Oliguria:** Decreased urine output; defined as less than 500 mL of urine in adults in a 24-hour period.
- **Nocturia:** The need to get up at night on a regular basis to urinate. Nocturia often causes sleep deprivation that affects a person's quality of life.[23]

22. Maddukuri, G. (2021). *Urinary frequency.* Merck Manual Professional Version. https://www.merckmanuals.com/professional/genitourinary-disorders/symptoms-of-genitourinary-disorders/urinary-frequency

23. Leslie, S. W., Sajjad, H., & Singh, S. (2024). *Nocturia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518987/

- **Polyuria:** Greater than 2.5 liters of urine output over 24 hours; also referred to as diuresis.[24] New polyuria should be reported to the health care provider because it can be a sign of many medical conditions.
- **Pruritus:** Itchy skin; a common symptom of kidney failure.
- **Pyuria:** White blood cells in a urine sample indicating infection. In severe infections, pus may be visible in the urine.[25] See Figure 8.11[26] for an image of pyuria.
- **Urgency:** A sensation of an urgent need to void.[27] Urgency can cause urge incontinence if the client is not able to reach the bathroom quickly.

24. A.D.A.M. Medical Encyclopedia [Internet]. (2021). *Urination – excessive amount*. https://medlineplus.gov/ency/article/003146.htm

25. Cherney, K. (2018). *Everything you should know about pyuria.* Healthline. https://www.healthline.com/health/pyuria

26. "Pyuria2011.JPG" by James Heilman, MD is licensed under CC BY-SA 3.0

27. Maddukuri, G. (2021). *Urinary frequency.* Merck Manual Professional Version. https://www.merckmanuals.com/professional/genitourinary-disorders/symptoms-of-genitourinary-disorders/urinary-frequency



Figure 8.11 Pyuria

View supplementary YouTube videos[28,29] about the urinary system:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2406#oembed-1

The Urinary System

28. RegisteredNurseRN. (2017, May 4). *Kidney and nephron anatomy structure function | Renal function system* [Video]. YouTube. All rights reserved. Reused with permission. https://www.youtube.com/watch?v=0qZxw0Nd1lI

29. Bozeman Science. (2017, February 13). *The urinary system* [Video]. YouTube. All rights reserved. https://youtu.be/H2VkW9L5QSU

8.3 General Urinary System Assessment

When evaluating a client for possible disorders of the urinary system, the nurse acknowledges individual and population risk factors, cultural influence, and socioeconomic factors that may impact health.

Risk Factors

Several risk factors can contribute to the development of urinary system alterations, and these factors may vary in their impact from person to person[1,2]:

- **Age:** As individuals age, the glomerular and tubular membranes thicken, and the tubules also decrease in length, decreasing glomerular filtration. Due to these physiological changes, many older adults experience nocturnal polyuria. Furthermore, most men experience benign prostate enlargement as they age, resulting in bladder outlet obstruction. This obstruction causes incomplete bladder emptying, resulting in symptoms of frequent urination in small amounts throughout the day and night.[3]
- **Genetics:** Family history of kidney disease can increase the risk of certain kidney conditions, such as polycystic kidney disease and chronic kidney disease.

1. Cerqueira, D., Tavares, J. R., & Machado, R. C. (2014). Predictive factors for renal failure and a control and treatment algorithm. *Revista Latino- Americana de Enfermagem, 22*(2), 211-7. https://doi.org/10.1590/0104-1169.3048.2404

2. Kuma, A., & Kato, A. (2022). Lifestyle-related risk factors for the incidence and progression of chronic kidney disease in the healthy young and middle-aged population. *Nutrients, 14*(18), 3787. https://doi.org/10.3390/nu14183787

3. Kallas, H. E., Chintanadilok, J., Maruenda, J., Donahue, J. L., & Lowenthal, D. T. (1999). Treatment of nocturia in the elderly. *Drugs & Aging, 15*(6), 429–437. https://doi.org/10.2165/00002512-199915060-00003

- **Concurrent Medical Conditions:**
  - Hypertension: Uncontrolled high blood pressure is a leading cause of kidney damage. High blood pressure can damage blood vessels in the kidneys, reducing their ability to function properly.
  - Diabetes mellitus, type 1 and type 2: Elevated blood sugar can damage the small blood vessels of the kidneys over time.
  - Atherosclerosis: Impacts blood flow to the kidneys.
  - Autoimmune diseases: May damage the kidneys due to sustained inflammatory processes.
  - Urinary tract infections: Recurrent infections may spread to the kidney, resulting in damage and scarring.
  - Urinary obstructions: Blockages in the urinary tracts due to kidney stones, prostate enlargement, or tumors may lead to urinary tract infections and reduced kidney function.
- **Drugs & Smoking:** Many drugs, including prescription and illicit drugs, can damage the kidneys, especially if used for sustained periods. Smoking increases the risk of hypertension and atherosclerosis, subsequently resulting in damage to the kidneys.
- **Toxins:** Exposure to heavy metals and solvents may result in damage to the kidneys.

Cultural Factors

Cultural factors can influence various aspects of health, including urinary health. Cultural beliefs and health practices can impact an individual's lifestyle choices. For example, some cultures may consume diets that are high in salt, processed foods, and protein that can potentially lead to hypertension and increased risk for kidney damage. Individuals who participate in fasting rituals may also sustain dehydration or electrolyte imbalances, which can result in kidney damage. Individuals who elect to use alternative healing methods or traditional medicines, such as specific herbs and rituals, may also experience increased risk to the kidneys. Delays in seeking medical treatment for kidney disorders can result in lasting kidney damage. Additionally, many ethnic

groups such as African Americans, Hispanics, and Native Americans have a higher risk of developing kidney disease.[4]

Socioeconomic Factors

Socioeconomic factors play a significant role in shaping health outcomes, including the development and progression of urinary system alterations. Individuals with lower socioeconomic status often face barriers to accessing and paying for health care, have limited resources for preventive measures, and may be exposed to environmental factors that can contribute to kidney problems. They may work in environments with exposure to toxins or pollutants that increase risk of kidney diseases. Individuals may elect to avoid routine checkups and laboratory monitoring or delay medical treatment like dialysis due to costs. Omissions in care and timely intervention may result in sustained and exacerbated kidney damage. Additionally, individuals with lower health literacy may also experience increased challenges in navigating the health care system and following recommendations related to their urinary system health.[5]

Assessment

Healthy kidney functioning is essential for regulating fluid and electrolyte balances, blood pH balance, blood pressure, and red blood cell production. Assessment of urinary system functioning includes obtaining a health history, performing a physical examination, and reviewing diagnostic test results. A

4. Hassan, M. O., & Balogun, R. A. (2022). The effects of race on acute kidney injury. *Journal of Clinical Medicine, 11*(19), 5822. https://doi.org/10.3390/jcm11195822

5. Anandh, U., Meena, P., Karam, S., & Luyckz, V. (2022). Social, political, and legal determinants of kidney health: Perspectives from lower- and middle-income countries with a focus on India. *Frontiers in Nephrology, 2*, 1-11. https://doi.org/10.3389/fneph.2022.1024667

thorough assessment allows for early detection and management of potential urinary system issues and helps prevent the progression of alterations to more advanced stages.

Health History

Many health history factors can influence the emergence of a urinary system alteration. Completing a detailed health history can provide evidence of areas of potential concern. When nurses suspect a potential alteration, specific assessment questions may reveal clues as to a diagnosis. Questions examining recent urinary changes, including urinary output, increased urinary frequency, urinary incontinence, a sense of urgency, pain with urination, difficulty starting urine flow, or difficulty emptying one's bladder, may offer guiding insight into a potential urinary system disorder.

Medications and diet can also impact urinary system health. Fluid and dietary intake should be closely examined for potential dehydration and the presence of salt and protein in meal choices. Additionally, any recent imaging studies are important to note because the use of contrast dyes can potentially damage the kidneys and diminish renal function.[6,7]

Physical Assessment

Urinary system alterations can impact other body systems. Early identification of abnormal findings and notification of the health care provider can lead to prompt intervention and help prevent lasting damage to the kidneys and other organs. See Table 8.3 for a summary of abnormal findings by body system related to urinary system alterations.

6. National Kidney Foundation. (n.d.). *Kidney disease: The basics*. https://www.kidney.org/news/newsroom/fsindex

7. Inker, L. A., & Perrone, R. D. (2023). *Assessment of kidney function*. https://www.uptodate.com/

Table 8.3. Abnormal Findings by Body System Related to Urinary System Disorders[8,9,10]

Body System	Abnormal Findings Related to Urinary Disorders
Urinary System	Hematuria, oliguria, polyuria, dysuria, frequency, urgency, cloudy or foul-smelling urine, pus in urine, or presence of bloody/purulent discharge on urinary meatus.
Cardiovascular	Edema (due to fluid retention), hypertension, abnormal heart rhythm (due to electrolyte imbalances), or heart murmur (related to fluid overload).
Gastrointestinal	Nausea, vomiting, constipation.
Skin	Pallor, yellow/grayish color, dry skin, or pruritus.
Neurological	New onset confusion or altered mental status, seizures, or other neurological symptoms. **Uremic encephalopathy** is a cerebral dysfunction caused by the accumulation of toxins resulting from acute or chronic kidney failure.
Musculoskeletal	Bone pain or tenderness (related to mineral imbalances during acute or chronic kidney failure), muscle cramps, fatigue, or weakness.

Review health history questions and physical assessment of the genitourinary system in the "Gastrointestinal and

8. National Kidney Foundation. (n.d.). *Kidney disease: The basics.* https://www.kidney.org/news/newsroom/fsindex
9. Inker, L. A., & Perrone, R. D. (2023). *Assessment of kidney function.* https://www.uptodate.com/
10. Maddukuri, G. (2022). *Evaluation of the renal patient.* Merck Manual Professional Version. https://www.merckmanuals.com/professional/genitourinary-disorders/approach-to-the-genitourinary-patient/evaluation-of-the-renal-patient

Genitourinary Assessment" section of the "Abdominal Assessment" chapter of Open RN *Nursing Skills, 2e*.

Life Span Considerations

The following characteristics should be considered for older adult and pediatric populations.[11,12,13]

OLDER ADULT CONSIDERATIONS

- As individuals age, the glomerular and tubular membranes thicken, and the tubules also decrease in length, causing decreased glomerular filtration. Due to these physiological changes, many older adults experience nocturnal polyuria.
- Most men experience benign prostate enlargement as they age, resulting in bladder outlet obstruction. This obstruction causes incomplete bladder emptying, resulting in symptoms of frequent urination in small amounts throughout the day and night.

11. State-wide Emergency Care of Children Working Group. (2024). *CHQ-NSS-51033 Anatomical and Physiological Differences in Children*. Children's Health Queensland Hospital and Health Service. https://www.childrens.health.qld.gov.au/__data/assets/pdf_file/0031/179725/how-children-are-different-anatomical-and-physiological-differences.pdf

12. Lu, H., & Rosenbaum, S. (2014). Developmental pharmacokinetics in pediatric populations. *Journal of Pediatric Pharmacology Therapeutics, 19*(4), 262-76. https://doi.org/10.5863/1551-6776-19.4.262

13. Kujubu, D. A. (2009). *Chapter 19: Nocturia in elderly persons and nocturnal polyuria*. American Society of Nephrology. https://www.asn-online.org/education/distancelearning/curricula/geriatrics/Chapter19.pdf

- In elderly clients, changes in mental status may be the presenting symptom of a urinary tract infection.
- Aging results in a decline in function for the urinary and renal systems. In addition, underlying diseases, sleep patterns, habits and use of medications may result in nocturia.
- Urinary urgency, urinary frequency, urinary retention, and urinary incontinence are also common concerns for older adults.
- As individuals get older, changes in bladder muscle tone and function and weakened pelvic floor muscles can increase the incidence of urinary incontinence.

PEDIATRIC CONSIDERATIONS

- Children have a faster metabolic rate and expend more calories, resulting in a higher requirement for fluids.
- Infants have a greater body surface area, compared to their weight, which may lead to water loss from skin.
- Due to immature tubular function, sodium may be dysregulated.
- Loss of water from a decreased ability to concentrate urine may affect small children.
- Immature glomerular filtration, tubular secretion, and reabsorption reduce renal excretion of medications.
- Expected urinary output is calculated in mL/kg/hr. The expected urine output for an infant and child is 1-2mL/kg/hr. For an adolescent, urine output should be 0.5-1mL/kg/hr.
- In infants, the reflex to urinate is active, but as toddlers mature, they learn how to override the reflex and control the external sphincter, thus delaying voiding until it is appropriate to do so (commonly referred to as “potty training”).
- To assess for urine output in infants and toddlers, assess the frequency of wet diapers and the daily number of wet diapers. In hospitalized infants and toddlers, the diapers may be weighed for precise measurements of urine output.
- Enuresis in children is considered normal unless it continues past seven

or eight years of age, when it should be addressed with a pediatrician.

Diagnostic Testing

Definitive signs of a urinary system alterations are often reflected in blood and urine tests. Tests are ordered by health care providers based on signs and symptoms that may reflect a suspected disorder.

BLOOD TESTS

Common blood tests for diagnosing and monitoring kidney function include serum creatinine, blood urea nitrogen (BUN), and glomerular filtration rate. Other blood tests used to diagnose and monitor urinary system alterations include electrolyte panel, albumin, serum protein, and complete blood count[14]:

- **Serum Creatinine:** Creatinine is a waste product that is produced by the breakdown of muscle and must be filtered out by the kidneys. Elevated creatinine levels may indicate kidney dysfunction because of their decreased ability to effectively filter creatinine out of the bloodstream.
- **Blood Urea Nitrogen (BUN):** BUN is a measurement of the amount of nitrogen present in the bloodstream. Nitrogen is produced from urea, a waste product from the liver when proteins are broken down. Elevated BUN levels can indicate kidney damage because of decreased ability to filter urea out of the bloodstream. However, BUN levels can also be elevated due to dehydration or from increased protein in the diet.
- **Glomerular Filtration Rate (GFR):** GFR estimates how well the kidneys are filtering waste from the blood. eGFR is a standardized calculation reflecting the amount of creatinine in the blood based on the client's age and gender. In adults with healthy kidneys, the glomerular filtration rate

14. Gounden, V., Bhatt, H., & Jialal, I. (2024). *Renal Function Tests*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507821/

is 90 mL per minute or higher. Kidney damage causes this number to decrease. See more information about GFR rates and kidney damage in the "Chronic Kidney Disease" section of this chapter.

- **Electrolyte Panel (Sodium, Potassium, Calcium, Phosphorus):** The kidneys help regulate electrolyte balance in the bloodstream. Clients with kidney dysfunction often experience elevated levels of potassium, phosphate, and magnesium and decreased levels of sodium and calcium. Abnormal electrolyte levels affect the transmission of impulses in the nerves and muscles throughout the body, which can have serious implications. For example, potassium imbalance can cause life-threatening cardiac dysrhythmias.
- **Serum Albumin:** Albumin is a protein in the blood that helps maintain fluid balance inside and outside of blood vessels. Healthy kidneys retain albumin and keep normal levels in blood vessels, thus keeping fluid inside the blood vessels. Kidney damage results in the kidneys being unable to retain albumin, causing low levels of albumin in blood vessels. When albumin levels are decreased, fluid leaks out of blood vessels into interstitial areas around tissues, referred to as "**third spacing**."
- **Serum Protein:** Individuals with kidney dysfunction can also experience abnormal levels of other blood proteins like globulins due to impaired filtering.
- **Complete Blood Cell Count (CBC):** Many clients with kidney dysfunction have decreased production of erythropoietin by the kidneys, which stimulates red blood cell production. As a result, they often experience anemia due to decreased red blood cell (RBC) levels.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

URINE TESTS

Common urine tests diagnosing and monitoring urinary system alterations include urinalysis, urine culture and sensitivity, composite urine collection, and creatinine clearance.

- **Urinalysis (UA):** A urine sample is collected and analyzed for several elements, including the following:
    - **Color, Odor, and Turbidity:** Color ranges from pale yellow to amber. Changes in color can indicate conditions like dehydration or hematuria (blood in the urine). Urine can have a mild ammonia-like odor, but malodorous urine is a sign of infection. Normal urine is clear. **Turbidity** (cloudiness) can indicate the presence of particles like bacteria, white blood cells, or crystals.
    - **Specific Gravity:** Specific gravity refers to the concentration of solutes in the urine, a measurement that reflects the kidney's ability to concentrate urine. Low specific gravity values indicate dilute urine, and high levels indicate concentrated urine.
    - **pH:** pH measures the acidity or alkalinity of the urine. Normal pH ranges from 4.6 to 8.0. Abnormal pH can be the result of diet, medications, or conditions like infection, acidosis, or alkalosis.
    - **Glucose:** Normally, there is no glucose in urine. Glucose in urine indicates high blood glucose levels and possible diabetes mellitus.
    - **Ketones:** Normally, there are no ketones in the urine. The presence of ketones indicates the body is metabolizing fats for energy, which can be caused by fasting, a carbohydrate-restricted diet, or a complication of diabetes mellitus called diabetic ketoacidosis.
    - **Protein:** Elevated levels of protein in the urine can indicate kidney damage.
    - **Leukocyte Esterase & Nitrates:** The presence of leukocyte esterase and nitrates indicates a bacterial infection.
    - **Cells, Casts, Crystals, and Bacteria:** The presence of red blood cells, white blood cells, or epithelial cells in the urine suggests underlying conditions like kidney disease or urinary tract issues. Different types of casts (hyaline, granular, cellular, etc.) can indicate damage within the kidney tubules. Crystals can form due to changes in urine composition, indicating potential conditions like urinary tract infections, kidney stones, or metabolic disorders. The presence of bacteria can indicate a urinary tract infection or contamination of the urine sample by normal flora.

- **Urine Culture and Sensitivity:** A urine culture and sensitivity test is used to identify the presence of bacteria or other microorganisms in the urine and determine the most effective antibiotics for treating a bacterial infection.
- **Composite Urine Collections:** Composite urine collections involve combining multiple urine samples collected over a specific time period to create a single representative sample for analysis. Two types of composite urine collections are timed urine collections and pooled or mixed collections.
    - **Timed Urine Collection:** This method involves collecting all urine produced over a specified time period, such as over 24 hours or a shorter duration (e.g., 2, 4, or 12 hours). This collection is used for evaluating substances in the urine like creatinine, protein, or certain hormones that require accurate measurements of total urine output within a specific time frame.
    - **Pooled or Mixed Urine Samples:** In this approach, smaller urine samples are collected at various intervals, such as morning, afternoon, and evening. These samples are pooled together to create a composite sample. This method can be used for general analysis or to monitor changes in urinary components throughout the day, such as variations in electrolyte levels or hormones.

- **Creatinine Clearance:** Creatinine clearance is a urine test used to estimate the glomerular filtration rate (GFR). Creatinine clearance is calculated based on the amount of creatinine cleared from the blood by the kidneys over a 24-hour period. The test requires collecting a 24-hour urine sample, as well as a blood sample to calculate the clearance rate. The calculation is (urine concentration x urine volume) divided by the serum creatinine concentration. A lower creatinine clearance reflects reduced kidney function, and a higher creatinine clearance reflects improved kidney function.[15]

IMAGING STUDIES

Common imaging studies used to diagnose urinary system alterations include bladder ultrasound, KUB imaging, IV urography/IV pyelogram, CT scan, and cystoscopy[16,17]:

- **Bladder Ultrasound:** A bladder ultrasound assesses the bladder's size, shape, and emptying ability and is useful for identifying thickened tissue, masses, or obstructions within the urinary tract. Bladder ultrasounds can also measure post-void residuals, reflux of urine from the bladder into the ureters, and the presence of urinary tract inflammation.
- **Kidneys, Ureters, Bladder (KUB):** KUB refers to radiographic imaging of the abdomen with or without contrast dye to assess the kidneys, ureters, and bladder.
- **IV Urography/ IV Pyelogram:** IV urography, also called IV pyelogram, uses contrast dye administered intravenously and radiographic imaging taken at specific intervals to visualize the urinary system, including the kidneys, ureters, and bladder, as the contrast dye is filtered by the kidneys and eliminated from the body. Nursing priorities prior to procedures that use contrast dye include assessing for allergies and reviewing kidney function test results. Nurses also teach clients about the importance of water consumption following the procedure to aid in flushing the dye from the kidneys.
- **Computed Tomography (CT) Scan:** A CT scan is an imaging procedure that uses a combination of X-rays and computer technology to produce a variety of images of the urinary tract looking for disease, cancer,

15. Gounden, V., Bhatt, H., & Jialal, I. (2024). *Renal Function Tests*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507821/

16. Centers for Disease Control and Prevention. (n.d.). *Kidney testing: Everything you need to know*. https://www.cdc.gov/kidney-disease/

17. American Kidney Fund. (2023). *Tests for kidney disease*. https://www.kidneyfund.org/all-about-kidneys/tests-kidney-disease

obstructions, and other disorders.[18]

- **Cystoscopy:** A cystoscopy is performed by a urologist who uses a cystoscope to look inside the urethra and bladder. A cystoscope is a long, thin optical instrument with an eyepiece at one end, a rigid or flexible tube in the middle, and a tiny lens and light at the other end of the tube. The urologist fills the bladder with fluid and looks at detailed images of the urethra and bladder on a computer monitor. During a cystoscopy, the urologist can see kidney stones, tumors, strictures or narrowing of the urethra, and other signs of blockage, such as an enlarged prostate gland. Treatments may also be performed during the procedure, such as removing a stone, taking a sample of the urethra or bladder tissue for a biopsy, injecting medicines into the bladder to treat urinary leakage, or removing abnormal tissue.[19] See Figure 8.12[20] for an illustration of cystoscopy.

18. Johns Hopkins Medicine. (n.d.). *Computed tomography (CT or CT scan) of the kidney*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/ct-scan-of-the-kidney

19. National Institute of Diabetes and Digestive and Kidney Disorders. (2021). *Cystoscopy & ureteroscopy.* National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/cystoscopy-ureteroscopy

20. "Diagram_showing_a_cystoscopy_for_a_man_and_a_woman_CRUK_064.svg" by Cancer Research UK is licensed under CC BY-SA 4.0

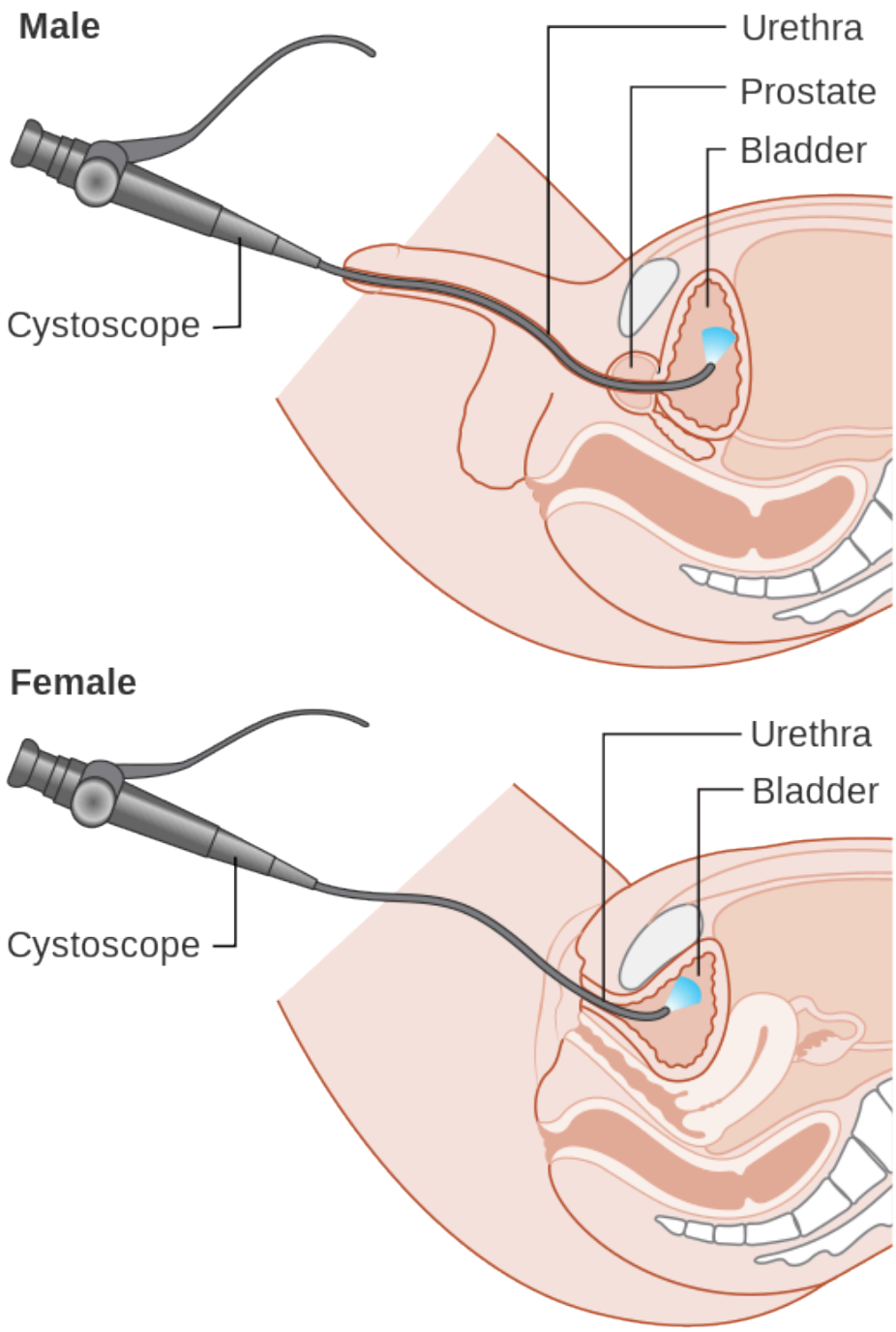


Figure 8.12 Cystoscopy

8.4 Common Urinary System Disorders

Alterations related to the urinary system that will be discussed in this chapter include acute renal failure, chronic kidney disease, cystitis, pyelonephritis, glomerulonephritis, urinary incontinence, urolithiasis, benign prostate hypertrophy, and cancer of the prostate and bladder.

8.5 Acute Renal Failure

Acute renal failure (also known as acute kidney injury) is the sudden loss of kidney function. Acute renal failure can be reversible if it is detected early, and intervention is promptly initiated. The condition can happen over a few hours to a few days and reflects the rapid decline in the kidney's ability to filter waste products and fluids from the blood, resulting in a buildup of waste products and toxins in the blood.

Pathophysiology and Risk Factors

Acute renal failure is the result of three main types of injury to the kidneys referred to as prerenal, intrarenal, and postrenal:

- **Prerenal:** Prerenal injury is caused by factors external to the kidneys that reduce renal blood flow, resulting in decreased glomerular perfusion and filtration. Examples of prerenal factors are hypovolemia, decreased cardiac output, and vascular obstruction that decrease the amount of circulating volume of blood to the kidneys.
- **Intrarenal:** Intrarenal injury is caused by conditions that directly damage the renal tissue, resulting in impaired nephron function. Examples of intrarenal injury are prolonged ischemia to the kidneys, nephrotoxins (such as aminoglycoside antibiotics and contrast media), excess hemoglobin released from hemolyzed RBCs, or myoglobin released from necrotic muscle cells.
- **Postrenal:** Postrenal injury is caused by mechanical obstruction of urinary outflow, resulting in the reflux of urine into the renal pelvis and impaired kidney function. Examples of postrenal injury include benign prostatic hyperplasia, prostate cancer, kidney stones, trauma, and tumors in the urinary tract.

See Figure 8.13[1] for an image of these types of acute renal failure.

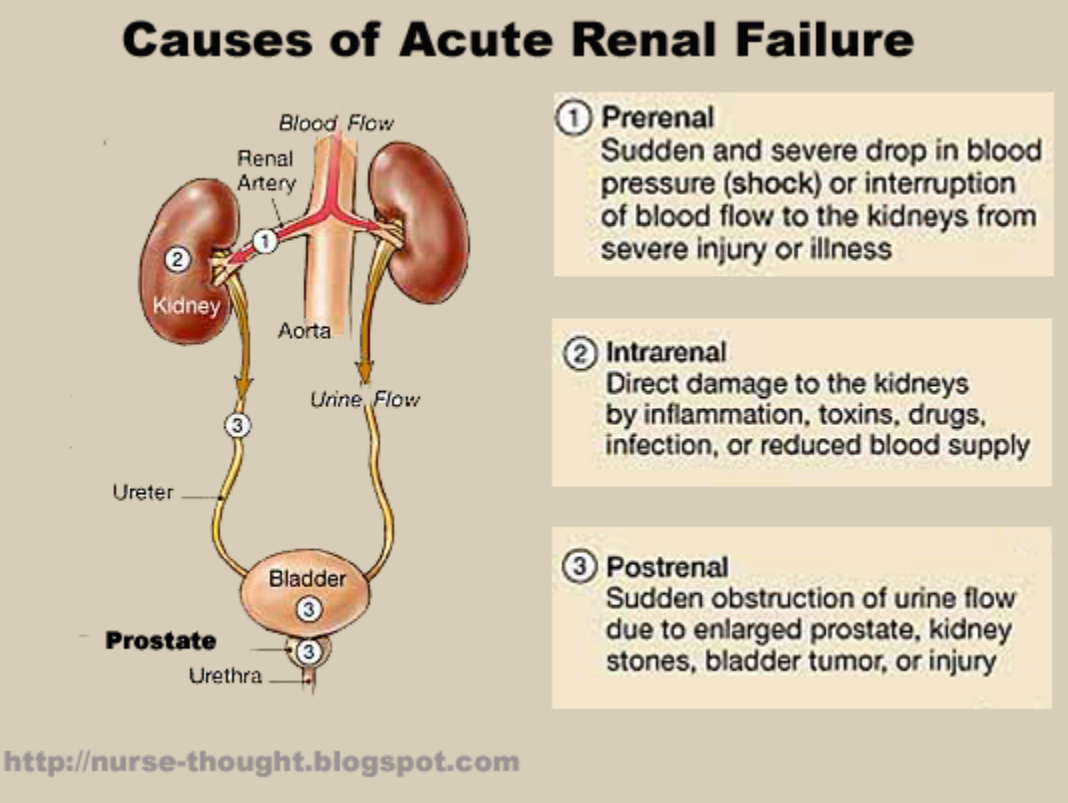


Figure 8.13 Causes of Acute Renal Failure

Several factors can increase the risk of developing acute renal failure. Acute renal failure is more common in aging individuals due to a natural decline in kidney function. Individuals with underlying health conditions such as chronic kidney disease, diabetes, hypertension, heart failure, liver disease, and autoimmune disorders are also at increased risk. Risk also increases for

1. This is a derivative of "causesofacuterenalfailure.png" by Cassio Lymn and is used under Fair Use. Access for free at https://fundamentalsofnursingblog.wordpress.com/2016/12/15/acute-kidney-injury/

individuals experiencing dehydration, blood loss/trauma, severe infections, or exposure to toxins.[2,3]

Assessment

Common symptoms of acute renal failure across body systems are summarized in Table 8.5.

Table 8.5. Manifestations of Acute Renal Failure Across Body Systems[4,5,6]

2. Goyal, A., Daneshpajouhnejad, P., Hashmi, M. F., et al. (2023). *Acute Kidney Injury*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441896/

3. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Acute kidney failure*. https://medlineplus.gov/ency/article/000501.htm

4. Goyal, A., Daneshpajouhnejad, P., Hashmi, M. F., et al. (2023). *Acute Kidney Injury*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441896/

5. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Acute kidney failure*. https://medlineplus.gov/ency/article/000501.htm

6. Mayo Clinic. (2024). *Acute kidney failure*. https://www.mayoclinic.org/diseases-conditions/kidney-failure/diagnosis-treatment/drc-20369053

Body System	Clinical Manifestations of Acute Renal Failure
Renal	Oliguria, anuria, and **uremia** (elevated urea and nitrogenous waste in the blood)
Cardiovascular	Hypertension, fluid overload, pitting edema, heart failure, arrhythmias, and pericarditis
Respiratory	Dyspnea (shortness of breath from pulmonary edema) and Kussmaul breathing (in severe metabolic acidosis)
Gastrointestinal	Nausea, vomiting, anorexia, gastrointestinal bleeding, and gastritis
Neurological	Confusion, **asterixis** (flapping tremor), peripheral neuropathy, seizures, and coma
Hematological	Anemia (due to decreased erythropoietin production) and bleeding tendencies/coagulopathies
Integumentary	Pruritus, dry skin, pallor, ecchymosis, and **uremic frost** (whitish coating of urea crystals on the skin when there is a significant buildup of urea in the bloodstream during severe kidney failure)
Musculoskeletal	Muscle weakness and muscle cramps
Endocrine	Fluid retention, electrolyte imbalances (i.e., hyperkalemia, hyponatremia), metabolic acidosis, and insulin resistance

Diagnostic Testing

Laboratory studies and diagnostic imaging tests are used to identify the cause and severity of acute renal failure. Blood tests commonly performed include serum creatinine, blood urea nitrogen (BUN), and glomerular filtration rate (GFR) that demonstrate elevated creatinine and BUN with decreased GFR. Electrolyte and acid-base abnormalities during acute renal failure include elevated potassium levels, low sodium levels, and metabolic acidosis. A complete blood cell count (CBC) may reflect anemia as the result of decreased erythropoietin production. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Urinalysis and renal ultrasound may also be performed to assess for potential causes of failure such as structural abnormalities, obstruction, or infection.[7]

7. Goyal, A., Daneshpajouhnejad, P., Hashmi, M. F., et al. (2023). *Acute Kidney Injury*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441896/

Nursing Diagnoses

Nursing diagnoses for clients with acute renal failure help guide nursing care and address the specific needs of these individuals. Common nursing diagnoses for acute renal failure include the following:

- Decreased Urinary Output
- Electrolyte Imbalance
- Fluid Volume Excess
- Risk for Bleeding
- Imbalanced Nutrition
- Anxiety

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with acute renal failure are as follows:

- *The client will exhibit a gradual increase in urinary output to within normal limits, maintaining a minimum of 30 mL/hour, indicating improved renal perfusion and function within 24 hours.*
- *The client's electrolyte levels (potassium, sodium, calcium) will be within normal ranges within 48 hours, demonstrating restored electrolyte balance and renal function stability.*
- *By discharge, the client will maintain stable body weight, absence of edema, and balanced intake/output, indicating effective fluid volume management by the kidneys.*
- *The client will demonstrate an increase in nutritional intake, maintaining adequate calorie and nutrient intake, achieving weight stabilization, and reporting improved appetite and energy levels within one week.*

Interventions

Medical Interventions

Medical interventions to treat acute renal failure focus on identifying and correcting the underlying causes, restoring kidney function, and preventing lasting damage to the kidneys. Common underlying causes of acute kidney failure requiring treatment include hypotension, sepsis, heart failure, renal obstructions, medication toxicity, and dehydration. Medical interventions may include fluid management, medication management, electrolyte management, nutritional support, dialysis, and surgery[8,9,10]:

- **Fluid Management:** Intravenous fluids may be administered cautiously to restore adequate circulating blood volume while also closely monitoring for fluid overload.
- **Medication Management:** Potentially nephrotoxic drugs are identified. Medications are prescribed to treat underlying causes, such as infection. Diuretics may be used cautiously to manage fluid overload in some cases.
- **Electrolyte Management:** High potassium levels are common during acute renal failure and can result in serious complications like cardiac dysrhythmias. Insulin with glucose and/or potassium binders may be prescribed to quickly lower potassium levels in the blood.
- **Nutritional Support:** Nutritional intake, especially protein, potassium, sodium, phosphorus, and fluids, may be restricted to support kidney function and prevent fluid overload.

8. Goyal, A., Daneshpajouhnejad, P., Hashmi, M. F., et al. (2023). *Acute Kidney Injury*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441896/

9. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Acute kidney failure*. https://medlineplus.gov/ency/article/000501.htm

10. Mayo Clinic. (2024). *Acute kidney failure*. https://www.mayoclinic.org/diseases-conditions/kidney-failure/diagnosis-treatment/drc-20369053

- **Surgery:** In situations of obstruction or severe damage, surgical interventions like stent placement, nephrostomy, or other corrective procedures may be performed.
- **Dialysis:** Hemodialysis or peritoneal dialysis may be needed in cases of severe renal impairment due to the accumulation of significant waste and fluids. Continuous renal replacement therapy may be used when more gradual removal of fluids and wastes is needed due to hemodynamic instability. Read more information about different types of dialysis in the following box.

A Closer Look at Dialysis...

Dialysis is a procedure to artificially perform the functions of the kidneys when they are unable to effectively filter waste products and excess fluids from the blood. There are three main types of dialysis.

Hemodialysis

- **Procedure: Hemodialysis** involves using a machine called a dialyzer or artificial kidney. Blood is removed from the body through a catheter or arteriovenous fistula/graft, circulated through the dialyzer to remove waste and excess fluid, and then returned to the body. It is important for nurses to know what medications should be held prior to dialysis because they will be dialyzed out or may cause hypotension.
- **Access:** Vascular access is crucial and is typically established through a surgically created arteriovenous fistula or arteriovenous graft that is only used for dialysis. A central venous catheter may also be used.
- **Frequency:** Hemodialysis is usually performed several

times a week in sessions lasting around three to four hours each, but frequency may vary based on the client's needs and condition.

Peritoneal Dialysis

- **Procedure: Peritoneal dialysis** uses the peritoneum, a membrane lining the abdominal cavity, as a natural filter. A catheter is placed into the abdomen, and a special fluid (dialysate) is introduced and drained out after a dwell time, allowing waste products and excess fluids to pass from the blood into the dialysate.
- **Access:** A catheter is surgically placed in the abdomen to allow access for the dialysis solution. The fluid is typically straw colored in the dialysate.
- **Frequency: Continuous Ambulatory Peritoneal Dialysis (CAPD)** involves manual exchanges multiple times a day, while **Continuous Cycling Peritoneal Dialysis (CCPD)** uses a machine for automated exchanges during the night.

Continuous Renal Replacement Therapy (CRRT)

- **Procedure:** CRRT is a slow and continuous form of dialysis that occurs 24 hours a day, emulating the continuous filtration process of the kidneys. Blood is continuously removed from the body via a catheter and passed through a machine that filters waste products and excess fluids before returning the filtered blood to the client.
- **Access:** Similar to hemodialysis, a catheter is placed in a large vein, typically the jugular or femoral vein, for vascular access.
- **Frequency:** CRRT is continuous and runs over an extended period, often days to weeks, providing slower and

gentler fluid and solute removal compared to traditional hemodialysis.

View a supplementary YouTube video[11] on dialysis: Procedure of DIALYSIS.

Nursing Interventions

Nursing interventions for acute renal failure are aimed at managing symptoms, supporting kidney function, preventing complications, and promoting overall client well-being.

MEDICATION MANAGEMENT

During inpatient care, nurses administer medications while considering safe dosage ranges based on kidney function tests like serum creatinine. Health teaching is provided regarding the purpose of medications, common side effects, and when to notify the provider.

MONITOR FLUID AND ELECTROLYTE BALANCE

Fluid intake and urine output are closely monitored and documented. Although nurses may delegate the measurement and documentation of fluid intake and output to unlicensed assistive personnel (UAPs), they must ensure it is measured and documented accurately. Registered nurses analyze intake/

11. 7activestudio. (2016, November 27). *Procedure of DIALYSIS* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=EU2skU3bgS8&t=19s

output data per shift, as well as trended data over 24 hours, and promptly communicate fluid imbalance concerns to the health care provider. If fluid imbalance occurs, appropriate strategies are implemented (such as fluid restriction and diuretic administration for fluid overload, or IV fluid administration for hypovolemia).

Weight is also closely monitored as an indicator of fluid balance. Daily weights are commonly prescribed for clients receiving dialysis.

Electrolyte levels are closely monitored (i.e., potassium, sodium, calcium, phosphorus, and magnesium), and abnormal levels are promptly communicated to the health care provider. Nurses also collaborate with dieticians to plan appropriate diet selections, considering potential restrictions in protein, sodium, potassium, and phosphorus.

HEALTH TEACHING

Health teaching is provided regarding medications, dietary and fluid restrictions, and follow-up care. Signs and symptoms requiring immediate medical attention are reinforced.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Acute Renal Failure

View a brief YouTube video overview of acute renal failure[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2498#oembed-1

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 8 – Acute renal failure* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/9Dh3VnhlcXc?si=XF9UdrOEx0CH9aa9

8.6 Chronic Kidney Disease

Chronic kidney disease (CKD) refers to the gradual, progressive loss of kidney function over time. As kidney function declines, the ability to remove excess fluids and filter wastes from the blood becomes impaired. Additionally, electrolyte imbalance and hormone production may also be compromised.

CKD typically progresses slowly over months or years and is asymptomatic in the early stages. As kidney function continues to decline, symptoms like fatigue, swelling in the legs and ankles, difficulty concentrating, decreased appetite, and changes in urination patterns may begin to emerge.

Pathophysiology and Risk Factors

There are many potential risk factors for developing CKD. Older adults, individuals with a family history of CKD, and certain ethnic groups such as African Americans, Hispanics, and Native Americans have an increased risk of developing CKD. Factors that decrease blood flow to the kidneys, such as atherosclerosis, diabetes, and high blood pressure, can damage the kidneys. Urinary tract disorders like glomerulonephritis (inflammation of the kidneys' filtering units), polycystic kidney disease, kidney stones, prolonged urinary tract obstruction, and recurrent urinary tract infections can also cause damage. Other risk factors include autoimmune diseases and chronic long-term use of certain medications such as nonsteroidal anti-inflammatory medications and antibiotics.[1]

CKD is classified by health care providers by stages according to the individual's glomerular filtration rate (GFR). The stage of CKD guides medical treatment. See Table 8.6a for an overview of the stages of CKD.[2]

1. Centers for Disease Control and Prevention. (n.d.). *Chronic kidney disease basics*. https://www.cdc.gov/kidney-disease/about/

2. Levey, A. S., & Inker, L. A. (2022). Definition and staging of chronic kidney disease in adults. *UpToDate*. https://www.uptodate.com/

Table 8.6a. Stages of CKD

Stage	Description	GFR (mL/min/1.73 m²)
1	Normal GFR	90 or higher
2	Mild reduction in GFR	60 – 89
3	Moderate reduction in GFR	30 – 59
4	Severe reduction in GFR	15 – 29
5	Kidney failure (End-stage)	Less than 15

Assessment

CKD affects multiple body systems due to the kidneys' crucial role in regulating fluids, electrolytes, and hormone levels. See Table 8.6b for an overview of clinical manifestations of CKD by body system.

Table 8.6b. Signs and Symptoms of CKD by Body System[3,4,5]

Body System	Clinical Manifestations
Urinary	Oliguria, anuria, proteinuria, and hematuria
Cardiovascular	Edema, hypertension and heart murmurs (due to fluid overload), dysrhythmias (due to hyperkalemia), and pericarditis (in advanced stages)
Respiratory	Dyspnea (difficulty breathing) due to fluid overload
Neurological	Confusion or cognitive changes due to uremic toxins affecting the brain (called cerebral encephalopathy)
Gastrointestinal	Anorexia, nausea, metallic taste in mouth (uremic taste), gastritis or peptic ulcer disease, and gastrointestinal bleeding due to uremic platelet dysfunction
Integumentary	Pallor, pruritus, and uremic frost (rare, indicates severe uremia)
Musculoskeletal	Bone pain or fractures due to weakened bones (renal osteodystrophy), muscle weakness and cramping, and fatigue
Hematologic	Anemia (low red blood cell count) due to decreased production of erythropoietin by the kidneys and bleeding tendency due to platelet dysfunction

3. Centers for Disease Control and Prevention. (n.d.). *Chronic kidney disease basics*. https://www.cdc.gov/kidney-disease/about/

4. National Kidney Foundation. (2023). *Chronic kidney disease*. https://www.kidney.org/atoz/content/about-chronic-kidney-disease

5. MedlinePlus [Internet]. (2018). *Chronic kidney disease*. https://medlineplus.gov/chronickidneydisease.html

Diagnostic Testing

Diagnostic testing for CKD is performed to assess and monitor kidney function, identify underlying causes, and stage the disease. Common blood tests include serum creatinine, blood urea nitrogen (BUN), glomerular filtration rate (GFR), and electrolyte panels. Typically, the creatinine and BUN results are increased and the GFR is decreased. In the electrolyte panel results, the potassium and phosphorous are typically elevated and the calcium level is decreased. Complete blood counts are also monitored for signs of anemia (decreased red blood cells) due to decreased erythropoietin production. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Urine tests may be performed to examine the urine for blood, protein, or signs of infection. Additional testing may include renal ultrasound, CT scan, or kidney biopsy to look for signs of structural abnormalities, blockage, tumor, and the extent of the kidney damage.[6,7]

Nursing Diagnoses

Nursing diagnoses for clients with CKD can help guide nursing care and address the specific needs of these individuals. Common nursing diagnoses include the following:

- Electrolyte Imbalance
- Fluid Volume Excess
- Risk for Infection
- Imbalanced Nutrition
- Anxiety

6. Centers for Disease Control and Prevention. (n.d.). *Chronic kidney disease basics*. https://www.cdc.gov/kidney-disease/about/

7. MedlinePlus [Internet]. (2018). *Chronic kidney disease*. https://medlineplus.gov/chronickidneydisease.html

- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with chronic kidney disease are as follows:

- *The client will verbalize three dietary modifications required to maintain stable electrolyte levels by the end of the teaching session.*
- *The client will demonstrate a reduction in edema in lower extremities by 50% within three days.*
- *The client will demonstrate no signs of infection (e.g., fever, elevated WBC count) throughout the hospital stay.*
- *The client will demonstrate effective relaxation techniques to cope with anxiety related to chronic disease management before discharge from the hospital.*
- *The client will verbalize the actions and side effects of prescribed medications after the teaching session.*

Interventions

Medical Interventions

Medical interventions for CKD aim to slow disease progression, manage symptoms, and prevent complications. Interventions vary depending on the stage of the disease and client condition and may include medication management, dialysis, nutritional support, and kidney transplant.

MEDICATION MANAGEMENT

Controlling hypertension and managing complications are important parts of

medical treatment for CKD. Medications such as angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) can help to control elevated blood pressure and protect the kidneys from additional damage. Erythropoietin-stimulating agents may be prescribed to stimulate red blood cell production. Electrolyte-lowering agents (such as phosphate binders to lower phosphate levels and sodium polystyrene to lower potassium levels) and electrolyte replacement (such as calcium supplements) may be prescribed based on the individual's lab results.

DIALYSIS

Hemodialysis and peritoneal dialysis are prescribed for individuals with Stage 5 CKD (also called kidney failure or end-stage renal disease). Both types of dialysis remove waste products and excess fluids from the body. The choice between hemodialysis and peritoneal dialysis depends on various factors such as the client's medical condition, lifestyle, residual kidney function, vascular access, and personal preference. Fluid and electrolyte balances are routinely assessed, and dialysis therapy is tailored to optimize fluid removal and restore electrolyte balance. See Table 8.6c for a comparison of the aspects of hemodialysis and peritoneal dialysis.

Table 8.6c. Types of Dialysis

	Hemodialysis	Peritoneal Dialysis
Access	AV fistula, AV graft, or central venous catheter	Catheter placed in the peritoneal cavity
Location	Typically done in a dialysis center	Can be performed at home (CAPD – continuous ambulatory peritoneal dialysis/APD – automated peritoneal dialysis)
Frequency of treatments	Usually 3 times per week, 3-5 hours per session	Daily exchanges (CAPD) or nightly with a machine (APD)
Dialysis process	Blood is filtered through a machine outside the body	Dialysis fluid (dialysate) is infused and drained within the peritoneal cavity
Duration of each session	3-5 hours per session	Continuous throughout the day (CAPD) or overnight (APD)
Need for a caregiver	Usually done in a clinic; minimal self-care required	May require assistance initially, especially for catheter care
Mobility and lifestyle	Less flexibility due to clinic-based treatments	More flexibility with self-administration at home
Risk of infections	Potential risk due to access site and equipment	Risk of peritonitis (infection of the abdominal cavity)
Diet and fluid restrictions	Strict dietary restrictions and fluid control	More liberal diet and fluid intake
Residual kidney function	May preserve residual kidney function	May have less impact on residual kidney function
Complications	Hypotension, access site issues, and blood clotting	Peritonitis and catheter-related issues
Initial training and learning	Requires training on machine use and access care	Training on catheter care, solution exchange, and hygiene

Access Sites

Access for hemodialysis may be initiated through a temporary access site and then transitioned to a long-term, stable access. Temporary and emergent access may be achieved through insertion of a central venous access device into a large vein in the neck, chest, or groin.

For long-term dialysis, an arteriovenous fistula is established where a surgical connection is made between an artery and vein that can withstand repeated access for multiple weekly treatments. The AV fistula is typically inserted into the arm. Special care measures must be taken to preserve the integrity of the fistula, such as avoidance of blood pressure measurements, blood draws, or other procedures that constrict blood flow in the AV extremity. Additionally, fistulas are only used for dialysis; they are not used for blood draws, and they are not flushed between dialysis treatments. Cleanliness of the fistula site is also important. The client is taught to gently wash the area with soap and water, allowing it to adequately dry, and to monitor the site daily for signs of redness and infection. The patency of the fistula site can be monitored by assessing for a **thrill** (vibration) and **bruit** (whooshing) sound. The presence of thrill and bruit indicates the fistula has adequate blood flood and is functioning.

An **arteriovenous graft** may also be created for long-term access. An arteriovenous graft is similar to a fistula but uses a synthetic tube to create a conduit between the artery and vein. An AV graft is a preferable long-term access when a client's blood vessels are unsuitable for a fistula.

View a supplementary YouTube video on fistulas: What does a fistula for dialysis look like? [CHT CERTIFICATION REVIEW] 2022.[8]

8. Utopia HCC. (2021, February 19). *What does a fistula for dialysis look*

NUTRITIONAL SUPPORT

Nutrition plays a crucial role in managing CKD, particularly in terms of controlling fluid and electrolytes balances. With the complexity of dietary modifications that are often required for individuals with CKD, it is often helpful for a referral to a registered dietician who specializes in renal nutrition. Common dietary restrictions include the following:

- **Sodium Restriction:** Limiting sodium helps manage fluid balance and blood pressure. Typical recommended sodium intake for clients with CKD is 1,500-2,300 mg per day. Health teaching is provided to avoid processed foods, canned goods, and use of salt when preparing meals.
- **Potassium Restriction:** For individuals with CKD with high potassium levels, limiting intake of potassium-rich foods like bananas, oranges, potatoes, tomatoes, and dried fruits is advised. Recommended intake may vary based on potassium blood levels and the individual's stage of CKD.
- **Phosphorus Restriction:** Foods high in phosphorus (dairy, nuts, seeds, colas) should be limited because damaged kidneys have difficulty removing excess phosphorus. Medications called phosphate binders may be prescribed to limit the absorption of phosphate in the digestive tract.
- **Protein Restriction:** Reducing the amount of protein consumed can lessen the workload on the kidneys. A moderate amount of high-quality protein is often recommended for individuals with CKD to maintain muscle mass without taxing the kidneys. Intake is personalized based on the individual's stage of CKD and their dietary needs.
- **Fluid Restriction:** In later stages of CKD, fluid intake may be restricted to avoid fluid overload and prevent complications like edema and high blood pressure. The amount of fluid permitted is individualized based on their urine output and residual kidney function.
- **Vitamin & Mineral Supplementation:** CKD may cause deficiencies in certain vitamins and minerals (like vitamin D, iron, and B vitamins).

like? [CHT CERTIFICATION REVIEW] 2022 [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=gjB5eKo4eh8

Supplements may be prescribed to manage deficiencies.

KIDNEY TRANSPLANTATION

Kidney transplantation may be an option for eligible clients with end-stage renal disease (ESRD). A kidney transplant involves surgically implanting a healthy kidney from a living or deceased donor to restore kidney function. A transplant offers beneficial outcomes compared to long-term dialysis. Clients undergo a thorough evaluation to determine if they are suitable candidates for transplantation. If eligible, they are placed on a waiting list for a donated kidney. After receiving a kidney transplant, the client is on life-long immunosuppressant medications.[9,10,11,12]

Nursing Interventions

Nursing interventions for individuals with CKD aim to manage symptoms, slow disease progression, prevent complications, and support the client's overall well-being. Interventions include routine monitoring, medication management, fluid and electrolyte management, and health teaching.

9. Centers for Disease Control and Prevention. (n.d.). *Chronic kidney disease basics*. https://www.cdc.gov/kidney-disease/about/
10. National Kidney Foundation. (n.d.). *Chronic kidney disease*. https://www.kidney.org/atoz/content/about-chronic-kidney-disease
11. MedlinePlus [Internet]. (2018). *Chronic kidney disease*. https://medlineplus.gov/chronickidneydisease.html
12. Rosenberg, M. (2022). Overview of the management of chronic kidney disease in adults. *UpToDate*. https://www.uptodate.com/

ROUTINE MONITORING

Routine monitoring for clients with CKD includes blood pressure (compared to their baseline), fluid intake/output, and signs of fluid overload or dehydration. Nurses also monitor the results of lab tests like kidney function tests (serum creatinine, BUN, GFR), electrolyte levels, and red blood cells/ hemoglobin.

MEDICATION MANAGEMENT

During inpatient care, nurses administer prescribed medications for managing blood pressure and fluid retention, treating anemia, promoting bone health, and preventing complications associated with CKD. Health teaching is provided regarding the actions of prescribed medications, their potential side effects, and when to notify the health care provider.

NUTRITIONAL SUPPORT/FLUID AND ELECTROLYTE MANAGEMENT

Nurses monitor for symptoms of electrolyte imbalances (sodium, potassium, phosphorus) and assist in maintaining balanced electrolyte levels through dietary modifications and medications. Nutritional intake is assessed, and deficiencies or malnutrition is addressed through dietary modifications or supplements. Prescribed fluid restrictions are implemented to prevent fluid overload. Referrals may be encouraged to dieticians to educate clients about a kidney-friendly diet, including restrictions on protein, sodium, potassium, and phosphorus.

HEALTH TEACHING AND PSYCHOSOCIAL SUPPORT

Nurses provide health teaching about CKD, its progression, prescribed treatments, and the importance of self-management and not missing their dialysis appointments. Clients are also taught to monitor their daily weights or their weight before/after dialysis and to avoid medications that are nephrotoxic. Lifestyle modifications like exercise, smoking cessation, and

stress management are encouraged to improve overall health and slow disease progression.

Nurses use active listening and therapeutic communication to help clients cope with the challenges, anxiety, and lifestyle changes associated with chronic disease and self-management. Clients are encouraged to participate in support groups to connect with others facing similar challenges.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Chronic Kidney Disease

View a brief YouTube video overview on chronic kidney disease[13]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2524#oembed-1

13. Open RN Project. (2024, April 24). *Health Alterations – Chapter 8 Renal and urinary disease – Chronic kidney disease [Video]. YouTube.* CC BY-NC 4.0 https://www.youtube.com/watch?v=w3A3qGZViJU

8.7 Cystitis

Cystitis refers to inflammation of the bladder that can result from various causes such as infectious cystitis, noninfectious cystitis, and interstitial cystitis. **Infectious cystitis**, a common type of urinary tract infection (UTI), is the most common cause of cystitis. It can be caused from a bacterial, viral, or parasitic infection. Although bladder infections may seem benign, if untreated they can progress to severe complications like **pyelonephritis** (infection of the kidneys) and sepsis. Sepsis refers to the body's response to severe infection that causes widespread inflammation and can be life-threatening due to multiorgan failure. In older adults, UTI s are the leading cause of sepsis. **Noninfectious cystitis** arises from irritants, such as chemicals in chemotherapy drugs or radiation exposure, that trigger bladder inflammation. **Interstitial cystitis** is an inflammatory disease characterized by chronic bladder inflammation that lacks a known cause. It disproportionately affects women, occurring about ten times more frequently than in men. Due to its complex nature and the absence of clear causative factors, interstitial cystitis can be difficult to diagnose.[1,2] The focus of this section will be in infectious cystitis.

Pathophysiology and Risk Factors

Infectious cystitis commonly begins when bacteria, most commonly *Escheria coli*, enters the bladder through the urethra. The bacteria adheres to the bladder wall and begins to multiply. This colonization triggers the body's

1. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

2. Mayo Clinic. (2022). *Cystitis*. https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

immune response, and inflammatory mediators are released, causing swelling and irritation of the bladder lining.[3,4]

There are many risk factors for developing infectious cystitis[5,6]:

- Women are at higher risk for cystitis due to their shorter urethra and its closer proximity to the anus compared to a male, making it easier for bacteria to enter into the bladder.
- Pelvic organ prolapse (POP) such as rectocele or cystocele can cause chronic recurrent cystitis, especially after vaginal childbirth and history of chronic constipation.[7]
- Individuals with an enlarged prostate gland or who experience recurrent kidney stones may experience blockage, resulting in urinary retention, predisposing them to infection.
- Urinary catheterization predisposes clients to increased risk, so it should only be performed when medically necessary, and catheters should be removed as soon as possible.
- Changes in hormone levels during menopause can also lead to changes in vaginal flora, making women more susceptible to colonization.

3. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

4. Mayo Clinic. (2022). *Cystitis.* https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

5. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

6. Mayo Clinic. (2022). *Cystitis.* https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

7. Hamid, R., & Losco, G. (2014). Pelvic organ prolapse-associated cystitis. *Current Bladder Dysfunction Repository, 9*(3), 175-180. https://pubmed.ncbi.nlm.nih.gov/25170365/

- Hygiene habits can cause increased risk. Wiping should be performed from front to back, particularly after a bowel movement, or bacteria can be introduced into the urethra.
- Sexual intercourse can also introduce bacteria into the urethra. Voiding before and after intercourse can help prevent infection.
- Diabetes mellitus places clients at increased risk for infection due to the elevated glucose levels in the urine that can promote bacterial growth.
- Individuals with a neurogenic bladder have incomplete bladder emptying and are at increased risk for infection.

Assessment

Cystitis primarily causes urinary symptoms such as frequency, urgency, pain during urination, and changes in urine characteristics. Additional associated symptoms in other body systems may occur due to pain or gastrointestinal symptoms associated with infection. It is also important to remember that for older adults, change in mental status may be the only symptom of a urinary tract infection. Table 8.7 outlines clinical manifestations of cystitis across body systems.

Table 8.7. Clinical Manifestations of Cystitis[8,9,10]

8. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

9. Mayo Clinic. (2022). *Cystitis.* https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

10. Li, R., Leslie, S. W. (2023). *Cystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482435/

Body System	Clinical Manifestations
Genitourinary	Urinary frequency, urgency, dysuria, hematuria, foul-smelling or cloudy urine, suprapubic tenderness or discomfort, lower abdominal or pelvic pain, urinary incontinence, and nocturia (frequent urination at night)
Gastrointestinal	Nausea or vomiting, abdominal discomfort, decreased appetite, and gastrointestinal upset
Neurological	New onset confusion or delirium, especially in elderly clients
General	Fatigue or malaise or fever (in severe cases)

Diagnostic Testing

Diagnostic testing for cystitis typically includes a urinalysis to examine for increased levels of white blood cells, red blood cells, leukocyte esterase, or bacteria. If the urinalysis reflects signs of infection, a urine culture may be ordered to help the provider identify the most effective antibiotic to treat the infection.

For recurrent cystitis, imaging studies such as bladder ultrasound, KUB, CT scan, or cystoscopy may be ordered to help identify structural abnormalities. Cystoscopy involves the insertion of a small thin tube with a flexible camera to help visually examine the inside of the bladder and urethra.[11,12]

Nursing Diagnoses

Nursing diagnoses for clients with cystitis can help guide nursing care and address the specific needs of these individuals. Common nursing diagnoses include the following:

- Acute Pain
- Impaired Urinary Elimination

11. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

12. Mayo Clinic. (2022). *Cystitis*. https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

- Ineffective Self-Care Management
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with cystitis are as follows:

- *The client will report reduced pain with urination with a score of 3 or below on a scale of 0-10, within 48 hours.*
- *The client will experience reduced urinary frequency and urgency, achieving a voiding pattern of every 3-4 hours within 72 hours.*
- *The client will verbalize healthy hygiene practices, resulting in a reduction in the frequency of recurrent infections within three months.*
- *The client will verbalize effective preventive strategies, such as adequate hydration and regular voiding, upon completion of the teaching session.*

Interventions

Medical Interventions

Medical interventions for cystitis aim to treat the infection, alleviate symptoms, and prevent recurrence. Common interventions include medication therapy and identifying and treating causes of recurrent cystitis.

MEDICATION THERAPY

Several types of medications may be prescribed to treat cystitis[13,14,15,16]:

- **Antimicrobials:** Antimicrobials treat and eliminate the causative bacteria. Classes of antimicrobials include the following:
  - Sulfonamides (Trimethoprim/Sulfamethoxazole): Inhibit the growth of bacteria by interfering with the synthesis of folic acid, essential for bacterial DNA production. They work synergistically to prevent bacterial growth, particularly by *E. coli*, a common UTI-causing bacteria.
  - Quinolones (Ciprofloxacin, Levofloxacin): Inhibit enzymes necessary for bacterial DNA replication, effectively preventing bacterial growth and causing bacterial cell death. They're effective against a wide range of bacteria causing UTIs.
  - Penicillins (Amoxicillin, Amoxicillin/Clavulanate): Disrupt the bacterial cell wall synthesis, leading to cell lysis and death. However, their effectiveness against UTIs caused by *E. coli* may be limited due to bacterial resistance.
  - Cephalosporins (Cefadroxil, Cefixime): Similar to penicillins, cephalosporins interfere with bacterial cell wall synthesis, leading to bacterial cell death. They are often used as an alternative for UTIs when other antibiotics aren't suitable.

13. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

14. Mayo Clinic. (2022). *Cystitis*. https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

15. Li, R., Leslie, S. W. (2023). *Cystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482435/

16. A.D.A.M. Medical Encyclopedia [Internet]. (2022). Cystitis – acute. https://medlineplus.gov/ency/article/000526.htm

    - Urinary Antiseptics (Nitrofurantoin): Damage bacterial DNA, proteins, and cell walls, inhibiting bacterial growth. It's specifically concentrated in the urine, making it effective for treating lower urinary tract infections caused by susceptible bacteria.
- **Bladder Analgesics (Phenazopyridine):** Work as urinary analgesics by directly soothing and numbing the urinary tract mucosa, providing relief from pain, burning, and discomfort during urination. However, this medication can cause the color of urine to become reddish-orange and can also stain contact lenses. This medication is not typically prescribed for more than three days because it can mask signs of a continuing urinary tract infection.
- **Antispasmodics (Hyoscyamine):** These drugs work by relaxing smooth muscles, including those in the bladder, and reducing bladder spasms and the urgency and frequency of urination. They help alleviate discomfort associated with UTIs.

> Read additional information about antimicrobials in the "Antimicrobials" chapter of Open RN *Nursing Pharmacology, 2e*.

TREAT UNDERLYING CAUSES

Health care providers order additional diagnostic testing for clients with recurrent cystitis to identify underlying factors such as urinary tract

abnormalities, kidney stones, and hormonal fluctuations.[17,18,19,20] Underlying causes may be treated surgically.

Nursing Interventions

Nursing interventions focus on health teaching and health promotion measures to provide comfort and prevent recurrent infections.

HEALTH TEACHING & HEALTH PROMOTION

Nurses provide health teaching regarding several topics:

- Take the full course of antibiotics, as prescribed, to prevent antibiotic resistance.
- Notify the health care provider of symptoms of developing pyelonephritis, such as fever, flank/low back pain, and nausea/vomiting.
- Use appropriate perineal hygiene, such as wiping from front to back after a bowel movement and voiding after intercourse to prevent the introduction of bacteria into the urethra.
- Promote adequate hydration, typically six to eight glasses of water per day, to help flush bacteria from the urinary tract and dilute the urine.
- Encourage regular and complete bladder emptying. Encourage avoiding

17. Gupta, K. (2023). Acute simply cystitis in females. *UpToDate*. https://www.uptodate.com/

18. Mayo Clinic. (2022). *Cystitis*. https://www.mayoclinic.org/diseases-conditions/cystitis/diagnosis-treatment/drc-20371311

19. Li, R., Leslie, S. W. (2023). *Cystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482435/

20. A.D.A.M. Medical Encyclopedia [Internet]. (2022). Cystitis – acute. https://medlineplus.gov/ency/article/000526.htm

delaying or holding urine for extended periods to prevent bacterial growth.

- Avoid the intake of irritants like caffeine, alcohol, and spicy foods to minimize bladder irritation and reduce symptoms.
- Encourage the consumption of substances that acidify the urine, such as cranberry juice or supplements. These substances may help prevent bacterial adherence to the bladder wall.
- Suggest comfort measures, such as using a heating pad or warm compress over the lower abdomen, to alleviate discomfort or pelvic pain associated with cystitis. Take prescribed analgesics or bladder analgesics to alleviate discomfort during urination. Encourage rest and positioning to reduce bladder pressure or discomfort, such as lying down with knees bent.
- Avoid irritants to perineal area that can contribute to the development of cystitis, such as harsh soaps and bubble baths, douches, ill fitting clothing/underwear, or fragrances.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Cystitis

View a brief YouTube video overview of cystitis, UTI, and pyelonephritis[21]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2545#oembed-1

21. Open RN Project. (2024, June 23). *Health Alterations – Chapter 8 – Cystitis, UTI, and pyelonephritis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/L7KWIe6_Yr4?si=0prM4UPPqUtBdnkn

8.8 Pyelonephritis

Pyelonephritis refers to a bacterial infection that typically starts as a urinary tract infection (UTI) that progresses up the ureters to the kidneys.

Pathophysiology and Risk Factors

After the bacteria reach the kidneys, they multiply and cause inflammation, often causing classic symptoms of lower back/flank pain and systemic infection. See Figure 8.14[1] for an illustration of a client experiencing flank pain. The inflammatory response within the renal pelvis causes tissue damage and increased permeability of the blood vessels.

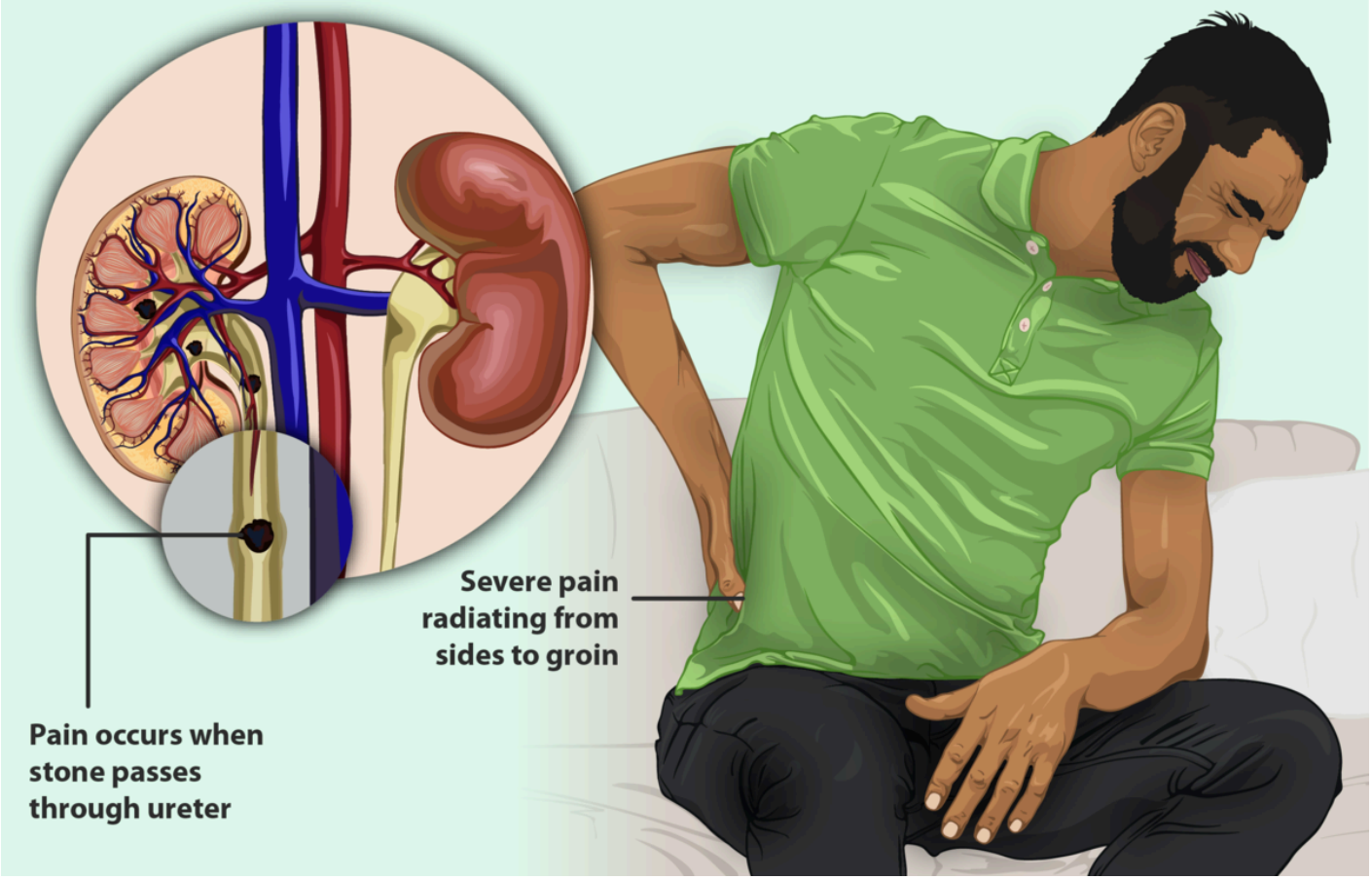


Figure 8.14 Flank Pain Associated With Pyelonephritis

1. "A_man_with_Kidney_Stones.png" by https://www.myupchar.com/en is licensed under CC BY-SA 4.0

Risk factors for developing pyelonephritis include urinary tract obstructions like kidney stones, repeated urinary tract infections, diabetes, pregnancy, and conditions that weaken the immune system. If an infection is not properly treated, the bacteria will continue to multiply, resulting in a sustained infection, kidney abscess, sepsis, or chronic kidney damage.[2]

Assessment

Pyelonephritis is a bacterial kidney infection, resulting in inflammation of the functional parts of the kidney, including the renal cortex (the outermost part of the kidney) and the renal medulla. It is caused by the ascent of bacteria through the urinary tract, thus replicating signs and symptoms of urinary tract infections but leading to severe complications if left untreated. See Table 8.8 for clinical manifestations of pyelonephritis.

Table 8.8. Signs and Symptoms of Pyelonephritis[3,4]

2. Cleveland Clinic. (2023). *Kidney infection (pyelonephritis).* https://my.clevelandclinic.org/health/diseases/15456-kidney-infection-pyelonephritis

3. Cleveland Clinic. (2023). *Kidney infection (pyelonephritis).* https://my.clevelandclinic.org/health/diseases/15456-kidney-infection-pyelonephritis

4. Mayo Clinic. (2022). *Kidney infection.* https://www.mayoclinic.org/diseases-conditions/kidney-infection/symptoms-causes/syc-20353387

Body System	Common Signs and Symptoms in Pyelonephritis
General	High-grade fever, chills, general malaise, and fatigue
Urinary	Flank/low back pain, dysuria, frequency, urgency, hematuria (blood in urine), and **costovertebral angle tenderness** (tenderness to palpation over the kidneys)
Gastrointestinal	Nausea and vomiting
Cardiovascular	Blood pressure fluctuations and tachycardia due to systemic infection
Neurological	Confusion (in severe cases with sepsis)
Respiratory	Elevated respiratory rate (in severe cases with sepsis)

Diagnostic Testing

Diagnostic testing for pyelonephritis involves various methods to diagnose and assess the extent of the infection. To diagnose pyelonephritis, providers typically order a urinalysis and urine culture to initially assess for infection. Additional laboratory blood tests may be performed such as a complete blood cell count (to assess white blood cell count), creatinine and BUN levels to assess kidney function, and C-reactive protein (to assess for inflammation). Blood cultures may be performed to assess for systemic infection that can lead to sepsis. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Imaging studies may also be ordered to examine the size of the kidneys, any structural abnormalities, and the extent of the infection. Occasionally, nuclear medicine imaging may be ordered to help detect areas of reduced function or scarring.[5]

5. Cleveland Clinic. (2023). *Kidney infection (pyelonephritis)*. https://my.clevelandclinic.org/health/diseases/15456-kidney-infection-pyelonephritis

Nursing Diagnoses

Nursing diagnoses for clients with pyelonephritis help guide nursing care and address the specific needs of these individuals.

Common nursing diagnoses include the following:

- Acute Pain
- Impaired Urinary Elimination
- Imbalanced Nutrition: Less Than Body Requirements

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with pyelonephritis are as follows:

- *The client will report a decreased pain level of ≤3 on a 0-10 scale (0 being no pain, 10 being the worst pain imaginable) in the flank region within 24 hours.*
- *The client will report decreased dysuria within 72 hours.*
- *By the end of hospitalization or treatment, the client will remain free from signs and symptoms of infection, such as fever or increased white blood cell count.*

Interventions

Medical Interventions

Medical interventions for pyelonephritis aim to treat the underlying infection, alleviate symptoms, and prevent complications. Clients with severe cases of pyelonephritis may require hospitalization for close monitoring and IV

antibiotic/fluid therapy. Additional interventions may be implemented to drain renal abscess and treat sepsis if present.[6,7]

MEDICATION THERAPY

Antibiotics, analgesics, and intravenous fluids may be prescribed to treat pyelonephritis[8,9]:

- **Antibiotic Therapy:** Antibiotics target the specific bacteria causing the infection. Empirical treatment is often initiated based on the suspected pathogen and adjusted due to the effectiveness of the therapy. Commonly prescribed antibiotics include fluoroquinolones, cephalosporins, or trimethoprim-sulfamethoxazole.
- **Analgesics:** Analgesics such as NSAIDs (nonsteroidal anti-inflammatory drugs) or other pain medications may be prescribed to alleviate flank pain associated with pyelonephritis.
- **Intravenous Fluids:** IV fluids may be administered to maintain hydration and ensure adequate urine output. This helps to flush out bacteria from the urinary tract and support kidney function.

6. Cleveland Clinic. (2023). *Kidney infection (pyelonephritis).* https://my.clevelandclinic.org/health/diseases/15456-kidney-infection-pyelonephritis

7. Mayo Clinic. (2022). *Kidney infection.* https://www.mayoclinic.org/diseases-conditions/kidney-infection/symptoms-causes/syc-20353387

8. Cleveland Clinic. (2023,). *Kidney infection (pyelonephritis).* https://my.clevelandclinic.org/health/diseases/15456-kidney-infection-pyelonephritis

9. Mayo Clinic. (2022). *Kidney infection.* https://www.mayoclinic.org/diseases-conditions/kidney-infection/symptoms-causes/syc-20353387

SURGICAL INTERVENTION

In situations where an obstruction from a kidney stone is causing recurrent infections, surgery may be necessary to remove the stone if it is too large to pass on its own or removed by another means.

Nursing Interventions

Nursing interventions for pyelonephritis are centered on managing medication, addressing pain, and providing health teaching to prevent chronic kidney disease.

MEDICATION MANAGEMENT

During inpatient care, nurses administer prescribed antibiotics and monitor urine culture results for potential antibiotic resistance. IV fluids may be administered, especially if there is poor oral intake.

PAIN MANAGEMENT

Prescribed pain medications are administered as indicated to alleviate flank pain, such as NSAIDs, acetaminophen, or other analgesics. Nurses also encourage nonpharmacological pain interventions such as repositioning and heat application. Encourage using pillows for support or lying in a semi-Fowler's position. A heating pad or warm compress may be applied to the affected flank area per the health care provider's recommendations to help alleviate discomfort.

HEALTH TEACHING

Nurses provide health teaching on several topics related to pyelonephritis in terms of self-management and health promotion. Emphasize the importance of completing the full course of prescribed antibiotics to completely eradicate the infection and prevent recurrent infections that could lead to chronic kidney disease. Encourage hydration by drinking plenty of water to maintain adequate urinary flow and flush out bacteria. Explain the importance of

regular and complete emptying of the bladder to prevent UTIs. Provide guidance on lifestyle changes such as maintaining a balanced diet, avoiding excessive salt intake, and avoiding habits detrimental to kidney health, such as smoking and excessive alcohol consumption.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.

8.9 Glomerulonephritis

Glomerulonephritis refers to an inflammatory disease that specifically affects the kidney glomeruli. **Glomeruli** are tiny structures within the kidneys responsible for filtering waste and excess fluids from the blood to produce urine. In glomerulonephritis, the inflammation within the glomeruli impairs their ability to function properly. This condition can be acute and occur suddenly or develop gradually over time and become chronic.[1]

Pathophysiology and Risk Factors

There are several potential causes of acute glomerulonephritis. A common cause of acute glomerulonephritis is an immune system response triggered by *Streptococcus* bacterial infection (commonly referred to as strep throat). When the immune system produces antibodies to fight the infection, they mistakenly attack the glomeruli in the kidneys. This immune response leads to inflammation and damage to the glomeruli, affecting their ability to filter waste and fluids properly. Other common causes of acute glomerulonephritis include viral infections (like hepatitis B or C, HIV, or upper respiratory infections) and certain medications or toxins.

Chronic glomerulonephritis develops from sustained inflammatory processes that occur over time. Conditions such as systemic lupus erythematosus (SLE), vasculitis, or other autoimmune diseases can cause ongoing inflammation and damage the kidneys.[2,3]

1. Radhakrishnan, J. (2022). Glomerular disease. Evaluation and differential diagnoses in adults. *UpToDate*. https://www.uptodate.com/

2. Radhakrishnan, J. (2022). Glomerular disease. Evaluation and differential diagnoses in adults. *UpToDate*. https://www.uptodate.com/

3. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Glomerular disease.* National Institutes of Health. https://www.niddk.nih.gov/health-information/kidney-disease/glomerular-disease

Assessment

Assessment findings across different body systems can help clinicians identify and monitor the effects of glomerulonephritis on a client's overall health. See Table 8.9 for clinical manifestations of glomerulonephritis across body systems.

Table 8.9. Clinical Manifestations of Glomerulonephritis Across Body Systems[4,5]

Body System	Assessment Findings
Urinary	Hematuria, proteinuria, and oliguria
Cardiovascular	Hypertension and fluid overload (edema, heart murmurs, jugular venous distention)
Hematologic	Anemia due to decreased production of erythropoietin by the kidneys, bleeding tendencies due to platelet dysfunction, and increased susceptibility to infections
Neurologic	Confusion and altered mental status (in severe cases with uremia)
Gastrointestinal	Nausea, vomiting, and poor appetite due to uremia, signs of gastrointestinal bleeding (if severe kidney impairment), and metallic taste in the mouth
Musculoskeletal	Muscle weakness and cramping (related to electrolyte imbalances)
Dermatologic	Pallor due to anemia, pruritus due to uremic toxins accumulating in the skin, easy bruising, and petechiae (if platelet dysfunction present)

Diagnostic Testing

Diagnostic testing for glomerulonephritis includes laboratory and imaging studies to confirm the diagnosis and determine the underlying cause and severity of the condition. Laboratory tests often include BUN, creatinine, glomerular filtration rate, and electrolyte panel. Creatinine and BUN results are typically increased and GFR is decreased. In the electrolyte panel results, the potassium and phosphorous may be elevated and the calcium level may be decreased. Complete blood counts are also monitored for signs of anemia

4. Radhakrishnan, J. (2022). Glomerular disease. Evaluation and differential diagnoses in adults. *UpToDate*. https://www.uptodate.com/
5. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Glomerular disease.* National Institutes of Health. https://www.niddk.nih.gov/health-information/kidney-disease/glomerular-disease

(decreased red blood cells) due to decreased erythropoietin production. A urinalysis is typically performed to assess the presence of infection. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

A kidney biopsy may be performed to determine the cause of the nephritis. Additionally, imaging studies such as a CT scan and renal ultrasound may be performed to identify inflammation within the kidneys and structural abnormalities.[6]

Nursing Diagnoses

Nursing diagnoses for clients with glomerulonephritis help guide nursing care and address the specific needs of these individuals.

Common nursing diagnoses include the following:

- Excess Fluid Volume
- Acute Pain
- Impaired Urinary Elimination
- Readiness for Enhanced Knowledge
- Imbalanced Nutrition

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with acute glomerulonephritis are as follows:

6. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Glomerular disease.* National Institutes of Health. https://www.niddk.nih.gov/health-information/kidney-disease/glomerular-disease

- *The client will exhibit a reduction in fluid retention within 48 hours, as evidenced by decreased edema in the extremities and a weight decrease of at least two pounds.*
- *The client will exhibit improved urinary output, achieving at least 75% of the expected urine output for age and body weight within 72 hours.*
- *The client will verbalize an understanding of glomerulonephritis, its causes, treatment regimen, and recommended lifestyle modifications.*

Interventions

Medical Interventions

Medical interventions for glomerulonephritis aim to treat any underlying infection, alleviate symptoms, and prevent recurrence. Common medical interventions include medication therapy, dialysis, plasmapheresis, and treating underlying conditions.

MEDICATION THERAPY

Medication therapy for glomerulonephritis may include several classes of medications:

- **Antibiotics:** When glomerulonephritis is caused by a bacterial infection, antibiotics are prescribed to eliminate the infection.
- **Immunosuppressants:** In cases of autoimmune or immune-mediated glomerulonephritis, medications that suppress the immune system, such as corticosteroids or other immunosuppressants, may be used to reduce inflammation and immune response attacking the kidneys.
- **Diuretics:** To manage excess fluid volume and edema, diuretics may be prescribed to increase urine output and reduce fluid retention.
- **Antihypertensives**: Controlling high blood pressure is crucial to prevent further kidney damage. Medications like ACE inhibitors or angiotensin II receptor blockers (ARBs) are commonly used to manage hypertension and reduce proteinuria (excessive protein in the urine).

DIALYSIS

When glomerulonephritis results in acute kidney failure, dialysis may be required to restore fluid and electrolyte balance. (Review information about types of dialysis under the "Chronic Kidney Disease" section.)

PLASMAPHERESIS

If excessive antibodies or immune response complexes are formed as the result of the glomerulonephritis, plasmapheresis may be required. **Plasmapheresis** involves removal of blood plasma and replacement with donor plasma.

TREATMENT OF UNDERLYING CONDITIONS

Treating underlying conditions that contribute to glomerulonephritis, such as diabetes or infections, is essential to prevent further kidney damage.[7,8]

Nursing Interventions

Nursing interventions for glomerulonephritis focus on management of infection, prevention of complications, and health teaching.

MANAGEMENT OF INFECTION

Nurses monitor the client's temperature, blood pressure, heart rate, and respiratory rate to monitor for signs of worsening infection and promptly report changes in condition. They ensure timely administration of prescribed

7. Radhakrishnan, J. (2022). Glomerular disease. Evaluation and differential diagnoses in adults. *UpToDate*. https://www.uptodate.com/
8. National Institute of Diabetes and Digestive and Kidney Diseases. (2022). *Glomerular disease.* National Institutes of Health. https://www.niddk.nih.gov/health-information/kidney-disease/glomerular-disease

antibiotics to treat underlying bacterial infections that are causing glomerulonephritis. They monitor white blood cell count levels to assess the body's response to infection and the effectiveness of antibiotic therapy. The client, family, and caregivers are educated on infection control practices and proper hand hygiene to prevent the spread of infections.

PREVENTION AND MANAGEMENT OF FLUID IMBALANCES

Nurses monitor daily weights, fluid intake and output, and 24-hour I/O trends for indications of fluid overload. Blood pressure is monitored, and antihypertensive medications are administered as prescribed to maintain optimal blood pressure levels and prevent further kidney damage. Health teaching is provided to the client on elevating extremities to reduce edema, if present. If prescribed, information on fluid restrictions and limited sodium intake is provided.

HEALTH TEACHING

Health teaching is provided about the importance of adhering to prescribed antibiotic regimens and other medications (such as immunosuppressants or antihypertensives) to manage the condition effectively. Individuals with kidney disorders may need guidance for carefully managing their protein intake. The level of recommended protein intake varies depending on the stage of kidney disease and individual health conditions.

Clients are taught about symptoms of worsening kidney function to report to the health care provider, such as increased edema and decreased urine output. The importance of adhering to follow-up appointments for monitoring kidney function, blood pressure, and overall health status is emphasized.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not

met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Glomerulonephritis

View a brief YouTube video overview of glomerulonephritis[9]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2564#oembed-1

9. Open RN Project. (2024, June 23). *Health Alterations – Chapter 8 – Glomerulonephritis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/JPanSdCW7Ac?si=peZQOoxnuUMhS06L

8.10 Urinary Incontinence

Urinary incontinence refers to the involuntary loss of urine. Contrary to common misconceptions, urinary incontinence is not a normal consequence of aging or childbirth. Urinary incontinence can significantly affect a person's participation in social activities and cause them emotional distress. It often goes underreported due to feelings of embarrassment, making it critical for nurses to assess for signs and symptoms of urinary incontinence and encourage appropriate treatment.

There are many types of urinary incontinence. Common types are stress incontinence, urge incontinence, overflow incontinence, and functional incontinence. See Table 8.10a for a comparison of these types of incontinence.[1]

Table 8.10a. Common Types of Urinary Incontinence[2,3,4]

1. Mayo Clinic. (2023). *Urinary incontinence*. https://www.mayoclinic.org/diseases-conditions/urinary-incontinence/symptoms-causes/syc-20352808
2. Mayo Clinic. (2023). *Urinary incontinence*. https://www.mayoclinic.org/diseases-conditions/urinary-incontinence/symptoms-causes/syc-20352808
3. Urology Care Foundation. (n.d.). *What is urinary incontinence?* https://www.urologyhealth.org/urology-a-z/u/urinary-incontinence
4. Cleveland Clinic. (2025). *Urinary incontinence*. https://my.clevelandclinic.org/health/diseases/17596-urinary-incontinence

Type of Urinary Incontinence	Definition	Cause	Clinical Manifestations
Stress Incontinence	Involuntary loss of urine due to weakened pelvic floor muscles, leading to leakage during physical activities, coughing, sneezing, or laughing.	Weakened pelvic floor support from factors like childbirth, pelvic surgeries, obesity, or hormonal changes.	Leakage during activities that exert pressure on the bladder.
Urge Incontinence	A sudden, strong urge to urinate followed by involuntary loss of urine before one can reach the restroom.	Involuntary contractions of the bladder muscles cause an urgent need to urinate. Bladder irritants like caffeine, artificial sweeteners, and nicotine are also causative factors.	Frequent, sudden urges to urinate, often resulting in incontinence if a restroom isn't immediately accessible.
Overflow Incontinence	Continuous or intermittent leakage of small amounts of urine due to incomplete bladder emptying.	Bladder outlet obstruction (e.g., enlarged prostate) or nerve damage affecting bladder contraction.	Constant dribbling of urine or frequent leakage even when the bladder doesn't feel full.
Functional Incontinence	The client has normal bladder control but has difficulties getting to the toilet because of arthritis or other disorders that make it hard to move quickly or manipulate zippers or buttons.	Arthritis, dementia, or decreased mobility.	Incontinence occurs when unable to access a toilet or remove clothing in time to use the toilet.

As described in Table 8.10a, urinary incontinence can be caused by numerous factors. As individuals get older, changes in bladder muscle tone and function and weakened pelvic floor muscles can increase the incidence of urinary incontinence. Women are prone to urinary incontinence due to factors such as pregnancy, childbirth, and menopause, which can weaken pelvic floor muscles. Obesity can also predispose an individual to urinary incontinence because excess weight can put increased pressure on the bladder and pelvic floor muscles, leading to stress incontinence. Other medical conditions like chronic constipation and neurological disorders also increase the risk for urinary incontinence.[5,6,7]

5. Mayo Clinic. (2023). *Urinary incontinence*. https://www.mayoclinic.org/diseases-conditions/urinary-incontinence/symptoms-causes/syc-20352808

6. Urology Care Foundation. (n.d.). *What is urinary incontinence?*https://www.urologyhealth.org/urology-a-z/u/urinary-incontinence

7. Cleveland Clinic. (2025). *Urinary incontinence.*https://my.clevelandclinic.org/health/diseases/17596-urinary-incontinence

Assessment

While urinary incontinence primarily affects the urinary system, its clinical manifestations can involve various body systems. See Table 8.10b for a summary of clinical manifestations associated with urinary incontinence.

Table 8.10b. Clinical Manifestations of Urinary Incontinence[8,9,10]

Body System	Clinical Manifestations
Urinary	Involuntary leakage of urine during activities (stress incontinence), sudden strong urge to urinate (urge incontinence), intermittent dribbling of urine (overflow incontinence), and frequent urination or nocturia (frequent night-time urination)
Integumentary	Skin irritation or breakdown due to constant moisture from urine exposure and increased risk of skin infections or dermatitis in the perineal area
Emotional/ Psychological	Anxiety or emotional distress due to the fear of incontinence in public areas, decreased self-esteem, or social withdrawal due to the impact of urinary incontinence on daily activities and relationships
Musculoskeletal	Weakened or strained pelvic floor muscles
Gastrointestinal	Increased intra-abdominal pressure from straining during bowel movements may exacerbate stress incontinence

Diagnostic Testing

Diagnostic testing for urinary incontinence involves various assessments and examinations to identify the type of incontinence, severity, and potential underlying causes. Urinalysis may be performed to assess for infection, and BUN and creatinine levels may be performed to assess kidney function. For example, kidney function may be impacted if overflow incontinence occurs due to urinary retention. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

8. Mayo Clinic. (2023). *Urinary incontinence*.https://www.mayoclinic.org/diseases-conditions/urinary-incontinence/symptoms-causes/syc-20352808

9. Urology Care Foundation. (n.d.). *What is urinary incontinence?*https://www.urologyhealth.org/urology-a-z/u/urinary-incontinence

10. Cleveland Clinic. (2025). *Urinary incontinence*.https://my.clevelandclinic.org/health/diseases/17596-urinary-incontinence

Diagnostic imaging and urodynamic studies may be performed. Postvoid residual amounts may be measured to determine the amount of urine remaining in the bladder after voiding. This measurement can be obtained by a bladder scan, ultrasound of the bladder, or with urinary catheterization.

Clients are encouraged to complete a bladder diary in which they record fluid intake, voiding times and amounts, and episodes of incontinence episodes as part of the assessment process.

Nursing Diagnoses

Nursing diagnoses for clients with urinary incontinence guide nursing care and address the specific needs of individuals. Common nursing diagnoses include the following:

- Risk for Impaired Skin Integrity
- Anxiety
- Risk for Infection
- Self-Care Deficit
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with urinary incontinence are as follows:

- *The client will describe skin care measures, such as cleansing and properly drying of the perineal area after episodes of incontinence to reduce the risk of skin breakdown, following the teaching session.*
- *The client will describe effective strategies for preventing urinary incontinence following the teaching session.*

Interventions

Medical Interventions

Medical interventions for incontinence aim to manage and treat the underlying causes of urinary incontinence and may include bladder training, pelvic floor muscle exercises, medication therapy, medical devices, or surgery. Additionally, intermittent catheterization may be prescribed for overflow incontinence caused by urinary retention.

BLADDER RETRAINING

Bladder retraining involves scheduled voiding and then gradually extending the time between voids to increase bladder capacity and reduce the brain's urgent response to signals from bladder filling.

PELVIC FLOOR MUSCLE EXERCISES

Pelvic floor muscle exercises, including Kegel exercises, strengthen the pelvic floor muscles and can improve bladder control, especially in cases of stress incontinence. Clients may be referred to physical therapy for pelvic floor rehabilitation exercises.

MEDICATION THERAPY

Medications may be prescribed, depending on the type of urinary incontinence:

- **Anticholinergics/Antispasmodics:** Medications like oxybutynin, tolterodine, or solifenacin help relax bladder muscles and reduce urinary urgency in cases of urge incontinence.
- **Alpha-blockers:** In men who have urge incontinence or overflow incontinence, alpha-blockers like tamsulosin may be prescribed to relax the bladder neck muscles and muscle fibers in the prostate and make it easier to empty the bladder.

- **Estrogen Therapy:** Estrogen may be used in postmenopausal women to improve poor urethral tone causing stress incontinence.

MEDICAL DEVICES

Pessaries are medical devices that are inserted into the vagina to support the bladder in cases of stress incontinence. Urethral inserts are small devices inserted into the urethra before activities that might trigger leakage, acting as a barrier to prevent urine leakage.

SURGERY

Surgical placement of a sling or mesh under the urethra or bladder neck may be performed for support of these structures and reduction of stress incontinence. A bladder neck suspension procedure may be performed to support the urethra and bladder neck.[11,12,13]

Nursing Interventions

Nursing interventions for urinary incontinence focus on empowering individuals to improve bladder control and provide emotional support.

HEALTH TEACHING AND HEALTH PROMOTION

Health teaching is provided about possible factors contributing to urinary

11. Mayo Clinic. (2023). *Urinary incontinence*. https://www.mayoclinic.org/diseases-conditions/urinary-incontinence/symptoms-causes/syc-20352808

12. Urology Care Foundation. (n.d.). *What is urinary incontinence?* https://www.urologyhealth.org/urology-a-z/u/urinary-incontinence

13. Cleveland Clinic. (2025). *Urinary incontinence*. https://my.clevelandclinic.org/health/diseases/17596-urinary-incontinence

incontinence, such as bladder irritants (such as caffeine and alcohol). Educate clients and caregivers on proper perineal hygiene to prevent skin breakdown and infections due to constant moisture from incontinence. Incontinence products, like absorbent pads, briefs, or bed protectors may be used to manage leaks, and barrier creams may be applied to protect the skin from irritation.

Based on the type of incontinence, bladder training techniques may be helpful. For example, scheduled voiding and gradually increasing time between voids may be helpful to improve bladder control and reduce the sensations of urgency.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Urinary Incontinence

View a brief YouTube video overview of urinary incontinence[14]:

14. Open RN Project. (2024, June 23). *Health Alterations – Chapter 8 –*

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2573#oembed-1

Urinary incontinence [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/J6R_cR5yO2Q?si=RlewtB6QcPG6FeBu

8.11 Urolithiasis

Urolithiasis, commonly referred to as kidney stones or renal calculi, refers to stones that develop within the urinary tract. **Nephrolithiasis** refers to stones in the kidney, and **ureterolithiasis** refers to stones in the ureter(s).

Pathophysiology and Risk Factors

Urolithiasis typically occurs due to the crystallization of substances present in urine, such as calcium, oxalate, uric acid, cystine, or phosphate. Different types of stones form based on the predominant mineral content. See Figure 8.15[1] for an image of renal calculi.

1. "Kidney_stones_(_renal_calculi_),_Бубрежни_камења_15.jpg" by Jakupica is licensed under CC BY-SA 4.0



Figure 8.15 Renal Calculi

Risk factors for stone development include insufficient fluid intake, excessive dietary intake of high mineral content, and hypercalcemia related to hyperparathyroidism or other medical conditions. Risk factors also include gout, repeated urinary tract infections, anatomical abnormalities within the urinary tract, and family history of urolithiasis.[2,3]

2. Curhan, G. C., Aronson, M., & Preminger, G. M. (2023). Kidney stones in adults: Diagnoses and acute management of suspected nephrolithiasis. *UpToDate*. https://www.uptodate.com/

3. Preminger, G. M., & Curhan, G. C. (2023). Kidney stones in adults: Evaluation of

Assessment

Signs and symptoms of urolithiasis can vary depending on the size and location of the stone, associated complications of the blockage, and an individual's tolerance of the pain associated with urolithiasis. See Table 8.11a for clinical manifestations of urolithiasis across body systems.

Table 8.11a. Clinical Manifestations of Urolithiasis[4,5]

Body System	Physical Assessment Findings
Urinary	Flank or abdominal pain (often described as severe and intermittent that may radiate to the groin or lower abdomen), hematuria, dysuria, urgency, and presence of crystals in urine
Integumentary	Pallor or diaphoresis due to severe pain
Cardiovascular	Tachycardia due to severe pain and associated anxiety
Gastrointestinal	Nausea and vomiting due to severe pain
Musculoskeletal	Guarding of the abdomen or affected side due to severe pain, restlessness, or inability to find a comfortable position

Diagnostic Testing

Diagnostic testing for urolithiasis involves various examinations and imaging studies to confirm the presence of urinary stones; determine their location, size, composition; and assess any associated complications. A urinalysis is

the patient with established stone disease. *UpToDate*. https://www.uptodate.com/

4. Preminger, G. M., & Curhan, G. C. (2023). Kidney stones in adults: Evaluation of the patient with established stone disease. *UpToDate*. https://www.uptodate.com/

5. National Institute of Diabetes and Digestive and Kidney Diseases. (2017). *Kidney stones.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/kidney-stones

performed to detect the presence of blood, crystals, or signs of infection in the urine. A 24-hour urine collection can help to measure various components in the urine such as high levels of calcium, oxalate, uric acid, or citrate. Imaging studies are ordered to visualize the presence of stones. A CT scan performed without contrast can provide detailed images of the urinary tract, allowing for localization, measurement, and characterization of the stones. X-rays can be useful in identifying certain types of stones, especially calcium stones.[6,7]

Nursing Diagnoses

Nursing diagnoses for clients with urolithiasis can help guide nursing care and address the specific needs of these individuals.

Common nursing diagnoses include the following:

- Acute Pain
- Impaired Urinary Elimination
- Risk for Infection
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with urolithiasis are as follows:

6. Preminger, G. M., & Curhan, G. C. (2023). Kidney stones in adults: Evaluation of the patient with established stone disease. *UpToDate*. https://www.uptodate.com/

7. National Institute of Diabetes and Digestive and Kidney Diseases. (2017). *Kidney stones.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/kidney-stones

- *The client will report a reduction in pain intensity to 3/10 or less on a 0-10 pain scale, within one hour following analgesic administration and nonpharmacological pain management interventions.*
- *The client will void without pain, indicating the resolution of impaired urinary elimination, by discharge.*
- *The client will verbalize three lifestyle modifications such as dietary changes to prevent recurrent stone formation by the end of the teaching session.*

Interventions

Medical Interventions

Medical interventions for urolithiasis aim to manage symptoms, facilitate the passage of stones, and prevent stone recurrence. In some cases, if the stone is small, the client may be advised to let it pass on its own.

MEDICATION THERAPY

Several types of medications may be prescribed to manage the severe pain associated with urolithiasis:

- **Analgesics:** Analgesics like nonsteroidal anti-inflammatory drugs (NSAIDs) or opioids may be prescribed to manage severe pain associated with kidney stones.
- **Alpha-blockers:** Alpha-blockers like tamsulosin help relax the muscles in the ureter, facilitating the passage of stones and reducing pain.
- **Calcium Channel Blockers:** Specific calcium-channel medications can help relax the ureter and assist in stone passage.
- **Intravenous (IV) Fluids:** IV fluids maintain hydration and help flush out the stone(s).

LITHOTRIPSY & URETEROSCOPY

Shock wave lithotripsy (SWL) utilizes shock waves to break larger stones into smaller fragments, making them easier to pass through the urinary tract.

If an individual is unable to pass the stone, ureteroscopy may be utilized. **Ureteroscopy** refers to the insertion of a thin scope through the urethra and bladder and into the ureter to remove stones or break them up with laser therapy. Ureteral stenting may be performed to relieve obstruction caused by kidney stones. Stones lodged in the ureter can cause partial or complete blockage, resulting in severe pain, damage to the kidneys from urine backflow, and urinary stasis. The stent bypasses the obstruction, allowing urine to flow from the kidney to the bladder, reducing pressure, and minimizing associated symptoms.

SURGICAL INTERVENTION

Percutaneous nephrolithotomy refers to the removal of large kidney stones using a nephroscope inserted through a small incision in the client's back.[8,9]

Nursing Interventions

Nursing interventions for urolithiasis aim to alleviate symptoms, facilitate stone passage, prevent complications, and provide support and education to clients. The client's urine is often strained, and the stone(s) is collected and sent to the lab for analysis of its makeup. This information can help guide interventions to prevent future stones.

8. Preminger, G. M., & Curhan, G. C. (2023). Kidney stones in adults: Evaluation of the patient with established stone disease. *UpToDate*. https://www.uptodate.com/

9. National Institute of Diabetes and Digestive and Kidney Diseases. (2017). *Kidney stones.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/kidney-stones

HEALTH TEACHING AND HEALTH PROMOTION

Nurses encourage adequate hydration by drinking adequate amounts of fluids to help dilute urine and prevent the concentration of minerals that can form stones. Other dietary changes to reduce the risk of stone formation are encouraged, such as the intake of oxalate-rich foods, sodium, and animal proteins. See Table 8.11b for a summary of suggested dietary modifications based on the type of stone present.

Table 8.11b. Dietary Modifications Based on Stone Type[10,11]

Stone Type	Dietary Modifications
Calcium Oxalate Stones	Consume adequate calcium from sources like low-fat dairy and reduce intake of high-oxalate foods like spinach, nuts, tea, and chocolate. Limit salt intake to prevent excessive calcium in urine.
Uric Acid Stones	Maintain adequate fluid intake to increase urine volume and dilute uric acid. Reduce intake of purine-rich foods like red meat, shellfish, and organ meats. Limit sodium intake to minimize uric acid excretion.
Struvite Stones	Avoid excess consumption of foods high in phosphates like dairy products, organ meats, and some processed foods. Acidifying urine through diet or medications may be recommended.
Cystine Stones	Increase fluid intake to maintain high urine output and reduce cystine concentration. Limit sodium intake to help decrease cystine excretion. Reduce intake of animal proteins because they contain cystine precursors.

SYMPTOM MANAGEMENT

Nurses teach about prescribed analgesics and nonpharmacological interventions to manage severe pain. Nonpharmacological interventions include application of heat, repositioning, and ambulation to help facilitate the passage of the stone. Comfortable positions that may alleviate pain include lying on the affected side or assuming a position that eases the passage of stones. Stress management techniques like relaxation breathing, guided imagery, and distractions can also help manage discomfort. Clients

10. Preminger, G. M., & Curhan, G. C. (2023). Kidney stones in adults: Evaluation of the patient with established stone disease. *UpToDate*. https://www.uptodate.com/

11. National Institute of Diabetes and Digestive and Kidney Diseases. (2017). *Kidney stones.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/kidney-stones

may feel nauseated from the sensations of severe pain, so antiemetic medications may also be required.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Urolithiasis

View a brief YouTube video overview of urolithiasis[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2577#oembed-1

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 8 – Urolithiasis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/3Xl76JjQgpA?si=54N-fTU9LpMsc6YY

8.12 Benign Prostate Hypertrophy

Benign prostatic hyperplasia (BPH) refers to enlargement of the prostate that is not cancerous. See Figure 8.16[1] for an illustration of BPH.

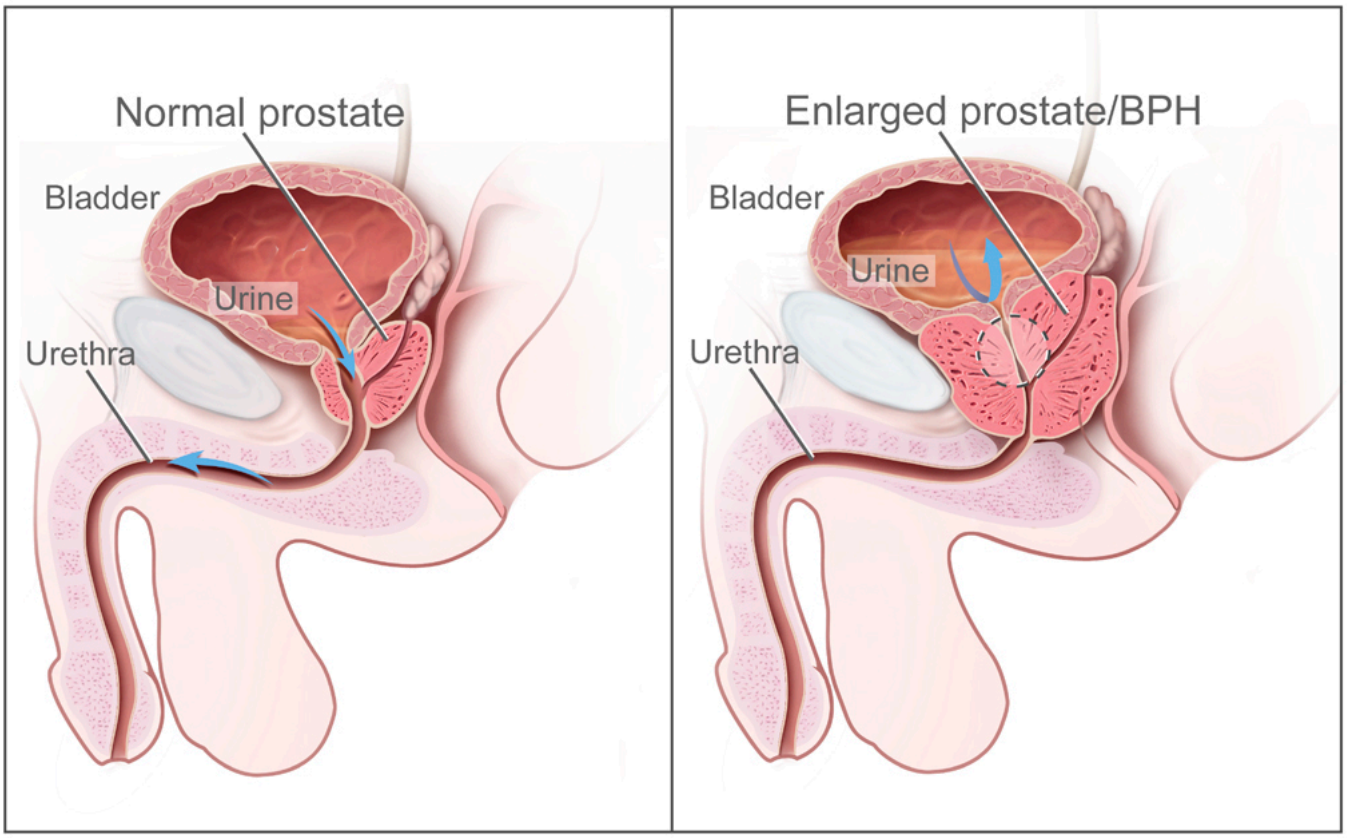


Figure 8.16 BPH

Pathophysiology

BPH is a common condition in males aged 50 and older. During BPH, the enlarged prostate presses against the urethra, causing it to narrow. Eventually, the bladder becomes weak from trying to pass urine through the

1. "Benign_Prostatic_Hyperplasia_nci-vol-7137-300.jpg" by unknown author for National Cancer Institute is licensed in the Public Domain.

narrowed urethra. It loses its ability to completely empty, leaving some urine in the bladder called **urinary retention**.[2]

Assessment

The inability to completely empty the bladder causes many of the symptoms associated with BPH, such as a frequent and intense urge to urinate, urinating frequently at night, difficulty starting a urine stream or a weak stream, and a sensation that the bladder has not emptied completely. If urinary retention is not adequately addressed, it can cause complications such as urinary tract infections, bladder damage, and kidney damage.[3]

The American Urological Association Symptom Index/International Prostate Symptom Score can be used to measure the severity of BPH symptoms.

View the American Urological Association Symptom Index/ International Prostate Symptom Score on the MDCalc website.

Diagnostic Testing

A health care provider may order several types of diagnostic tests to diagnose BPH, such as prostate specific antigen blood test, urodynamic flow testing, voiding cystourethrogram, or a cystoscopy:

- **Prostate specific antigen (PSA):** The PSA test measures the level of prostate-specific antigen in the blood, a protein produced by normal, as

2. MedlinePlus [Internet]. (2022). *Enlarged prostate (BPH)*. https://medlineplus.gov/enlargedprostatebph.html
3. MedlinePlus [Internet]. (2022). *Enlarged prostate (BPH)*. https://medlineplus.gov/enlargedprostatebph.html

well as malignant, cells of the prostate gland. BPH can cause elevated PSA levels.[4]

- **Digital rectal exam:** A digital rectal exam is commonly performed to identify abnormalities such as bumps or hardened spots on the prostate.
- **Urodynamic flow testing:** A procedure that looks at how well the bladder, sphincters, and urethra are storing and releasing urine. Most urodynamic tests focus on the bladder's ability to hold urine and empty steadily and completely. Urodynamic tests can also show whether the bladder is having involuntary contractions that cause urine leakage.[5]
- **Voiding cystourethrogram:** X-ray technology called fluoroscopy visualizes the urinary tract and bladder to examine the size, shape, and direction of urine flow. A thin, flexible tube called a catheter is inserted into the urethra and passed into the bladder by a urologist. Contrast dye flows through the catheter into the bladder. X-rays are taken from various angles while the bladder is full of contrast dye, and then the catheter is removed, and X-rays are taken as the client empties their bladder.
- **Cystoscopy:** During a cystoscopy, the urologist can see signs of blockage, such as an enlarged prostate gland. Read more information about cystoscopy under "Diagnostic Testing" in the "General Urinary System Assessment" section.

Nursing Diagnoses

Nursing diagnoses for clients with BPH focus on managing urinary retention and preventing urinary tract infection. Common nursing diagnoses include the following:

4. National Cancer Institute. (2025). *Prostate-specific antigen (PSA) test*. https://www.cancer.gov/types/prostate/psa-fact-sheet

5. National Institute of Diabetes and Digestive and Kidney Diseases. (2021). *Urodynamic testing*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/urodynamic-testing

- Impaired Urinary Elimination
- Urinary Retention
- Risk for Infection
- Disturbed Sleep Pattern
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Examples of expected outcomes for clients with BPH are as follows:

- *The client will verbalize three methods to manage urinary retention by the end of the teaching session.*
- *By the end of the teaching session, the client will verbalize symptoms of urinary tract infection to promptly report to the health care provider.*
- *The client will remain free from urinary tract injury caused by urinary retention.*

Interventions

Medical Interventions

BPH may be treated with lifestyle changes, medications, or transurethral procedures.

LIFESTYLE MODIFICATIONS

Health care providers may recommend lifestyle changes for men whose BPH

symptoms are mild to help manage the symptoms. Lifestyle modifications include the following[6]:

- Reducing intake of liquids, particularly before going out in public or before sleeping
- Avoiding or reducing intake of caffeinated beverages and alcohol
- Avoiding medications such as decongestants, antihistamines, antidepressants, and diuretics that can worsen symptoms
- Training the bladder to hold more urine for longer periods
- Trying to urinate a second time after voiding to fully empty the bladder, referred to as double voiding
- Pelvic floor muscle exercises
- Preventing or treating constipation

MEDICATION THERAPY

Medications may be prescribed to stop the growth of the prostate, shrink it, or reduce symptoms associated with BPH[7]:

- **Alpha-blockers:** Alpha-blockers relax the smooth muscles of the prostate and bladder neck to improve urine flow and reduce bladder blockage. Examples include tamsulosin, doxazosin, prazosin, and terazosin.

6. National Institute of Diabetes and Digestive and Kidney Disease. (2024). *Prostate enlargement (benign prostatic hyperplasia).* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/prostate-problems/prostate-enlargement-benign-prostatic-hyperplasia#complications

7. National Institute of Diabetes and Digestive and Kidney Disease.(2024). *Prostate enlargement (benign prostatic hyperplasia).* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/prostate-problems/prostate-enlargement-benign-prostatic-hyperplasia#complications

- **5-alpha reductase inhibitors:** These medications block the production of DHT, which accumulates in the prostate and may cause prostate growth. Examples include dutasteride and finasteride.
- **Combination therapy:** Research indicates combining two classes of medications can more effectively improve symptoms, urinary flow, and quality of life. Examples of combination medications include finasteride and doxazosin or dutasteride and tamsulosin. Alpha-blockers and antimuscarinics may also be prescribed for overactive bladder symptoms, where the bladder muscles contract uncontrollably causing urinary frequency, urinary urgency, and urinary incontinence. Antimuscarinics are a class of medications that relax the bladder muscles.
- **Phosphodiesterase inhibitors:** Although commonly prescribed for erectile dysfunction, this medication is also used to relax smooth muscles in the lower urinary tract to improve urine flow. An example of this medication is tadalafil.

MINIMALLY INVASIVE PROCEDURES

Minimally invasive procedures may be performed by urologists to relieve BPH symptoms when medications are ineffective. These procedures use the transurethral method, which involves inserting a catheter or cystoscope through the urethra to destroy enlarged prostate tissue or widen the urethra. This can help relieve blockage and urinary retention caused by benign prostatic hyperplasia. Minimally invasive procedures include the following[8]:

- **Transurethral needle ablation:** Uses heat generated by radiofrequency energy to destroy selected portions of prostate tissue.

8. National Institute of Diabetes and Digestive and Kidney Disease.(2024). *Prostate enlargement (benign prostatic hyperplasia).* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/prostate-problems/prostate-enlargement-benign-prostatic-hyperplasia#complications

- **Transurethral microwave thermotherapy:** Uses heat generated by microwave to destroy selected prostate tissue.
- **High-intensity focused ultrasound:** Uses heat generated by ultrasound waves to destroy enlarged prostate tissue.
- **Transurethral electrovaporization:** Electric current vaporizes selected prostate tissue and seals blood vessels, which reduces the risk of bleeding.
- **Water-induced thermotherapy:** Uses heated water to destroy selected prostate tissue.
- **Prostatic stent insertion:** A small device called a prostatic stent is passed through the urethra to the area narrowed by the enlarged prostate. Once in place, the stent expands like a spring, and it pushes back the prostate tissue, widening the urethra.

If a client is not a surgical candidate, intermittent catheterization or a chronic Foley may be utilized.

SURGERY

Surgery may be performed when symptoms are severe, other treatments haven't helped, or a complication has developed such as bladder damage. Surgeries remove part or all of the prostate or make cuts in the prostate to take pressure off the urethra. Although removing enlarged prostate tissue relieves many BPH symptoms, it does not cure BPH. Surgeries to remove enlarged prostate tissue include the following[9]:

- **Transurethral resection of the prostate (TURP):** TURP is considered the gold standard for treating blockage of the urethra due to BPH and is the

9. National Institute of Diabetes and Digestive and Kidney Disease. (2024). *Prostate enlargement (benign prostatic hyperplasia).* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/prostate-problems/prostate-enlargement-benign-prostatic-hyperplasia#complications

most common type of surgery performed. A resectoscope is passed through the urethra to reach the prostate and cuts pieces of enlarged prostate tissue with a wire loop. Special fluid carries the tissue pieces into the bladder, where it is flushed out at the end of the procedure.

- **Transurethral incision of the prostate (TUIP):** A cystoscope and an instrument that uses an electric current or a laser beam are inserted through the urethra to reach the prostate where it makes a few small cuts in the prostate and in the bladder neck to widen the urethra.
- **Laser surgery:** A cystoscope is used to pass a laser fiber through the urethra into the prostate where it destroys the enlarged tissue. The risk of bleeding is lower than in TURP and TUIP because the laser seals blood vessels as it cuts through the prostate tissue.
- **Open prostatectomy:** An incision is made through the skin to reach the prostate where part or all of it is removed through the incision. This surgery is used when the prostate is greatly enlarged, complications occur, or the bladder is damaged and needs repair. Open prostatectomy requires general anesthesia, a longer hospital stay than other surgical procedures for benign prostatic hyperplasia, and a longer rehabilitation period.

POSTOPERATIVE CONCERNS

After surgery is performed, the prostate, urethra, and surrounding tissues may be irritated and swollen, causing urinary retention. To prevent urinary retention, the urologist typically inserts an indwelling (Foley) catheter after the procedure so urine can drain freely out of the bladder. Sometimes, the indwelling catheter causes recurring, painful, difficult-to-control bladder spasms the day after surgery. Medications, such as oxybutynin, may be prescribed to relax bladder muscles and prevent bladder spasms.[10]

10. National Institute of Diabetes and Digestive and Kidney Disease. (2024). *Prostate enlargement (benign prostatic hyperplasia).* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/

Potential postoperative complications include the following[11]:

- **Problems urinating:** Painful urination, difficulty urinating, urinary frequency, urgency, or retention may occur after surgery but will gradually lessen. After a couple of months, urination will be easier and less frequent.
- **Urinary incontinence:** As the bladder returns to normal after surgery, clients may have temporary problems controlling their urination, resulting in incontinence. The longer their urinary problems existed before surgery, the longer it takes for the bladder to regain its full function after surgery.
- **Bleeding:** After surgery, the prostate or tissues around it may bleed, and blood or blood clots may appear in urine. Some bleeding is normal and should clear up within several days. However, the surgeon should be notified if the urine contains large clots, it is so red it is difficult to see through, or the client is experiencing pain.
- **Deep vein thrombosis:** Blood clots from BPH surgery can pass into the bloodstream and lodge in other parts of the body, most often the legs. The surgeon should be promptly notified of calf pain or unilateral leg warmth and swelling.
- **Infection:** Anesthesia used during surgery may cause urinary retention and increase the risk of a urinary tract infection (UTI). An indwelling catheter also increases the risk of a UTI. The health care provider should be promptly notified of UTI symptoms for the prescription of antibiotics.
- **Scar tissue:** Scar tissue may form in the urethra and cause it to narrow for

prostate-problems/prostate-enlargement-benign-prostatic-hyperplasia#complications

11. National Institute of Diabetes and Digestive and Kidney Disease. (2024). *Prostate enlargement (benign prostatic hyperplasia).* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/prostate-problems/prostate-enlargement-benign-prostatic-hyperplasia#complications

up to one year after surgery, which may require additional surgery.
- **Sexual dysfunction:** Some men may experience temporary problems with sexual function after BPH surgery. The length of time for restored sexual function depends on the type of surgery performed and how long symptoms were present before surgery.

Nursing Interventions

HEALTH TEACHING

Nurses reinforce lifestyle modifications to help manage BPH symptoms. Nurses teach clients about signs and symptoms of urinary tract infections and urinary retention. If medications are prescribed, nurses ensure the client understands the purpose of the medications and potential side effects. For example, clients taking alpha-blockers are instructed that dizziness may occur and to change positions slowly because of potential orthostatic blood pressure changes. Clients should also be instructed regarding therapeutic onset of medication therapy and that symptom improvement may take time to achieve.

POSTOPERATIVE CARE

In addition to monitoring for potential postoperative complications that were previously described under the “Surgery” subsection, nurses also perform urinary catheter care and monitor urine output.

If the client had a TURP procedure, continuous bladder irrigation is typically prescribed to decrease blood clots in the bladder and maintain the flow and patency of urine after surgery. The nurse titrates the flow of saline into the bladder to keep the urine light pink to clear. Maintaining accurate urinary output records is an important part of CBI intervention. The nurse should ensure that the total urine output is calculated to account for the volume of saline instilled. A large-size drainage bag should be utilized to collect the urine and irrigation fluids due to the high volume being instilled and drained.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Benign Prostate Hypertrophy

View a brief YouTube video overview on benign prostate hypertrophy[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2588#oembed-1

12. Open RN Project. (2024, April 24).*Health Alterations – Chapter 8 Renal and urinary disease – Benign prostatic hypertrophy [Video]. YouTube.* CC BY-NC 4.0 https://youtu.be/_DV0O6AVL0g

8.13 Bladder and Prostate Cancer

This section will provide an overview of two common cancers affecting the urinary tract, bladder cancer and prostate cancer and apply the nursing process to caring for clients diagnosed with these types of cancer.

Overview of Bladder Cancer

Bladder cancer is the most common malignancy affecting the urinary system. Bladder cancer is classified as non-muscle invasive, muscle-invasive, or metastatic, with treatment and prognosis based on the severity of the disease.[1]

Signs and Symptoms

Clients with bladder cancer typically have hematuria and some may have frequency, urgency, dysuria, and nocturia.[2]

Diagnostic Testing

The presence of hematuria requires diagnostic testing that usually begins with cystoscopy and biopsy of suspicious tissue or tumors. Read more about cystoscopy in the "General Urinary System Assessment" section of this chapter.

If tumors are found on cystoscopy, a transurethral resection of bladder tumor (TURBT) is typically performed to remove the tumor(s) and stage the

1. Lerner, S. (2023). Overview of the initial approach and management of urothelial bladder cancer. *UpToDate*. https://www.uptodate.com
2. Lerner, S. (2023). Overview of the initial approach and management of urothelial bladder cancer. *UpToDate*. https://www.uptodate.com

cancer. If bladder cancer is diagnosed, additional diagnostic testing for staging the cancer includes CT, MRI, and PET scans.[3]

Medical Treatment

Treatment is based on biopsy results that indicate if the cancer has invaded the bladder muscle tissue. For clients with bladder cancer that has not invaded the bladder muscle tissue, conservative treatment typically includes removal of the tumor with a TURBT followed by chemotherapy administered directly into the bladder, referred to as intravesical therapy. This conservative treatment is used to maintain a functional bladder.[4]

Muscle-invasive bladder cancer is treated with radical **cystectomy**, meaning removal of the bladder and regional lymph nodes. In males, radical cystectomy also includes the removal of the prostate and seminal vesicles. When a client's bladder is removed, urinary flow must be redirected, referred to as urinary diversion. Three common types of urinary diversion include the following[5]:

- **Ileal conduit:** A diversion is created for the urine to flow from the ureters through a segment of bowel (usually the ileum) to a stoma on the skin surface, where it is collected using an external appliance.
- **Cutaneous continent reservoir:** A reservoir is constructed under the skin and the client self-catheterizes at regular intervals to empty the reservoir. This option avoids the need for an external appliance.
- **Orthotopic neobladder:** A neobladder is formed from a segment of the

3. Lerner, S. (2023). Overview of the initial approach and management of urothelial bladder cancer. *UpToDate*. https://www.uptodate.com

4. Lerner, S. (2023). Overview of the initial approach and management of urothelial bladder cancer. *UpToDate*. https://www.uptodate.com

5. Lerner, S. (2023). Overview of the initial approach and management of urothelial bladder cancer. *UpToDate*. https://www.uptodate.com

bowel and attached to the urethra, enabling the client to void through the urethra.

If a client is diagnosed with metastatic cancer, they are typically treated with chemotherapy, immunotherapy, or targeted therapies.

CHEMOTHERAPY

Chemotherapy uses medications to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing. When chemotherapy is taken by mouth or injected into a vein or muscle, the drugs enter the bloodstream and can reach cancer cells throughout the body.[6]

TARGETED THERAPY

Targeted therapy uses medications or other substances to identify and attack specific cancer cells. Targeted therapies usually cause less harm to normal cells than chemotherapy or radiation therapy.[7]

IMMUNOTHERAPY

Immunotherapy uses the client's immune system to fight cancer. Substances made by the body or made in a laboratory are used to boost, direct, or restore the body's natural defenses against cancer.[8]

6. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

7. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

8. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient*

Overview of Prostate Cancer

Cancer of the prostate gland is the second most common cancer occurring in men. In the U.S., about 1 out of 8 men will be diagnosed with prostate cancer. Prostate cancer usually grows very slowly, so treating it before symptoms occur may not improve men's health or help them live longer.[9] Prostate cancer tends to grow on the peripheral edges of the gland first and, therefore, often does not result in urinary symptoms initially.

Signs and Symptoms

Symptoms of prostate cancer are initially similar to benign prostatic hypertrophy (BPH), such as trouble starting a urine stream and frequent urination, especially at night, and trouble emptying the bladder. Symptoms of advanced prostate cancer that have metastasized to other areas of the body include pain in the back, hips, or pelvis that doesn't go away, shortness of breath, fatigue, fast heartbeat, dizziness, pale skin caused by anemia, hematuria, blood in the semen, dysuria, and erectile dysfunction.[10]

A health care provider may assess for prostate cancer by performing a digital rectal exam, which entails inserting a lubricated, gloved finger into the rectum and palpating the prostate through the rectal wall to assess size, lumps, or other abnormal areas.[11]

version. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

9. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

10. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

11. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient*

Diagnostic Testing

Diagnostic testing for prostate cancer may include the following[12]:

- **Prostate-specific antigen (PSA):** A test that measures the level of PSA in the blood, a substance made by the prostate that may be found in higher-than-normal amounts in the blood of men who have prostate cancer. PSA levels may also be elevated in men who have BPH or prostatitis, so it is not a very reliable test.
- **Pelvic lymphadenectomy:** A surgical procedure to remove the lymph nodes in the pelvis. A pathologist views the tissue under a microscope to look for cancer cells.
- **PSMA PET scan:** An imaging procedure that is used to help find prostate cancer cells that have spread outside of the prostate into bone, lymph nodes, or other organs. For this procedure, a cell-targeting molecule linked to a radioactive substance is injected into the body and travels through the blood. It attaches to a protein called prostate-specific membrane antigen (PSMA) that is found on the surface of prostate cancer cells. A PET scan detects high concentrations of the radioactive molecule and shows where the prostate cancer cells are in the body.
- **Seminal vesicle biopsy:** The removal of fluid from the seminal vesicles using a needle that is then viewed under a microscope by a pathologist to look for cancer cells.
- **Transrectal ultrasound:** A procedure in which a probe that is about the size of a finger is inserted into the rectum to check the prostate. The probe is used to bounce high-energy sound waves (ultrasound) off internal tissues or organs and make echoes. The echoes form a picture of

version. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

12. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

body tissues called a sonogram. Transrectal ultrasound may also be used during a biopsy procedure called transrectal ultrasound guided biopsy.

- **Transrectal MRI:** A procedure that uses a strong, magnet radio waves and a computer to make a series of detailed images to determine if the cancer has spread outside the prostate into nearby tissues. Transrectal MRI may also be used during a biopsy procedure. This is called transrectal MRI guided biopsy.
- **Transrectal biopsy:** During this procedure, tissue is removed from the prostate by inserting a thin needle through the rectum and into the prostate. This procedure may be done using transrectal ultrasound or transrectal MRI to help guide where samples of tissue are taken. A pathologist views the tissue under a microscope to look for cancer cells.

If prostate cancer is diagnosed, additional testing to check for metastasis may include bone scan, MRI, or CT scans.

Medical Treatment of Prostate Cancer

There are several types of treatment for clients with prostate cancer, depending on the stage of the cancer and if it has metastasized[13]:

- Watchful waiting
- Surgery
- Radiation therapy and radiopharmaceutical therapy
- Hormone therapy
- Bisphosphonate therapy
- Chemotherapy
- Targeted therapy
- Immunotherapy

13. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

Watchful waiting refers to treatment used for older men whose prostate cancer is found during a screening test, but do not have signs or symptoms. Watchful waiting means closely monitoring a client's condition without any treatment unless signs or symptoms appear, or test results change. Treatment is provided to relieve symptoms and improve quality of life.

SURGERY

There are many types of surgeries performed to treat prostate cancer[14]:

- **Radical prostatectomy:** A surgical procedure to remove the prostate, surrounding tissue, and seminal vesicles. Removal of nearby lymph nodes may be done at the same time to check for possible metastasis. The main types of radical prostatectomy are as follows:
  - **Open radical prostatectomy:** An incision (cut) is made in the retropubic area (lower abdomen) or the perineum (the area between the anus and scrotum). Surgery is performed through the incision.
  - **Radical laparoscopic prostatectomy:** Several small incisions (cuts) are made in the wall of the abdomen. A laparoscope (a thin, tube-like instrument with a light and lens for viewing) is inserted through one opening to guide the surgery. Surgical instruments are inserted through the other openings to do the surgery.
  - **Robot-assisted laparoscopic radical prostatectomy:** Several small cuts are made in the wall of the abdomen, as in radical laparoscopic prostatectomy. The surgeon inserts an instrument with a camera through one of the openings and surgical instruments through the other openings using robotic arms. The camera gives the surgeon a three-dimensional view of the prostate and surrounding structures. The surgeon uses the robotic arms to do the surgery while sitting at a

14. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

computer monitor near the operating table.

- **Pelvic lymphadenectomy:** Lymph nodes are removed from the pelvis for examination under a microscope by a pathologist who looks for cancer cells. If the lymph nodes contain cancer, the doctor may not remove the prostate and may recommend other treatment.
- **Transurethral resection of the prostate (TURP):** TURP is a surgical procedure to remove tissue from the prostate using a resectoscope (a thin, lighted tube with a cutting tool) inserted through the urethra. This procedure is done to treat benign prostatic hypertrophy, and it is sometimes done to relieve symptoms caused by a tumor in the prostate gland before other cancer treatment is given. TURP may also be done in men who cannot have a radical prostatectomy because their tumor is only in the prostate.

RADIATION THERAPY AND RADIOPHARMACEUTICAL THERAPY

Radiation therapy uses high-energy X-rays or other types of radiation to kill cancer cells or keep them from growing. There are different types of radiation therapy[15]:

- External radiation therapy uses a machine outside the body to send radiation toward the area of the body with cancer. A computer may be used to make a three-dimensional (3-D) picture of the tumor and shape the radiation beams to fit the tumor. This allows a high dose of radiation to reach the tumor and causes less damage to nearby healthy tissue.
- Internal radiation therapy uses a radioactive substance sealed in needles, seeds, wires, or catheters that are placed directly into or near the cancer. Oftentimes these items may be left in place permanently. In early-stage

15. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

prostate cancer, radioactive seeds are placed in the prostate using needles that are inserted through the skin between the scrotum and rectum. The placement of the radioactive seeds in the prostate is guided by images from transrectal ultrasound or computed tomography (CT). The needles are removed after the radioactive seeds are placed in the prostate.

- Radiopharmaceutical therapy uses a radioactive substance to treat metastatic prostate cancer that has spread to the bone.

HORMONE THERAPY

Hormone therapy, also referred to as anti-androgen therapy, reduces the amount of testosterone or blocks its action to stop prostate cancer cells from growing. Hormone therapy includes medications, surgery, or other hormones. Orchiectomy is the surgical removal of one or both testicles, the main source of testosterone, to decrease the amount of hormone being made.[16]

BISPHOSPHONATE THERAPY

Bisphosphonate therapy uses medications to reduce bone disease when prostate cancer has metastasized to the bone. Men who are treated with hormone therapy or orchiectomy are at an increased risk of bone loss and fractures.[17]

16. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

17. National Cancer Institute. (2023). *Prostate cancer treatment (PDQ) – Patient version.* National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

Nursing Diagnoses for Clients with Bladder or Prostate Cancer

Nursing diagnoses for clients with bladder and prostate cancer focus on addressing the unique challenges and needs associated with this condition. The nursing priorities are centered around providing comprehensive care, managing symptoms, and enhancing the client's overall well-being while preventing complications.

Common nursing diagnoses for clients with prostate cancer include the following:

- Decreased Activity Tolerance
- Disturbed Body Image
- Fear
- Imbalanced Nutrition: Less Than Body Requirements
- Powerlessness
- Risk for Spiritual Distress

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions.

Sample expected outcomes for common nursing diagnoses related clients being treated for bladder or prostate cancer are as follows:

- *After the teaching session, the client will report symptoms to promptly report to the health care provider.*
- *The client will verbalize three positive coping strategies before discharge from the hospital.*

Nursing Interventions for Clients with Bladder or Prostate Cancer

Nursing interventions for bladder and prostate cancer are designed to

provide comprehensive care, symptom management, and emotional support. The goal is to improve the client's quality of life, assist with treatment-related side effects, and promote overall well-being.

Medication Management

Nurses administer medications as prescribed for symptom control. Nurses monitor and help manage the client's pain and other discomfort through pharmacological and nonpharmacological interventions, based on the client's preferences.

Specially trained oncology nurses administer chemotherapy. Nurses play an important role in monitoring for side effects and adverse effects, reporting concerns to the health care team, and advocating for symptom control and quality of life.

Clients are taught and encouraged to use energy conservation techniques to manage fatigue associated with the disease process and medical interventions.

> Review energy management techniques in the "Anemia" section of the "Hematological Alterations" chapter

Client Education

Clients undergoing specific cancer treatments typically require reinforced health teaching about the intervention and the ability to ask questions. If undergoing chemotherapy or surgical intervention, clients must also be instructed to monitor and report signs of infection.

Psychosocial Support

Emotional distress commonly occurs in clients diagnosed with cancer, as well

as their family members. Side effects and adverse effects associated with the disease and medical treatments can compound the emotional distress. Most people experience feelings of grief and loss when cancer is diagnosed. They may experience spiritual distress with a common question being, "Why me?" Nurses can play an important role in helping clients find spiritual support and a feeling of hope, even in the midst of terminal cancer.

In addition, the emotional burden of coping with an ostomy or other long-term consequences of treatment may be devastating for some clients and may affect their self-esteem, body image, quality of life, and ability to be intimate. For example, it is common for clients with ostomies to struggle with body image and their altered pattern of elimination. Nurses can promote healthy coping by ensuring the client has appropriate referrals to an appropriate nurse specialist, a social worker or case manager, and support group.

Nurses offer emotional support, empathy, and active listening to help clients and their family members cope with feelings resulting from the diagnosis, treatment, and changes in role performance. Information is reinforced as needed on medical treatments, and information is provided regarding available resources, counseling, and support groups. Nurses assess for signs of anxiety and depression and refer clients and family members to counseling as needed. Relaxation techniques and mindfulness practices are encouraged as positive coping strategies. Palliative care services are offered to manage symptoms, relieve pain, and enhance the client's quality of life. Nurses also initiate discussions about advance care planning and end-of-life preferences.

- Read more about palliative care, the loss/grief response, and end-of-life care in the "Grief and Loss" chapter Open RN *Nursing Fundamentals, 2e*.
- Read more about the nursing role in spiritual care in the "Spirituality" chapter of Open RN *Nursing Fundamentals, 2e*.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Prostate Cancer

View a brief YouTube video overview of prostate cancer[18]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2596#oembed-1

18. Open RN Project. (2024, June 23). *Health Alterations – Chapter 8 – Prostate cancer* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/s85S0va5LrE?si=4ds2QGX162i__FmU

8.14 Learning Activities

Learning Activities

Renal Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Jacob, a 32-year-old male, presents to the emergency department with severe pain on his right flank. The pain started suddenly and has been intensifying over the past four hours. On examination, he is found to be in moderate distress, pale, diaphoretic, and has a blood pressure of 140/90 mmHg. His heart rate is 120 bpm, respiratory rate is 26 breaths/min, and temperature is 37.2°C. Physical examination reveals right costovertebral angle tenderness and marked dehydration.

1. What are the likely differential diagnoses based on Jacob's symptoms?
2. Describe the pathophysiology of kidney stones formation.
3. What are the key clinical manifestations of kidney stones?
4. What laboratory tests would you order for Jacob? Explain the rationale for each.
5. What radiological investigations would be indicated in this case?
6. Discuss the role of a nurse in the management of a client with kidney stones.

1. "Renal Case Study" by Open RN is licensed under CC BY-NC 4.0

7. Jacob has a history of recurrent kidney stones. What advice would you provide him regarding prevention of further stone formation?
8. What pharmacological interventions are indicated for pain management in this case?
9. Describe the process of lithotripsy. What are the nursing interventions associated with this procedure?
10. Jacob is scheduled for discharge. What key education points would you provide to him and his family before discharge?



An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=2604#h5p-31

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https://wtcs.pressbooks.pub/healthalts/?p=2604#h5p-32

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https://wtcs.pressbooks.pub/healthalts/?p=2604#h5p-33

"Renal Stone Match-Up" by Open RN is licensed under CC BY-NC 4.0

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https://wtcs.pressbooks.pub/healthalts/?p=2604#h5p-44

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https://wtcs.pressbooks.pub/healthalts/?p=2604#h5p-59

2

2. "Case Study: Benign Prostatic Hyperplasia" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

- Test your knowledge on acute and chronic renal failure using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[3]

- Test your knowledge on urinary conditions using this NCLEX Next Generation-style drop down triad question. You may reset and resubmit your answers to this question an unlimited number of times.[4]

- Test your knowledge on urinary conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[5]

3. "Renal Failure" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

4. "Genitourinary Drop Down Triad" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

5. "Pediatric Urinary Bowtie" by Jennifer Hinz and OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on renal failure using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[6]

Telehealth Scenarios

Telehealth is an innovative technology that can bridge the gap between health care professionals and clients, especially for clients who live in remote areas. Telehealth not only makes health care more accessible but can also provide continuity of care and prevent unnecessary hospitalizations. Nurses who provide telehealth services become digital communicators and educators, merging clinical expertise with empathy and effective online communication.

Practice using effective telehealth communication in the following scenarios with Carolyn Smith, an 85-year-old Caucasian female with mild dementia who was recently discharged from the hospital with chronic kidney disease, Stage IV[7]:

- Carolyn Smith, Telehealth Visit 1: Post-hospitalization Follow-

6. "Renal Case Study" by Travis Christman for OpenRN is licensed under CC BY-NC 4.0

7. "Telehealth Scenarios" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

Up

- Carolyn Smith, Telehealth Visit 2: Identifying Learning Needs
- Carolyn Smith, Telehealth Visit 3: Evaluating Health Teaching

VIII Glossary

Acute renal failure: The sudden loss of kidney function; also known as acute kidney injury. (Chapter 8.5)

Anuria: Absence of urine output, typically found during kidney failure, defined as less than 50 mL of urine over a 24-hour period. (Chapter 8.2)

Arteriovenous graft: Similar to a fistula but uses a synthetic tube to create a conduit between the artery and vein. (Chapter 8.6)

Asterixis: Flapping tremor. (Chapter 8.5)

Benign prostatic hyperplasia (BPH): Enlargement of the prostate that is not cancerous. (Chapter 8.12)

Bladder: Hollow muscular organ which serves as a reservoir to collect urine. (Chapter 8.2)

Bruit: Whooshing sound. (Chapter 8.6)

Chronic kidney disease (CKD): The gradual, progressive loss of kidney function over time. (Chapter 8.6)

Continuous ambulatory peritoneal dialysis (CAPD): Peritoneal dialysis involving manual exchanges multiple times a day. (Chapter 8.5)

Continuous cycling peritoneal dialysis (CCPD): Peritoneal dialysis using a machine for automated exchanges during the night. (Chapter 8.5)

Continuous renal replacement therapy (CRRT): A slow and continuous form of dialysis that occurs 24 hours a day, emulating the continuous filtration process of the kidney. (Chapter 8.5)

Costovertebral angle tenderness: Tenderness to palpation over the kidneys. (Chapter 8.8)

Cystitis: A condition characterized by the inflammation of the bladder. (Chapter 8.7)

Cystectomy: Removal of the bladder. (Chapter 8.13)

Deamination: The process by which amino acids are converted into ammonia, urea, and uric acid. (Chapter 8.2)

Dialysis: A procedure to artificially perform the functions of the kidneys when they are unable to effectively filter waste products and excess fluids from the blood. (Chapter 8.5)

Distended: Stretched out. (Chapter 8.2)

Diuresis: Increased production of urine. (Chapter 8.2)

Diuretic: A substance that increases urine production. (Chapter 8.2)

Dysuria: Painful or burning sensation during urination. (Chapter 8.2)

Edema: Excess fluid around the cells. (Chapter 8.2)

Enuresis: Involuntary urination, especially by children. (Chapter 8.2)

Frequency: The need to urinate several times during the day or night in normal or less-than-normal volumes. (Chapter 8.2)

Functional incontinence: Normal bladder control but difficulties getting to the toilet because of arthritis or other disorders that make it hard to move quickly or manipulate zippers or buttons. (Chapter 8.10)

Glomerular filtration: The first step in urine production. (Chapter 8.2)

Glomerular filtration rate (GFR): The volume of filtrate formed by both kidneys per minute. (Chapter 8.2)

Glomeruli: Structures within the kidneys responsible for filtering waste and excess fluids from the blood to produce urine. (Chapter 8.9)

Glomerulonephritis: An inflammatory disease that specifically affects the kidney glomeruli. (Chapter 8.9)

Glomerulus: Cluster of high-pressure capillaries. (Chapter 8.2)

Hematuria: Blood in urine. (Chapter 8.2)

Hemodialysis: A type of dialysis using a machine called a dialyzer or artificial kidney. (Chapter 8.5)

Hydrostatic pressure: The pressure produced by a fluid against a surface. (Chapter 8.2)

Incontinence: Loss of bladder control. (Chapter 8.2)

Infectious cystitis: The most common type of urinary tract infection (UTI), resulting from a bacterial, viral, or parasitic infection. (Chapter 8.7)

Interstitial cystitis: An inflammatory disease characterized by chronic bladder inflammation that lacks a known cause. (Chapter 8.7)

Kidney: An organ that filters waste from the blood and produces urine. (Chapter 8.2)

Metabolic acidosis: A pH level below 7.35 and an HCO3 level below 22. (Chapter 8.2)

Metabolic alkalosis: A pH above 7.45 and an HCO3 level above 26. (Chapter 8.2)

Nephrolithiasis: Kidney stones. (Chapter 8.11)

Nephron: Functional unit of the kidney and filters the blood, removes wastes, and balances fluid and electrolyte levels. (Chapter 8.2)

Nocturia: Frequent urination at night. (Chapter 8.2)

Noninfectious cystitis: Cystitis from irritants such as certain chemicals (such as chemotherapy medications) or radiation exposure. (Chapter 8.7)

Oliguria: Decreased urine output, defined as less than 500 mL of urine in adults in a 24-hour period. (Chapter 8.2)

Oncotic pressure: Colloidal pressure that is created by the protein content of the blood that helps hold water inside of capillaries. (Chapter 8.2)

Osmosis: The movement of water across a semipermeable membrane that is impermeable to a solute. (Chapter 8.2)

Overflow incontinence: Continuous or intermittent leakage of small amounts of urine due to incomplete bladder emptying. (Chapter 8.10)

Percutaneous nephrolithotomy: The removal of larger stones from the kidney using a nephroscope inserted through a small incision in the back. (Chapter 8.11)

Peritoneal dialysis: Dialysis using the peritoneum, a membrane lining the abdominal cavity, as a natural filter. (Chapter 8.5)

Pessaries: Medical devices inserted into the vagina to support the bladder or urethra in cases of stress incontinence. (Chapter 8.10)

Plasmapheresis: Removal of blood plasma and replacement with donor plasma. (Chapter 8.9)

Polyuria: Greater than 2.5 liters of urine output over 24 hours; also referred to as diuresis. (Chapter 8.2)

Pruritus: Itchy skin; a common symptom of kidney failure. (Chapter 8.2)

Pyelonephritis: Bacterial infection that typically starts as a urinary tract infection (UTI) that progresses up the ureters to the kidneys. (Chapter 8.7, Chapter 8.8)

Pyuria: White blood cells in a urine sample indicating infection. In severe infections, pus may be visible in the urine. (Chapter 8.2)

Radical prostatectomy: A surgical procedure to remove the prostate, surrounding tissue, and seminal vesicles. (Chapter 8.13)

Shock wave lithotripsy (SWL): A medical procedure that utilizes shock

waves to break larger stones into smaller fragments, making them easier to pass through the urinary tract. (Chapter 8.11)

Sphincters: Circular muscles constricting an orifice. (Chapter 8.2)

Stress incontinence: Involuntary loss of urine due to weakened pelvic floor muscles, leading to leakage during physical activities, coughing, sneezing, or laughing. (Chapter 8.10)

Third spacing: Abnormal accumulation of fluid within interstitial spaces causing swelling within tissues. (Chapter 8.3)

Thrill: Vibration. (Chapter 8.6)

Transurethral resection of the prostate (TURP): A surgical procedure to remove tissue from the prostate using a resectoscope (a thin, lighted tube with a cutting tool) inserted through the urethra. (Chapter 8.13)

Turbidity: Cloudiness of urine caused by the presence of suspended particles that are not easily seen. (Chapter 8.3)

Urea: A waste product made when the liver breaks down protein into amino acids, and then deamination converts the amino acids into ammonia, urea, or uric acid. (Chapter 8.2)

Uremia: Elevated urea and nitrogenous waste in the blood. (Chapter 8.5)

Uremic encephalopathy: A cerebral dysfunction caused by the accumulation of toxins resulting from acute or chronic kidney failure. (Chapter 8.3)

Uremic frost: Whitish coating of urea crystals on the skin when there is a significant buildup of urea in the bloodstream during severe kidney failure. (Chapter 8.5)

Ureter: The duct by which urine passes from the kidney to the bladder. (Chapter 8.2)

Ureterolithiasis: Stones in the ureter(s). (Chapter 8.11)

Ureteroscopy: A medical procedure where a thin tube is passed through the urethra and bladder into the ureter to remove stones. (Chapter 8.11)

Urethra: Transports urine from the bladder to the outside of the body during urination. (Chapter 8.2)

Urge incontinence: Incontinence caused by a sudden, strong urge to urinate followed by involuntary loss of urine. (Chapter 8.10)

Urgency: A sensation of an urgent need to void. (Chapter 8.2)

Urinary incontinence: The involuntary loss of urine. (Chapter 8.2, Chapter 8.10)

Urinary retention: Inability of the bladder to completely empty, leaving residual urine in the bladder. (Chapter 8.12)

Urinary system: Also referred to as the renal system or urinary tract; consists of the kidneys, ureters, bladder, and urethra. (Chapter 8.2)

Urinate: The process of passing urine; also referred as void or micturate. (Chapter 8.2)

Urolithiasis: The formation of stones or calculi within the urinary tract. (Chapter 8.11)

Watchful waiting: Refers to treatment used for older men whose prostate cancer is found during a screening test, but do not have signs or symptoms. (Chapter 8.13)

PART IX

CHAPTER 9 NERVOUS SYSTEM ALTERATIONS

9.1 Neurological Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with nervous system disorders
- Explain the pathophysiology of nervous system disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in caring for the client with nervous system disorders
- Integrate pharmacological and nonpharmacological measures for the client with nervous system disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=91#h5p-50

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The nervous system includes the brain, the spinal cord, and a complex system of nerves in the body. It uses electrical signals and chemical substances for communication across body parts. This chapter will review the anatomy and physiology of the nervous system and then discuss medical care and nursing care for several common nervous system disorders.

9.2 Review of Anatomy & Physiology of the Nervous System

The nervous system is divided into two main parts called the central nervous system and the peripheral nervous system. See Figure 9.1[1] for an illustration of the nervous system.

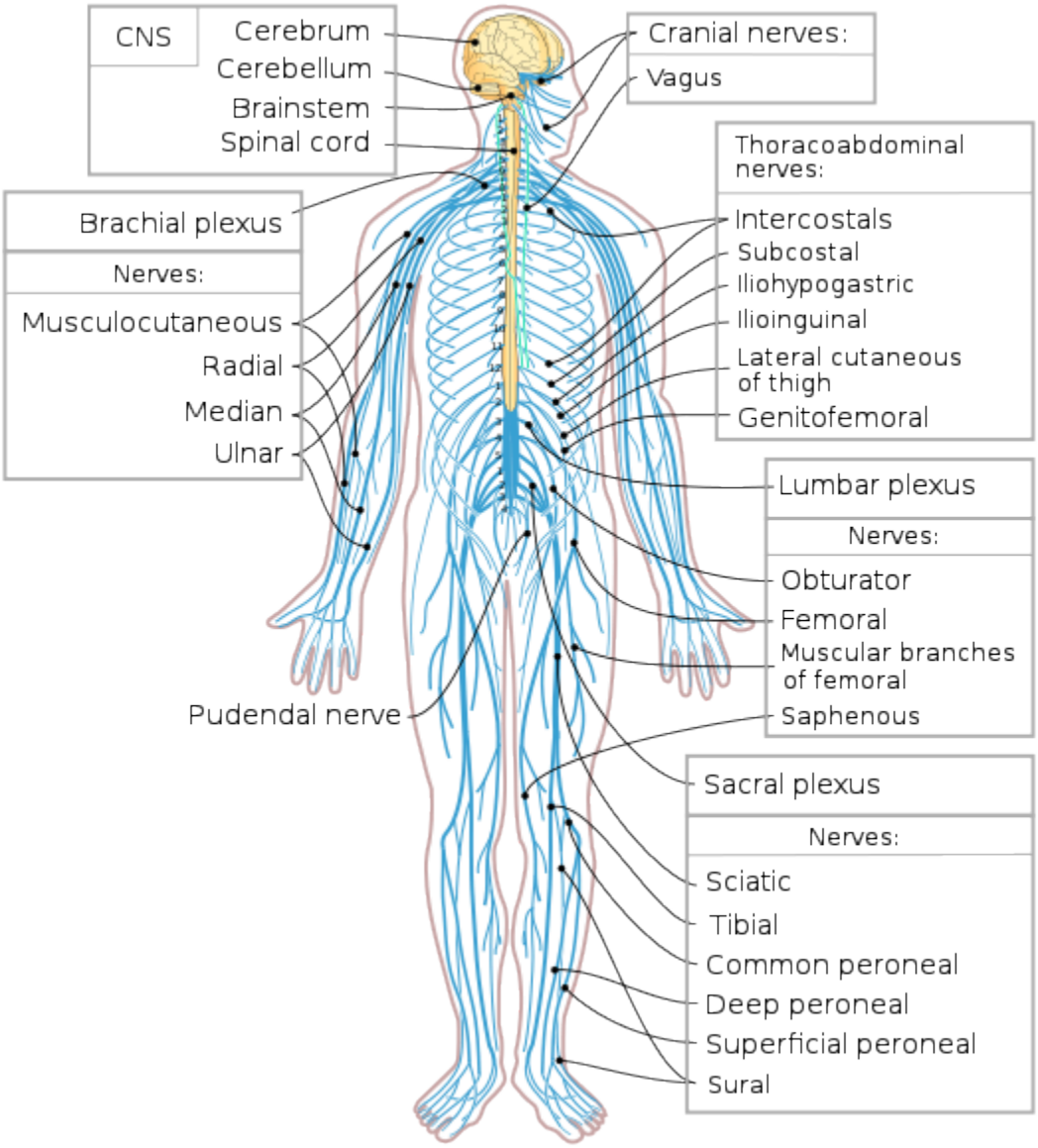


Figure 9.1 Nervous System

1. "Nervous_system_diagram-en.svg" by Medium69, Jmarchn is licensed under CC BY-SA 4.0

The **central nervous system (CNS)** includes the brain and the spinal cord. The brain can be described as the interpretation center, and the spinal cord can be described as the transmission pathway.[2]

Brain

The major regions of the brain are the cerebrum, cerebral cortex, hypothalamus, thalamus, brain stem, and the cerebellum.

The largest portion of our brain is called the cerebrum. The cerebrum is covered by a wrinkled outer layer of gray matter called the cerebral cortex. The cerebral cortex is involved in complex brain functions, including memory, attention, perceptual awareness, thought, language, and consciousness. The cerebral cortex is divided into four lobes named the frontal, parietal, occipital, and temporal lobes. Each lobe has the following specific functions:

- **Frontal Lobe:** The frontal lobe is associated with movement. It contains neurons that instruct cells in the spinal cord to move skeletal muscles. The anterior portion of the frontal lobe is called the prefrontal lobe. The prefrontal lobe provides cognitive functions such as planning and problem-solving that contribute to our personality, short-term memory, and consciousness. Broca's area is located in the frontal lobe and is responsible for the production of language and controlling movements responsible for speech.
- **Parietal Lobe:** The parietal lobe processes general sensations, including touch, pressure, tickle, pain, itch, and vibration.
- **Temporal Lobe:** The temporal lobe processes auditory information. Wernicke's area is located in the temporal lobe and is responsible for the comprehension of written and spoken language. Because regions of the

2. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

temporal lobe are part of the limbic system, memory is also an important function associated with the temporal lobe. The limbic system is involved with our behavioral and emotional responses needed for survival, such as feeding, reproduction, and the fight-or-flight responses.

- **Occipital Lobe:** The occipital lobe primarily processes visual information.

The **cerebellum** is the posterior part of the brain that controls fine motor skills. See Figure 9.2[3] for an illustration of the cerebellum and the lobes of the cerebral cortex.

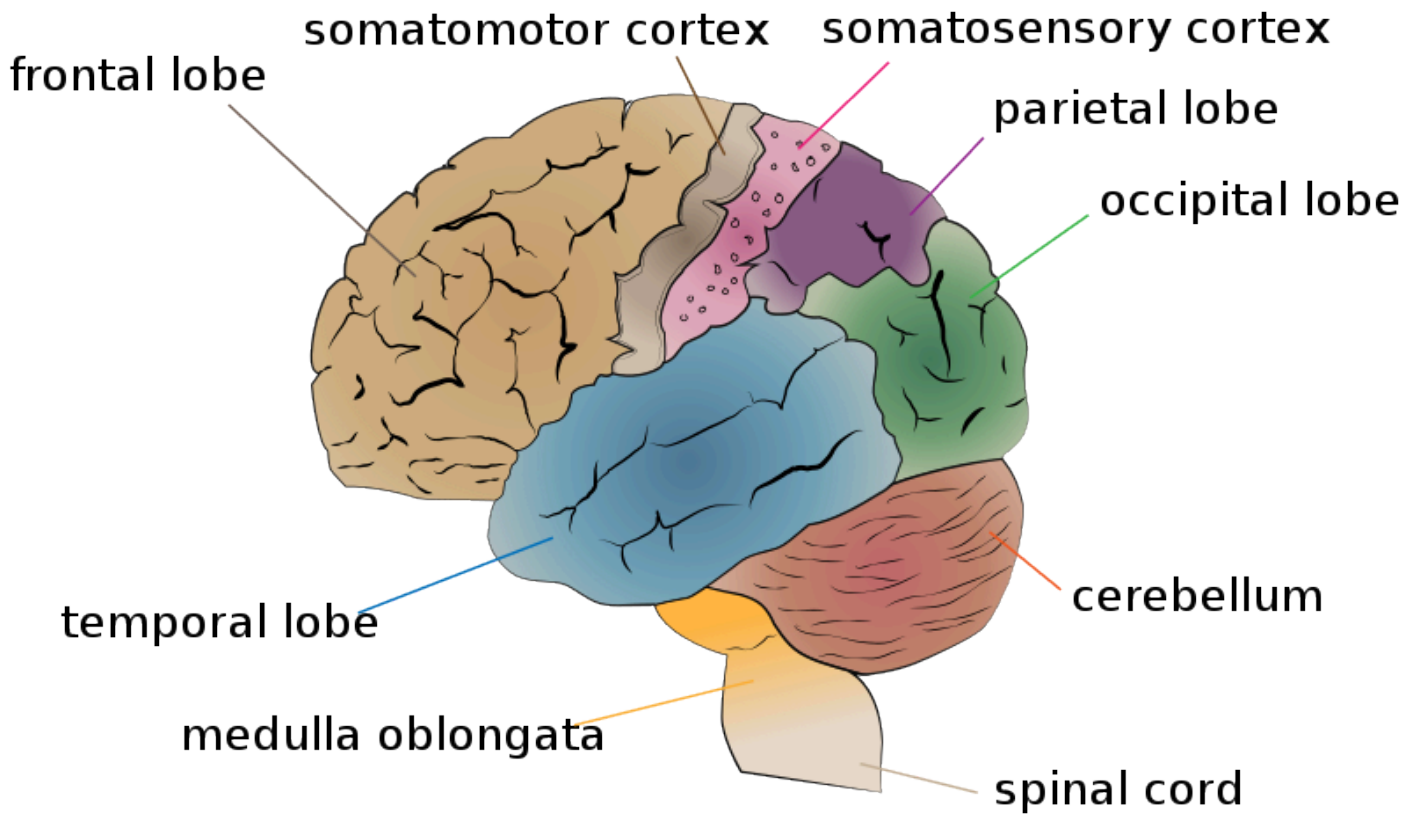


Figure 9.2 Cerebellum and Lobes of the Cerebrum

Deep within the cerebrum are the hypothalamus and the thalamus. The **hypothalamus** coordinates the autonomic nervous system and the activity of

3. "Cerebrum lobes.svg" by Jkwchui is licensed under CC BY-SA 3.0

the pituitary, controlling body temperature, thirst, hunger, and other homeostatic systems. The **thalamus** is the relay center for sensory and motor signals to the cerebral cortex. See Figure 9.3[4] for an illustration of the hypothalamus and the thalamus.

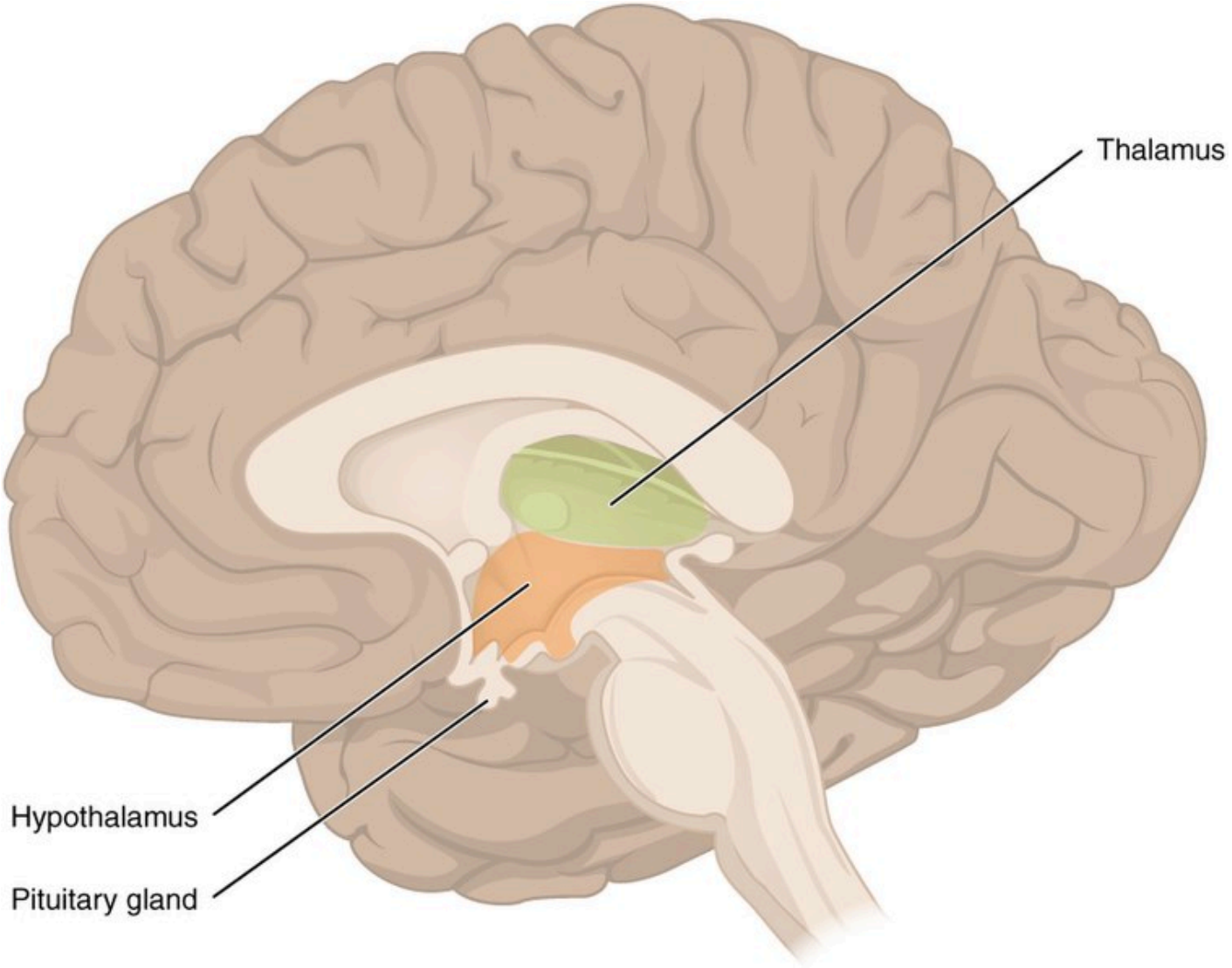


Figure 9.3 Hypothalamus and Thalamus

The **ventricles** are a group of interconnected, fluid-filled cavities within the brain. The purpose of the ventricles is to produce cerebrospinal fluid to cushion and protect the brain.

Meninges are three membranes that protect the brain and spinal cord

4. "1310_Diencephalon.jpg" by OpenStax is licensed under CC BY 4.0

called the pia mater, arachnoid, and dura mater. The **pia mater** is the delicate inner layer. The **arachnoid** is the middle layer filled with fluid that cushions the brain. The **dura mater** is the tough outermost membrane enveloping the brain and spinal cord. The meningeal spaces are the spaces between the meningeal layers. There are three clinically significant meningeal spaces called the **epidural**, **subdural**, and **subarachnoid**.

The **brain stem** connects the spinal cord with the brain. It regulates several crucial autonomic functions in the body, including involuntary functions in the cardiovascular and respiratory systems and reflexes like vomiting, coughing, sneezing, and swallowing.

Spinal Cord

The spinal cord is a bundle of nerve fibers enclosed in the spine that connects nearly all parts of the body to the brain. It is a continuation of the brain stem that transmits sensory information to the brain and motor impulses to the muscles.

Peripheral Nervous System

The **peripheral nervous system (PNS)** consists of the remaining parts of the nervous system outside of the brain and spinal cord, including the cranial nerves that branch out from the brain and the spinal nerves that branch out from the spinal cord. The peripheral nervous system is the communication network between the brain and the body.[5]

5. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

Cranial Nerves

Cranial nerves are directly connected from the brain to the periphery. They are primarily responsible for the sensory and motor functions of the head and neck. There are twelve cranial nerves that are designated by Roman numerals I through XII. A popular mnemonic for memorizing the names of the cranial nerves is "**O**h **O**nce **O**ne **T**akes **T**he **A**natomy **F**inal **S**ome **G**ood **V**acations **A**re **H**eavenly," in which the initial letter of each word corresponds to the initial letter in the name of each nerve. The cranial nerves include the following nerves[6]:

- **O:** The olfactory nerve is responsible for the sense of smell.
- **O:** The optic nerve is responsible for the sense of vision.
- **O:** The oculomotor nerve regulates eye movements by controlling four of the extraocular muscles, lifting the upper eyelid when the eyes point up and constricting the pupils.
- **T:** The trochlear nerve and the abducens nerve are both responsible for eye movement but do so by controlling different extraocular muscles.
- **T:** The trigeminal nerve regulates skin sensations of the face and controls the muscles used for chewing.
- **A:** The auditory/vestibulocochlear nerve manages hearing and balance.
- **F:** The facial nerve is responsible for the muscles involved in facial expressions, as well as part of the sense of taste and the production of saliva.
- **S:** The spinal (accessory) nerve controls movements of the neck, along with cervical spinal nerves.
- **G:** The glossopharyngeal nerve regulates the controlling muscles in the oral cavity and upper throat, as well as part of the sense of taste and the production of saliva.
- **V:** The vagus nerve is responsible for contributing to homeostatic control

6. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

of the organs of the thoracic and upper abdominal cavities.
- **A:** The abducens nerve supplies the muscles involved with the lateral eye movement.
- **H:** The hypoglossal nerve manages the muscles of the lower throat and tongue.

Spinal Nerves

Spinal nerves are named based on the level of the spinal cord where they emerge. See Figure 9.4[7] for an illustration of spinal nerves. There are eight pairs of cervical nerves designated C1 to C8, twelve thoracic nerves designated T1 to T12, five pairs of lumbar nerves designated L1 to L5, five pairs of sacral nerves designated S1 to S5, and one pair of coccygeal nerves. All spinal nerves are sensory and motor nerves. Spinal nerves extend outward from the vertebral column to innervate the periphery while also transmitting sensory information back to the brain.

7. "Spinal_Cord_Segments_and_body_representation.png" by David Nascari and Alan Sved is licensed under CC BY-SA 4.0

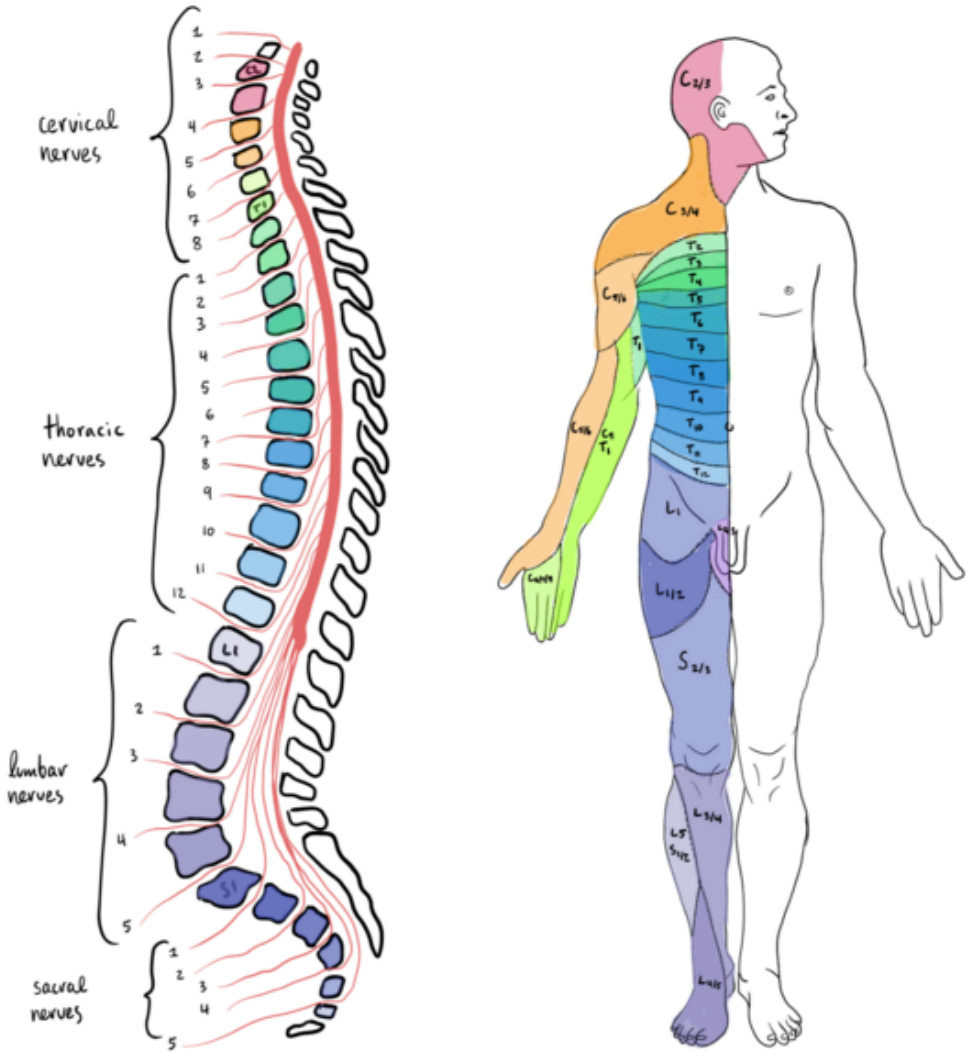


Figure 9.4 Spinal Nerves

Each spinal nerve innervates a specific region of the body[8]:

- C1 provides motor innervation to muscles at the base of the skull.
- C2 and C3 provide both sensory and motor control to the back of the head and behind the ears.

8. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

- The phrenic nerve from C3, C4, and C5 innervates the diaphragm to enable breathing. This is vital because if a client has an injury where the spinal cord is cut above C3, then spontaneous breathing is not possible.
- C5 through C8 and T1 combine to form the brachial plexus, a tangled array of nerves that serve the upper limbs and upper back.
- The lumbar plexus arises from L1-L5 and innervates the pelvic region and the anterior legs.
- The sacral plexus comes from the lower lumbar nerves L4 and L5 and the sacral nerves S1 to S4. The sciatic nerve is a part of the sacral plexus. If the sciatic nerve becomes compressed due to degeneration of an intervertebral disc, a medical condition called sciatica occurs that causes pain in the back, hip, and outer side of the leg.
- S5 and the coccygeal nerves leave the sacral canal and provide partial innervation to several pelvic organs, including the uterus, fallopian tubes, bladder, and prostate.

If a client experiences a spinal cord injury, the degree of paralysis can be predicted by the location of the spinal cord injury. The higher up on the spinal cord an injury occurs, the greater loss of function. For example, a spinal cord injury higher on the spinal cord can cause paralysis in most of the body and affect all limbs (tetraplegia or quadriplegia). An injury that occurs lower on the spinal cord may only affect a person's lower body and legs (paraplegia).

It is also important to remember when a client has a spinal cord injury and motor nerves are damaged, their sensory nerves may still be intact. If this occurs, the client can still feel sensation even if they can't move the extremity.

Neurons

Nervous tissue in the CNS and PNS contains two basic types of cells: neurons and glial cells. **Neurons** are responsible for the communication that the nervous system provides. They are electrically active and release chemical

signals called neurotransmitters. Glial cells play a supporting role for nervous tissue.[9]

Neurons provide electrical signals that communicate information about sensations and, in response, stimulate movements. The three-dimensional shape of neurons makes massive numbers of connections within the nervous system. The main part of a neuron is the cell body. A fiber that emerges from the cell body and projects to target cells is called the axon. A single axon can branch repeatedly to communicate with many target cells by sending nerve impulses. Dendrites conduct information received from other neurons at contact areas called a synapse. A synapse is a junction between two nerve cells, consisting of a tiny gap through which neurotransmitters pass. See Figure 9.5[10] for an illustration of a neuron.

9. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

10. "1206_The_Neuron-1.jpg" by OpenStax is licensed under CC BY 4.0

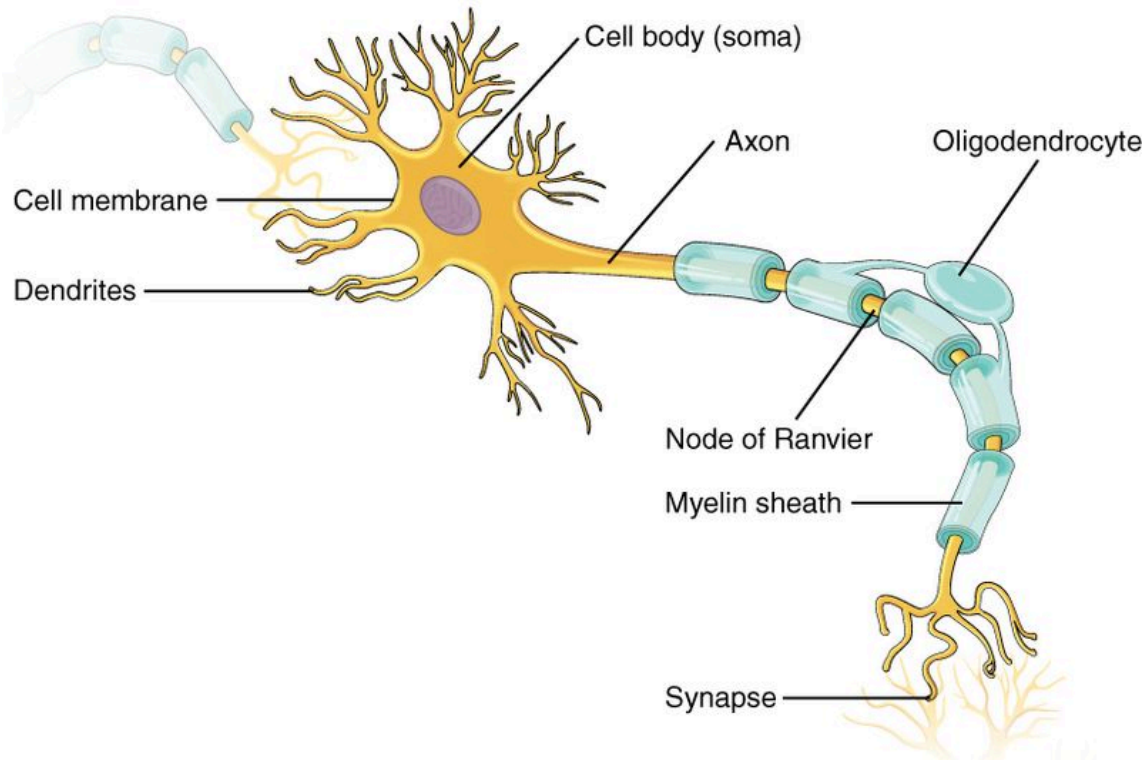


Figure 9.5 Neuron

Many axons are wrapped by an insulating substance called myelin, which is made from glial cells. The **myelin sheath** acts as insulation much like the plastic or rubber that is used to insulate electrical wires.

Neurotransmitters and Neuroreceptors

Electrical impulses from neurons signal the release of a neurotransmitter into a synapse. **Neurotransmitters** cause the impulse to be transferred to a neuroreceptor on another neuron, muscle fiber, or other structure. **Neuroreceptors** are specific for certain neurotransmitters, and the two fit together like a key and lock. See Figure 9.6[11] for an illustration of neuron communication.

11. "Chemical synapse schema cropped.jpg" by Looie496 is licensed under Public Domain.

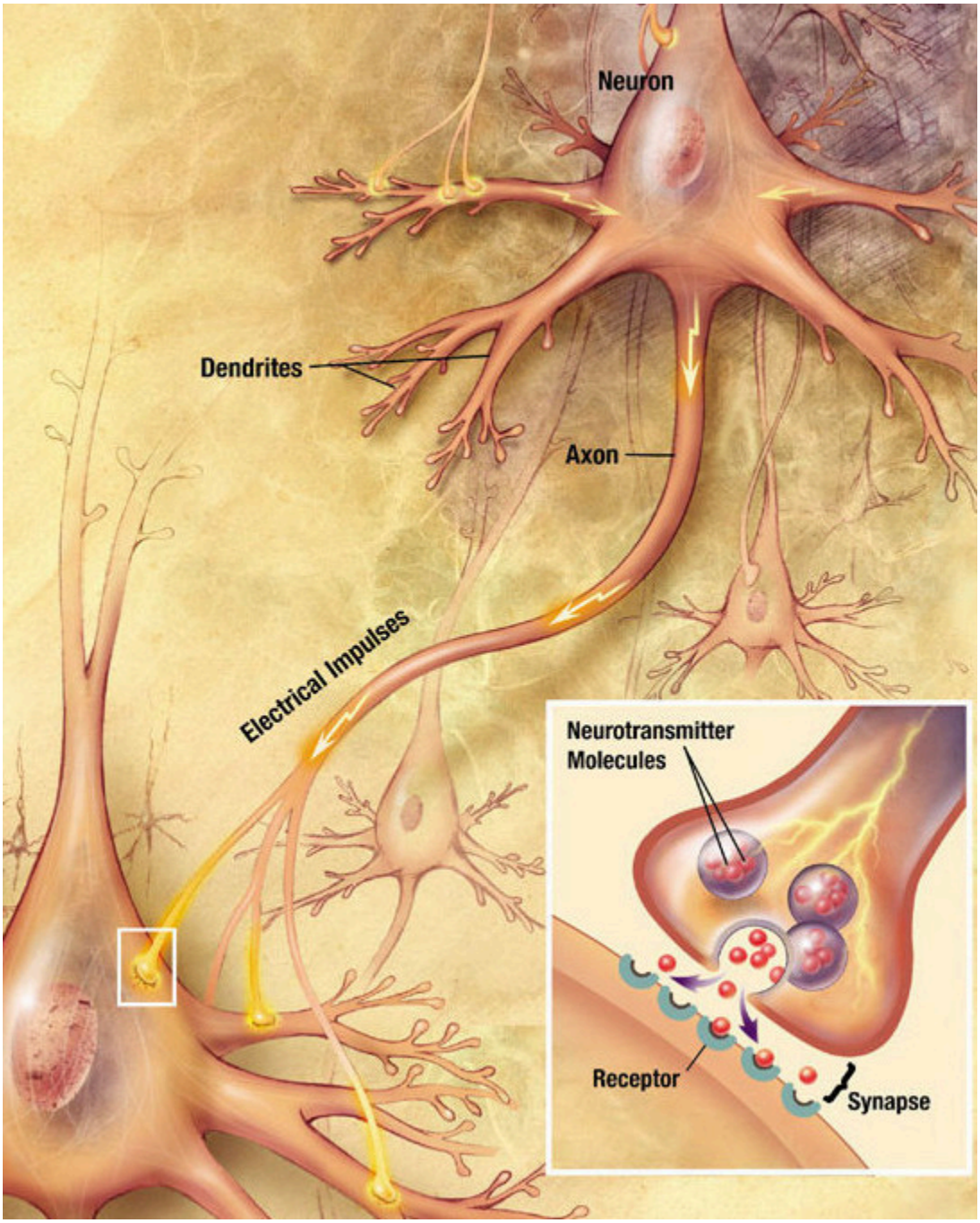


Figure 9.6 Neuron Communication

Several nervous system diseases and mental health disorders are related to abnormal impulse transmission and/or imbalanced levels of neurotransmitters. See Table 9.1 for a list of major neurotransmitters. In this chapter, many of the alterations presented include a dysfunction in neurotransmission. It is helpful to understand the common neurotransmitters and their function to better understand neurological alterations. For example,

dopamine is a neurotransmitter that influences movement and cognition. Dopamine imbalances are associated with Parkinson's disease.[12,13]

Table 9.1. Major Neurotransmitters

Neurotransmitter	Source	Action	Example of Dysfunction
Acetylcholine (major transmitter of the parasympathetic nervous system)	Autonomic nervous system; includes numerous areas of the brain	Excitatory; parasympathetic effects but can be inhibitory such as stimulation of heart by the vagus nerve.	Decreased levels lead to myasthenia gravis.
Dopamine	Substantia nigra and basal ganglia	Typically inhibits and affects behavior such as attention, emotions, and fine movement.	Decreased levels lead to Parkinson's disease.
Serotonin	Hypothalamus, brain stem, and dorsal horn of the spinal cord	Inhibitory effects and helps to control sleep and mood; inhibits pain pathways.	Decreased levels lead to depression.
Gamma-aminobutyric acid (GABA)	Spinal cord, basal ganglia, cerebellum, and some cortical areas	Inhibitory effect.	Decreased levels lead to seizures.
Norepinephrine (major transmitter of the sympathetic nervous system)	Brain stem, hypothalamus, and postganglionic neurons of the sympathetic nervous system	Typically excitatory; affects mood and overall activity levels.	Dysfunction is rarely seen.
Glutamate	Several types of receptors found through the CNS	Excitatory; its metabolism is important to maintaining optimal levels within the extracellular space. As such, it is important for memory, cognition, and mood regulation.	Dysfunction interferes with brain processing of information. Excess amounts can damage nerve cells.

12. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

13. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

9.3 General Nervous System Assessment

Risk Factors and Social Determinants of Health Related to the Nervous System

As with other body systems, neurologic health disparities are created and perpetuated by structural and social determinants of health. These factors include, but are not limited to, interpersonal bias, institutional factors that lead to disparate access to care, and neighborhood-level factors, such as socioeconomic status, segregation, and access to healthy food. Effects of these determinants of health can be seen throughout neurology, including in stroke, epilepsy, headache, amyotrophic lateral sclerosis, multiple sclerosis, and dementia.[1] Research shows that Black and Hispanic individuals were 30%-40% less likely to see an outpatient neurologist for care of a neurological condition compared with White individuals, even after adjusting for demographic, insurance, and health status differences.[2]

The environments in which individuals live and work also affect brain health. Lower socioeconomic status can result in exposure to toxic and unhealthy environments that increase risk for neurological disease.[3]

1. Rosendale, N. (2022). Social determinants of health in neurology. *Neurologic clinics. 40*(1), 231-247. https://doi.org/10.1016/j.ncl.2021.08.012

2. Rost, N. S., Salinas, J., Jordan, J. T., Banwell, B., Correa, D. J., Said, R. R., Selwa, L. M., Song, S., & Evans, D. A. (2023). The brain health imperative in the 21st century – A call to action. *Neurology. 101*(13), 570-579. https://doi.org/10.1212/WNL.0000000000207739

3. Rost, N. S., Salinas, J., Jordan, J. T., Banwell, B., Correa, D. J., Said, R. R., Selwa, L. M., Song, S., & Evans, D. A. (2023). The brain health imperative in the 21st century – A call to action. *Neurology. 101*(13), 570-579. https://doi.org/10.1212/WNL.0000000000207739

General Assessment of the Nervous System

Health History

Before obtaining a health history, note the client's cognition, appearance, speech, and motor function. If any deficits in speech, hearing, or cognition are noticed, it is helpful to interview a family member or significant other to obtain accurate baseline information. If a family member or significant other is not available, the nurse may need to use questions with "Yes" or "No" answers and rely on information in the electronic health record.

Interview questions often include the following questions[4]:

- Are you experiencing any current neurological concerns such as headache, decreased vision, dizziness, weakness, numbness, tingling, tremors, loss of balance, or decreased coordination?
- Have you experienced any difficulty swallowing or speaking?
- Have you experienced any recent falls or head injury?
- Have you ever experienced a neurological condition such as a stroke, transient ischemic attack, seizure, dementia, Parkinson's disease, multiple sclerosis, or myasthenia gravis?
- Are you currently taking any medications, herbs, or supplements for a neurological condition? (The nurse should be aware if the client is taking sedatives, analgesics, or neuromuscular-blocking agents, as these may interfere with an accurate neurologic assessment.)
- Do you use alcohol, marijuana, or other street drugs?

The nurse is also aware that neurologic disorders may be acute or progressive, and some are characterized by variation in symptoms or symptom-free periods.

4. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

Physical Examination of the Neurological System

The brain and spinal cord cannot be examined directly, so physical examination of the nervous system is performed using a variety of observations, assessments, and clinical testing. Much of the examination is an indirect evaluation of the functioning of specific body part(s) controlled or innervated by the nervous system.

Neurological assessment includes the following components[5]:

- Level of consciousness and orientation
- Memory and mood
- Cranial nerves
- Sensory function
- Motor function
- Cerebellar function
- Reflexes
- Psychosocial

LEVEL OF CONSCIOUSNESS (LOC)

One of the first cues of decreased neurological function is a change in level of consciousness. Evaluate the client's ability to respond appropriately to questions, as well as their orientation to person, self, time, and situation, and compare current findings to their baseline. In acute care of a neurological disorder, use the Glasgow Coma Scale. If acute deterioration is noted, notify the health care provider and/or seek emergency assistance according to agency policy.

5. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

Glasgow Coma Scale

The **Glasgow Coma Scale (GCS)** is a standardized tool used to objectively assess and continually monitor a client's level of consciousness when damage has occurred, such as after a head injury or a cerebrovascular accident (stroke). See Figure 9.7[6] for an illustration of the Glasgow Coma Scale. Three primary areas assessed in the GCS include eye opening, verbal response, and motor response. Scores are added from these three categories to assign a client's level of responsiveness. A score of 15 or higher is classified as the best response, a score less than 8 is classified as comatose, and a score of 3 is classified as unresponsive. (Note that 3 is the lowest possible score.) Additionally, a score that has decreased two or more points from the previous assessment is considered clinically significant and should be reported to the health care provider.

6. "glasgow-coma-scale-gcs-600w-309293585.jpg" by joshya on Shutterstock. All rights reserved. Image used with purchased permission.

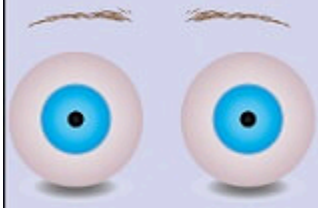
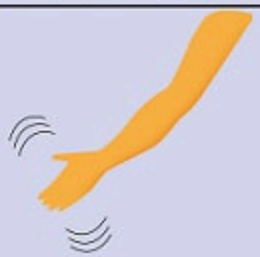
Behaviour	Response
 Eye Opening Response	4. Spontaneously 3. To speech 2. To pain 1. No response
 Verbal Response	5. Oriented to time, person and place 4. Confused 3. Inappropriate words 2. Incomprehensible sounds 1. No response
 Motor Response	6. Obeys command 5. Moves to localised pain 4. Flex to withdraw from pain 3. Abnormal flexion 2. Abnormal extension 1. No response

Figure 9.7 Glasgow Coma Scale

View the Glasgow Coma Scale and associated instructions: Glasgow Assessment Aid PDF.

MEMORY AND MOOD

Assess language and memory while asking the client for details regarding the current illness and any significant past events. During the exam observe for any agitation, anger, depression, or euphoria, as well as the appropriateness of these states.

CRANIAL NERVES

When assessing cranial nerves, compare opposite sides of face and neck, noting if there are differences. Each side should be symmetrical. The assessment of multiple cranial nerves can be combined, such as eye movement (controlled by cranial nerves III, IV, VI).

> Review how to perform a cranial nerve assessment in the "Assessing Cranial Nerves" section of the "Neurological Assessment" chapter of Open RN *Nursing Skills, 2e*.

SENSORY FUNCTION

When testing sensory function, several areas are tested. Recall that each sensory modality is carried by a specific ascending pathway in the spinal cord before it reaches the sensory cortex of the brain.

As a rule, when performing sensory testing, do so with the client's eyes closed. Avoid providing cues. For example, ask the client, "How does this feel?" rather than "Does this feel sharp?" Sensory testing of the anterior and posterior torso and all four extremities is typically sufficient in a routine neurological examination. However, if there is an abnormality within the routine neurological exam, further investigation is warranted.

Light touch is usually tested by using a cotton wisp or soft pinprick. Each of the four extremities is tested by asking the client to tell the examiner if they feel the stimulus. Testing pain reception is performed by alternatively touching the skin with a dull item and then a sharp end of a pin. The client is then asked to respond "Sharp" or "Dull." Each limb should be evaluated separately.

MOTOR FUNCTION

The motor system exam includes assessment of muscle strength, tonicity, coordination, and symmetry. Ask the client to push and pull against the

resistance of your arm, rating their strength on a scale of 1-5, with 5 being the strongest. These actions assess flexion and extension of the client's muscle and should be performed at the client's shoulder, elbows, wrists, hips, knees, and ankles.

To test muscle tone, passively move the client's limbs through their range of motion. As the client's muscles are moved, the nurse should be able to identify a slight resistance to the movements. Abnormal tone is referred to as **hypotonia** (flaccidity) or **hypertonia** (spasticity).

During the motor exam, observe and document any involuntary movements such as tics, tremors, or **myoclonus** (spasm of muscles) and evaluate for coordination and symmetry of movement.

CEREBELLAR FUNCTION

Cerebellar function is tested by assessing gait, balance, and coordination. **Ataxia** refers to lack of muscle control in the arms and legs that causes poor balance and coordination, which can result in trouble walking.

Observe a client's posture while standing, as well as their gait when walking. These are good screening tests for balance and muscle strength because being able to hold up one's weight in a standing position and walking require muscle strength, as well as the coordination of the nervous system. It is also an excellent way to determine the client's fall risk and level of fall precautions required.

To examine fine motor movement and coordination, perform the finger-to-nose test, heel-to-shin test, and alternative hand movement test. In the finger-to-nose test, ask the client to alternately touch their nose and then your finger. During the heel-to shin test, ask the client to stroke the heel of one foot up and down the shin of their opposite leg. During the alternating hand movement test, ask the client to rapidly pronate and supinate both hands simultaneously. Being able to perform these tests accurately and smoothly indicates a normal test.

View a supplementary YouTube video[7] on assessing cerebellar function: Cerebellar Function Tests.

REFLEXES

Reflexes are assessed by testing the reflex contraction of the skeletal muscle when the associated tendon is stretched. Tendons have built in receptors that are sensitive to stretch. The biceps, triceps, brachioradialis, patellar, Achilles tendon reflexes, and Babinski reflex are typically tested by advanced practice nurses and health care providers. The nurse should be aware of the purpose of reflex testing and correlate abnormal findings with the client's condition.

PSYCHOSOCIAL

Nurses assess the client's psychosocial response to illness or injury and plan customized interventions to promote effective coping.

Life Span Considerations

PEDIATRIC CONSIDERATIONS

Nurses consider the following differences when caring for pediatric clients.[8]

7. Patient Examination Videos – Educor. (2022, April 14). *Cerebellar function tests* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=VmsXL40Yado

8. Queensland Emergency Pediatric Care. (2022). *How children are different: Anatomic and physiological differences.*

- The anterior fontanel of an infant remains open until 12-18 months of age. The posterior fontanelle of an infant closes between 2-3 months of age.
- Newborns and infants have underdeveloped temperature regulation that can result in hypothermia if their heads are left exposed.
- Children have increased fall risk due to incomplete motor development.
- Children are more susceptible to head injuries due to their larger head size in relationship to their body size.
- The cranial bones of pediatric clients are thin and leave brain tissue less protected, resulting in hemorrhages, head trauma, and diffuse brain injury as the result of accidents or injuries.

OLDER ADULT CONSIDERATIONS

Nurses consider the following differences when caring for older adults.[9]

- The brains of older adults experience normal physiological changes associated with aging, such as atrophy, decreased vascularization, and memory impairment.
- The percentage of people with Alzheimer's disease (AD) increases dramatically with age, with 33% of people aged 85 or older having AD.
- The number of neurotransmitters, particularly dopamine and serotonin, decline with aging. In addition, neuronal, dendrite, and myelin changes negatively impact nerve impulse transmission.
- Ischemia that occurs later in life may result in white matter lesions, strokes, and increased risk for dementia. Prolonged decreased blood flow to the brain can result in permanent damage.

https://www.childrens.health.qld.gov.au/__data/assets/pdf_file/0031/179725/how-children-are-different-anatomical-and-physiological-differences.pdf

9. Peters, R. (2006). Ageing and the brain. *Journal of Postgraduate Medicine, 82*(964), 84-8. https://doi.org/10.1136/pgmj.2005.036665

Common Laboratory and Diagnostic Testing

Blood tests associated with neurological assessment may include the following:

- Complete blood count (CBC) and serum levels of albumin and vitamins/minerals (particularly B vitamins) because anemia, malnutrition, and vitamin deficiencies can contribute to neurological disorders.
- Basic metabolic panel (BMP) with serum calcium, phosphorous, and magnesium levels to assess for abnormal electrolytes and glucose that can cause neurologic impairment.
- Arterial blood gas (ABG) because respiratory distress can alter neurological status, so pH, oxygen, and carbon dioxide levels are evaluated.
- Drug screen because alcohol and drugs may contribute to neurological impairment.
- Blood, urine, or other cultures because underlying infection can lead to abnormalities in the neurologic system, such as meningitis and encephalitis.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

There are several common diagnostic tests that may be ordered for the diagnosis and monitoring of neurologic system disorders. See Table 9.3 for descriptions of common diagnostic tests and associated nursing considerations.

Table 9.3. Common Diagnostic Tests for Nervous System Disorders

Diagnostic Test	Description and Indication	Nursing Considerations
Lumbar puncture (See Figure 9.8[10])	Cerebrospinal fluid (CSF) is aspirated from the subarachnoid space by a health care provider by inserting a needle between L3-4 or L4-5. Used to examine CSF for infection or presence of blood and measure and reduce CSF pressure. Fluid should be clear and colorless. Pink or blood-tinged CSF may be a sign of subarachnoid hemorrhage, and cloudiness may be due to increased WBCs.	Before: Ensure written consent is obtained. Describe sensations that may occur during the procedure, such as a temporary, sharp pain or tingling that radiates down the leg as the sterile needle is passed between the lumbar vertebrae. Ask the client to void before the procedure and then assist the client into a side-lying position with their back toward the provider. Legs should be flexed as much as possible to make it easier for the provider to access the correct area. During: Assist the client to maintain the position and avoid sudden movement, which can cause injury. After: Assist the client to lie supine on bedrest for a few hours after the test. Encourage fluids. Monitor neurologic signs and vitals. Monitor for post puncture spinal headache, meningeal irritation (nuchal rigidity), hematoma, and pain. Administer analgesics as needed.

10. "Diagram_showing_how_you_have_a_lumbar_puncture_CRUK_157.svg" by Cancer Research UK is licensed under CC BY-SA 4.0

CT (computed tomography) scan	Computer assisted X-ray that provides cross-sectional views of body parts. Used to detect problems such as hemorrhage, tumor, cyst, infarction, edema, brain atrophy, and other abnormalities. Contrast can be used to enhance visualization of brain structures, although scanning is typically first performed without contrast.	Before: Assess for allergies or contraindications to contrast, such as allergies to shellfish, iodine, or dye. Evaluate kidney function tests and notify the provider of any concerns prior to the administration of contrast. Assess for and address anxiety related to procedure. Instruct the client to remain still during the procedure. Note: *If IV contrast is planned for clients taking metformin, there is risk for lactic acidosis if they have severe renal dysfunction (i.e., estimated glomerular filtration rate [eGFR] <30 mL/min) and contrast is contraindicated. Notify the provider before proceeding. After: Promote fluid intake to assist in elimination of contrast.
X-rays (skull and spine)	Simple X-ray images of the skull and spine are done to detect fractures, calcifications, bone erosion, and abnormal vascularity.	Before: Explain that the procedure is noninvasive.

Cerebral angiography	Considered the gold standard for diagnosis of intracranial vascular disease. This test is a series of X-rays using contrast medium to visualize intracranial and extracranial blood vessels and identify impaired perfusion to the brain tissue. It is performed to detect vascular lesions such as hematoma, AV malformations, and aneurysms and tumors of the brain. A catheter is typically inserted into the femoral artery and advanced into the base of the carotid or vertebral area to inject the contrast.	Before: Assess the client for stroke risk because thrombi may dislodge during the procedure. Provider orders typically include an NPO order after midnight prior to the procedure. Inform the client they may feel a hot flush when the contrast medium is injected and to lie still during the procedure. During: Monitor for signs and symptoms of an allergic/anaphylactic reaction from the contrast dye. After: Monitor insertion site and pulses distal to the insertion site. Perform neuro checks and vital signs according to agency policy, typically every 15-30 minutes x two hours and then every hour x 24 hrs. Ensure bed rest for the first six hours. If a closure device is used at the insertion site, bed rest is only required for one hour. Monitor for bleeding and report any neurological status changes.

Magnetic resonance imaging (MRI) (See Figure 9.9[11])	Provides imaging of the brain and spinal cord by using magnetic energy to detect strokes, multiple sclerosis, tumors, trauma, seizures, and brain herniation. Produces greater detail than CT with improved detail of intracranial structures, but the procedure takes longer to complete and may not be appropriate if a client is experiencing a life- threatening emergency. Contrast agents, such as gadolinium, can be used with MRI to enhance visualization.	Before: Screen the client for presence of any metal parts internally and externally, such as pacemakers, metal plates, jewelry, etc. Instruct the client they need to lie very still for up to one hour. Assess for claustrophobia prior to the procedure because sedation may be necessary. For client safety, no client care equipment such as oxygen tanks that contain metal can enter the MRI room.
Positron emission tomography (PET)	Measures metabolic activity of the brain to determine cell death or damage. A radioactive isotope is injected that shows up as a bright spot on the image if abnormal activity is occurring. Indicated for clients with stroke, Alzheimer's disease, seizure disorders, Parkinson's disease, infection, and tumors.	Before: Provider orders typically indicate the client should be NPO with no caffeine, alcohol, tobacco, sedatives, or tranquilizers prior to exam because these substances can interfere with the results. Ask the client to void before the procedure.
Myelogram	X-rays of the spinal cord and vertebral column are taken after contrast is injected into the subarachnoid space. Used to detect spinal lesions and/or CSF leaks.	Before: Explain the test is performed on a tilting table that is moved during the test. Ask the client to empty their bladder prior to the test. Administer sedative if ordered. After: Client should lie flat for a few hours. Perform neuro checks and vital signs according to agency policy. Monitor for headache and nausea/vomiting.

11. “HITACHI,_Magnetic_Resonance_Imaging_System,_ECHELON_OVAL,.jpg” by Mj-bird is licensed under CC BY-SA 3.0

Electroencephalography (EEG) (See Figure 9.10[12])	Electrodes are placed on the scalp to record electrical activity of the cerebral hemispheres. Each graphic recording represents electrical impulses within the brain. The frequency, amplitude, and characteristics of the brain waves are recorded to evaluate seizure disorders, cerebral disease, brain injury, and brain death.	Before: Instruct the client the test is noninvasive and does not cause electric shock. Anti-seizure medications are held prior to the procedure. Sleep deprivation prior to the procedure may be encouraged to attempt to invoke an event during testing. Fasting and caffeine should be avoided before the procedure because hypoglycemia and caffeine can alter the test results. Ensure that hair is clean and without conditioners, hair creams, lotions, sprays, or styling gels. Verify with the provider if any medications such as tranquilizers or anti-seizure medications should be held prior to the exam. After: Resume any medications that were held. Remove the electrode paste from the scalp/hair.
Electromyography (EMG)(See Figure 9.11[13])	Records the muscle and nerve integration and electrical activity. Needle electrodes are inserted into the specific muscle units being tested. Normal, relaxed muscles show no electrical activity, and contracted muscles show electrical activity. The test is indicated for testing for muscle and nerve diseases.	Before: Explain the procedure and inform the client that there will be some pain associated with the insertion of the needle electrodes.

12. "Normalt_EEG_vaken_vuxen.PNG" by Nitramus is licensed under CC BY-SA 3.0 and "Three_quarter_view_of_EEG_subject.jpg" by Chris Hope, with permissions from Tim Sheerman-Chase, is licensed under CC BY 2.0

13. "Normalt_EEG_vaken_vuxen.PNG" by Nitramus and "Needle_EMG_of_paravertebral_muscles(2J009).jpg" by Kychot are licensed under CC BY-SA 3.0

Electroneurography (nerve conduction studies)	Measures the conduction velocity of peripheral nerves. A brief electrical stimulus is initiated at the distal portion of the sensory nerve being tested. A recording of the depolarization wave is taken at a point proximal to the stimulus. The time between the initial stimulus and the beginning of the depolarization wave is measured (i.e., nerve conduction velocity). Damaged nerves will have slower conduction velocities.	Before: Instruct the client on the procedure.
Carotid artery duplex scan	Combines ultrasound and Doppler technology to evaluate the degree of stenosis (narrowing) of the carotid and vertebral arteries. Using transducer gel, a probe is placed over the common carotid artery and moved slowly along its length. Frequency of reflected ultrasound signal corresponds with the velocity of blood flow. Increased blood flow velocity may indicate stenosis or partial or total occlusion of the vessels.	Before: Explain the test is noninvasive.

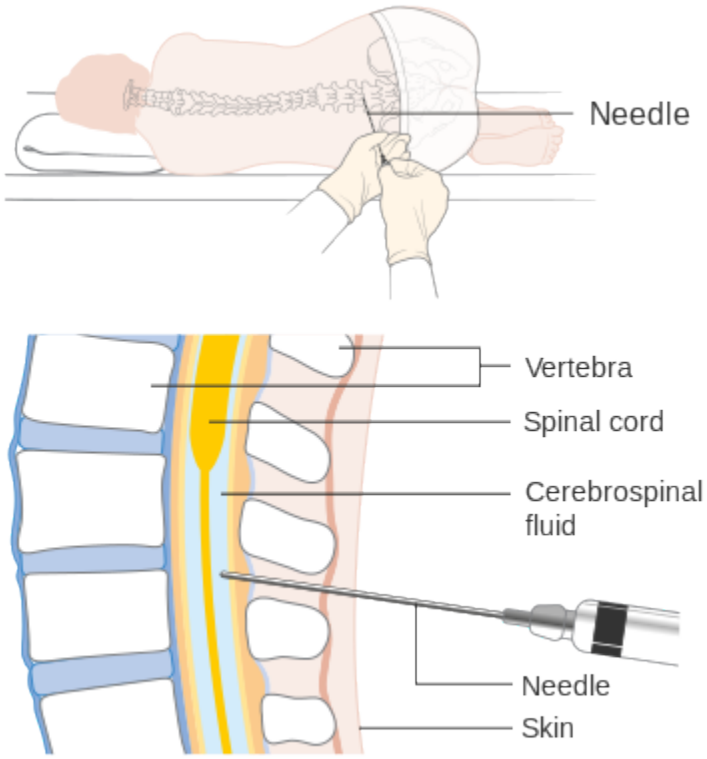


Figure 9.8 Lumbar Puncture

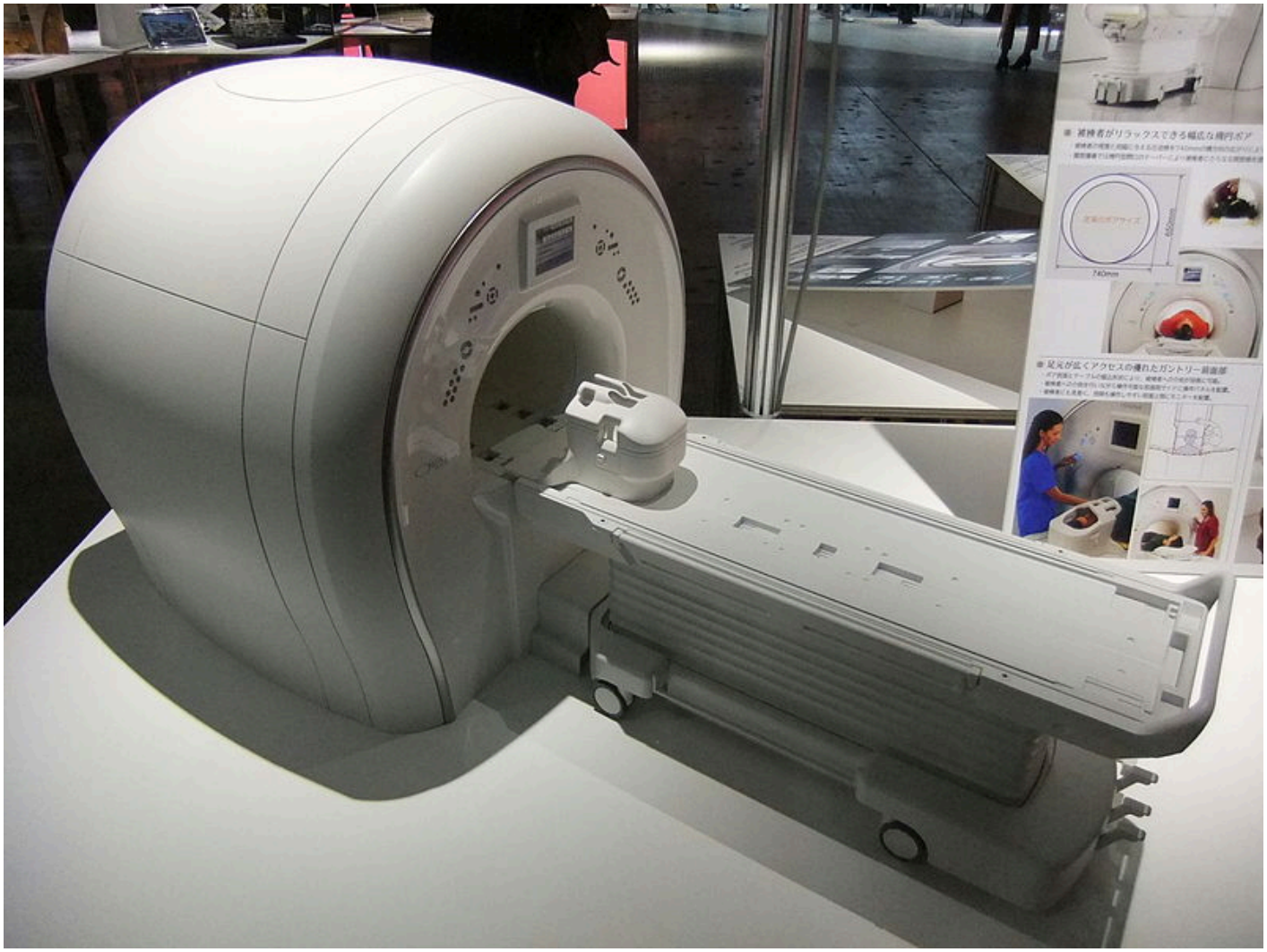


Figure 9.9 MRI

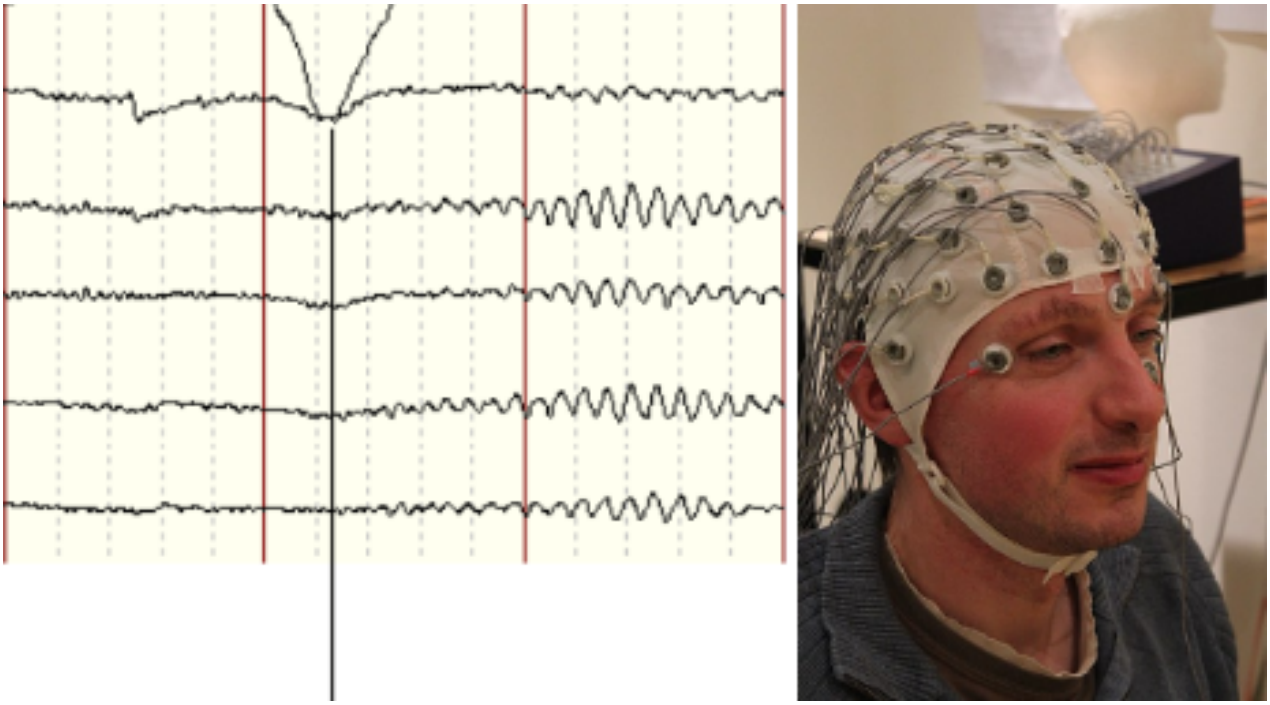


Figure 9.10 EEG: Electrode Placement and Waveform

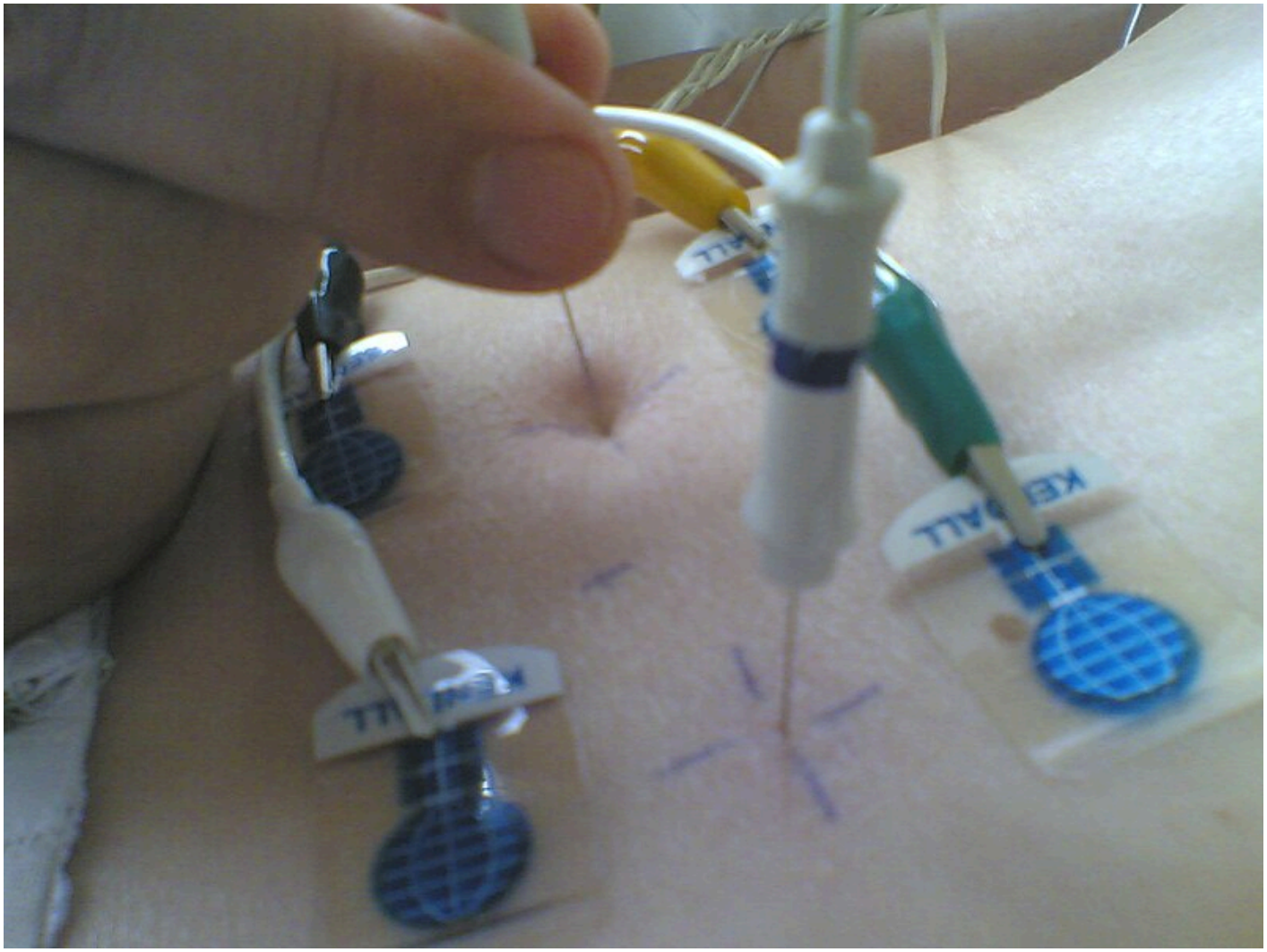


Figure 9.11 Needle EMG of Paravertebral Muscles

9.4 Common Neurological Conditions

Nurses care for clients with neurological disorders in a variety of clinical settings. Nervous system disorders can occur at any time during the life span and can be very mild to significantly severe or even life-threatening. The remaining sections of this chapter will describe several common neurological conditions, including Alzheimer's disease, Parkinson's disease, seizures and epilepsy, meningitis, cerebrovascular accident, multiple sclerosis, myasthenia gravis, and other nervous system disorders.

9.5 Alzheimer's Disease

Dementia is a general term that refers to a decline in cognitive ability severe enough to interfere with a person's ability to complete their activities of daily living. **Alzheimer's disease (AD)** is the most common type of dementia, accounting for at least two thirds of cases of dementia in people aged 65 and older. AD is a neurodegenerative disease that causes progressive and disabling impairment of cognitive functions, including memory, comprehension, language, attention, reasoning, and judgment. An estimated 6.7 million Americans are living with AD.[1]

Family members commonly function as unpaid caregivers to support individuals with AD who continue to live at home, including assistance with activities of daily living (ADLs), paying bills, shopping, and preparing meals. Caregivers also provide emotional support, help manage health conditions, and ensure safety at home. Caregiving is time-intensive and can be physically and emotionally exhausting, causing declines in the caregiver's health.[2] Nurses often address caregiver health when caring for clients with AD.

Pathophysiology

The brain of an older adult experiences normal physiological changes associated with aging, such as increased size of the ventricles. However, with Alzheimer's disease and other forms of dementia, these changes occur at a much more rapid pace, along with significant atrophy of the cerebral cortex

1. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5
2. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

and degeneration of neurons. See Figures 9.12[3] and 9.13[4] for illustrations comparing a normal brain to a brain of a person with Alzheimer's disease.

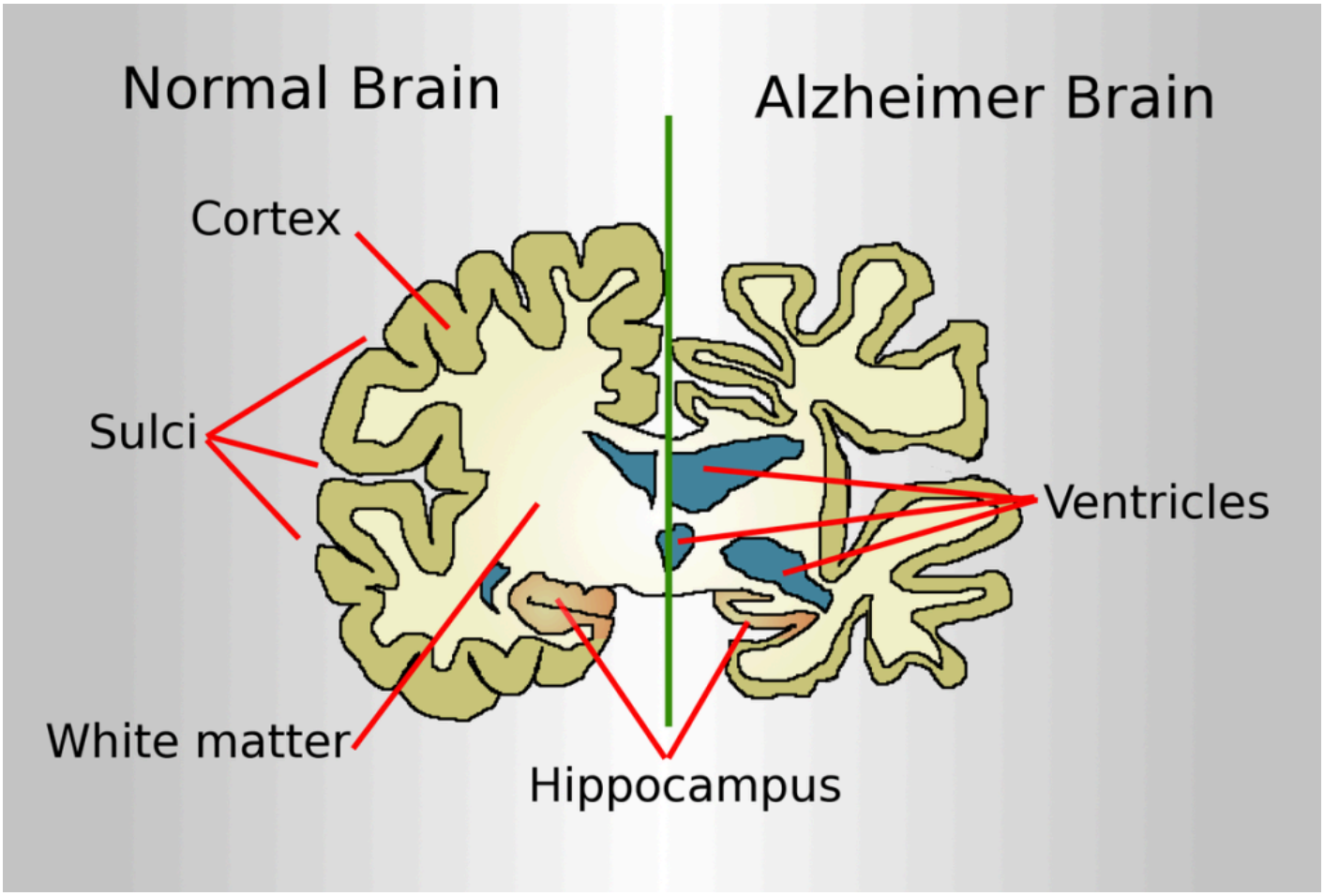


Figure 9.12 Structures of a Normal Brain (left) Compared to a Brain with Alzheimer's Disease (right)

3. "Brain-ALZH.png" by Garrondo is licensed in the Public Domain.
4. "Alzheimers_brain.jpg" by National Institutes of Health is licensed in the Public Domain.

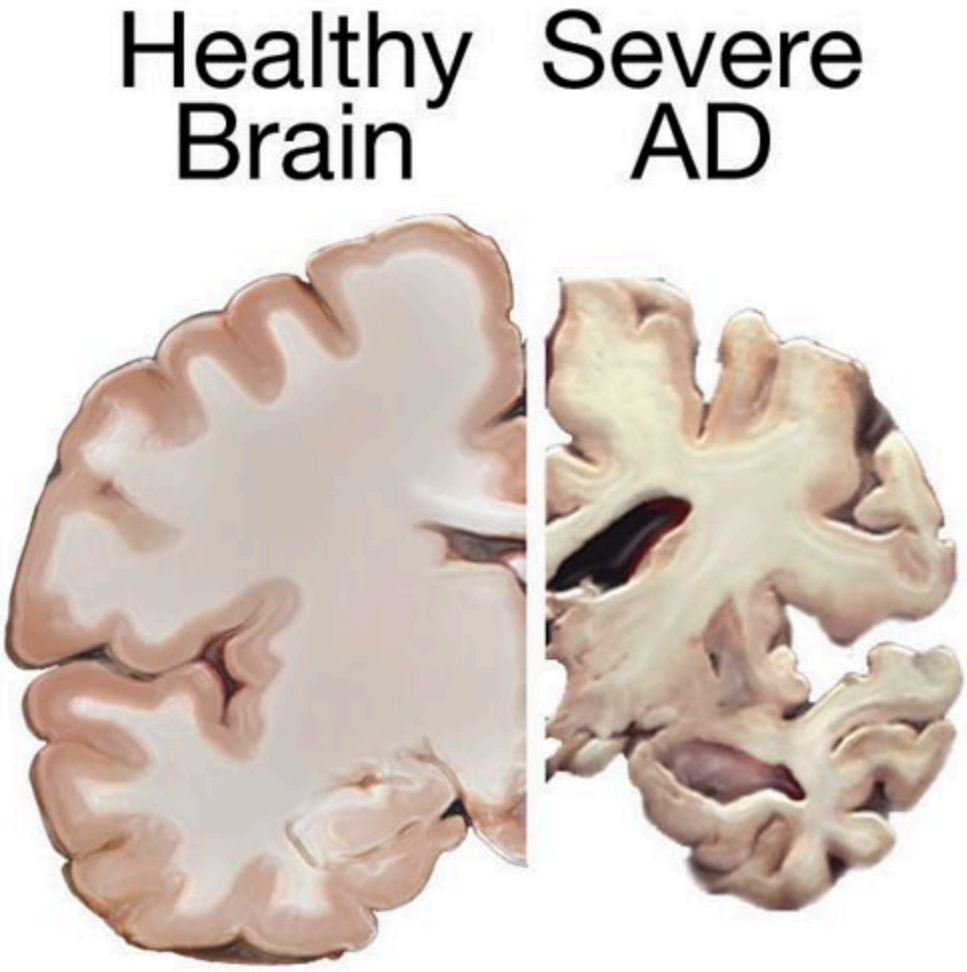


Figure 9.13 Comparison of a Normal Brain (left) and a Brain With Severe Alzheimer's Disease (right)

The hallmark microscopic changes of AD consist of neurofibrillary tangles and neuritic plaques. Neurofibrillary tangles consist of fibrous tissue that impair the transmission of impulses from neuron to neuron. Neuronal transmission is further hindered by neuritic plaques, composed of abnormal proteins called beta amyloid and tau, that damage the neurons. See Figure 9.14[5] for an illustration of neurodegeneration caused by these abnormal proteins.

5. "TANGLES_HIGH.jpg" by ADEAR: "Alzheimer's Disease Education and Referral Center, a service of the National Institute on Aging" is licensed in the Public Domain.

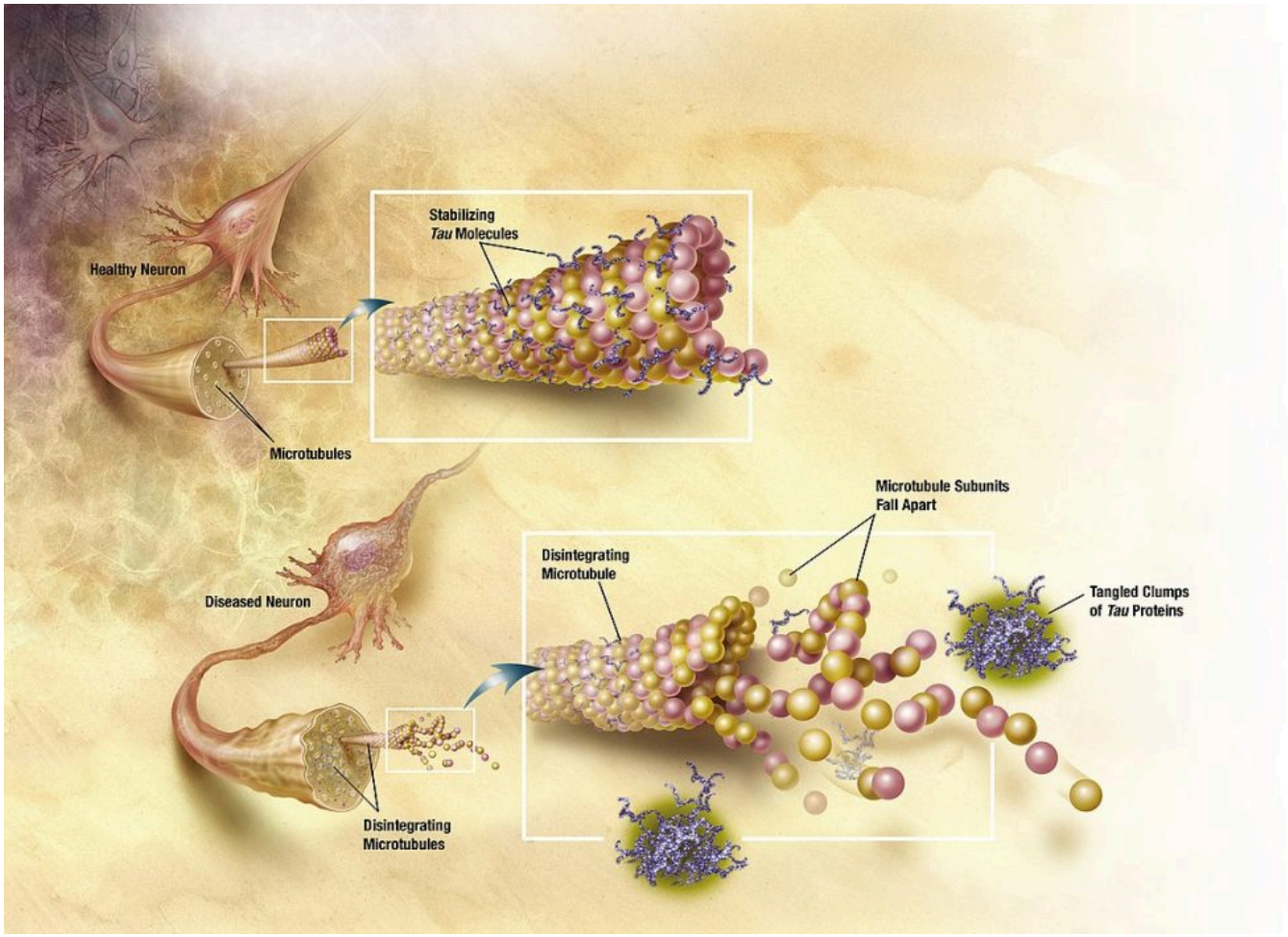


Figure 9.14 Abnormal Proteins Causing Neurodegeneration

Initial neuron damage occurs in the parts of the brain responsible for memory, language, and thinking, so initial symptoms of Alzheimer's disease are short-term memory loss and language and thinking problems. Brain changes that cause these symptoms are thought to begin 20 years or more before symptoms start.[6]

Imbalanced neurotransmitter levels are also associated with Alzheimer's disease. For example, decreased levels of acetylcholine (ACh), norepinephrine, dopamine, and serotonin can further contribute to impaired cognition, loss of short-term/recent memory, and ability to retain new memories.

6. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

Risk Factors

The cause of Alzheimer's disease is not certain. However, age, gender, and genetics are three major risk factors linked to AD, with increasing age being the greatest risk factor. The percentage of people with AD increases dramatically with age, with 33% of people aged 85 or older having AD. Females over 65 years old are more likely to develop AD than men, and having a first-degree relative with AD also increases one's risk. There is also an increased incidence of AD in people who have Down's syndrome. Certain medications are associated with higher risk for AD, including benzodiazepines, anticholinergics, and long-term use of proton pump inhibitors.[7,8] Other risk factors may also play a role, such as exposures to toxic chemicals and immunological changes.[9,10]

Although age, gender, and genetics cannot be changed, some risk factors can be modified to reduce the risk of cognitive decline and dementia. Examples of modifiable risk factors are participating in physical activity, stopping smoking, staying socially and mentally active, maintaining blood pressure in a normal range, and following a healthy diet.[11]

7. Harvard Health Publishing. (2021). *Two types of drugs you may want to avoid for the sake of your brain*. https://www.health.harvard.edu/mind-and-mood/two-types-of-drugs-you-may-want-to-avoid-for-the-sake-of-your-brain

8. Jaynes, M., & Kumar, A. B. (2018). The risks of long-term use of proton pump inhibitors: A critical review. *Therapeutic Advances in Drug Safety*. https://doi.org/10.1177/2042098618809927

9. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

10. Alzheimer's Association. (n.d.). *New IDEAS study*. https://www.alz.org/research/new-ideas-study

11. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

Some research also indicates that additional years of formal education builds cognitive reserve. **Cognitive reserve** refers to the brain's ability to make flexible and efficient use of networks of neuron-to-neuron connections that enable a person to continue to carry out cognitive tasks despite degenerative brain changes. In addition to years of formal education, having a mentally stimulating job and engaging in other mentally stimulating activities may also help build cognitive reserve.[12]

Research on the impact of ethnicity finds a lower incidence of dementia in African Americans, but those diagnosed with dementia showed greater cognitive deficits, neuropsychiatric symptoms, severity of symptoms, and functional dependence.[13]

Evidence indicates that even mild traumatic brain injury (TBI) increases the risk of developing certain forms of dementia. A recent meta-analysis estimates that any form of TBI increases the risk for dementia by nearly 70%. Post-traumatic stress disorder (PTSD) also increases the risk of dementia and is two to five times more common in veterans compared with the general population.[14]

A recent nationwide research study called New IDEAS (Imaging Dementia—Evidence for Amyloid Scanning) is looking for better ways to diagnose and care for people from diverse backgrounds who are experiencing changes in their memory, including mild cognitive impairment

12. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

13. Lennon, J. C., Aita, S. L., Bene V. A. D., Rhoads, T., Resch, Z. J., Eloi, J. M., & Walker, K. A. (2021). Black and White individuals differ in dementia prevalence, risk factors, and symptomatic presentation. *Alzheimer's & Dementia*. *18*(8), 1461-1471. https://doi.org/10.1002/alz.12509

14. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

and dementia.[15] The goal of the New IDEAS study is to ensure that its results represent all racial and ethnic groups. As new treatments are being developed, the research hopes to provide information for safe and effective care for everyone, regardless of race, ethnicity, age, or gender.[16]

- Read additional information in the 2023 Alzheimer's Disease Facts and Figures PDF by the Alzheimer's Association.
- Read about the Alzheimer's Association's New IDEAS Study.

Stages of Alzheimer's Disease

The initial presenting symptom of AD is impaired short-term memory although long-term memory remains intact. Impaired short-term memory is followed by impaired problem-solving, judgment, executive functioning, motivation, and organization, leading to problems with multitasking and abstract thinking.

Alzheimer's disease is classified into these different states based on the degree of cognitive impairment: mild, moderate, and severe[17]:

- **Mild:** Most people with mild AD are able to function independently but require assistance with some activities to maximize their independence and remain safe. Handling finances and paying bills may be especially

15. Alzheimer's Association. (n.d.). *New IDEAS study.* https://www.alz.org/research/new-ideas-study
16. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease.* https://portal.alzimpact.org/media/serve/id/5b219da2644f5
17. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease.* https://portal.alzimpact.org/media/serve/id/5b219da2644f5

challenging, and they may need more time to complete common daily tasks. They may still be able to drive, work, and participate in their favorite activities.

- **Moderate:** Individuals with moderate AD experience additional problems with memory and language, are more likely to become confused, and find it harder to complete multistep tasks such as bathing and dressing. They may wander, become incontinent, and have difficulty sleeping. Personality and behavioral changes may occur, including suspiciousness, agitation, and depression. They may experience increased confusion at night or when lighting is inadequate, referred to as **sundowning**. They may also begin to have difficulty recognizing loved ones.
- **Severe:** The ability to verbally communicate becomes greatly diminished in people with severe AD, and individuals are likely to require around-the-clock care. Because areas of the brain involved in movement become damaged, individuals become bed bound. Being bed-bound makes them vulnerable to additional medical complications resulting from immobility, including blood clots, pressure injuries, skin infections, and sepsis. Damage to areas of the brain that control swallowing causes dysphagia and can result in aspiration pneumonia, a contributing cause of death among many individuals with AD.

The symptoms of Alzheimer's disease worsen over time. On average a person with Alzheimer's disease lives four to eight years after diagnosis, but depending on variable factors, they may live as long as 20 years.

Assessment

Obtaining a thorough health history and physical assessment is important to distinguish AD from other forms of dementia and acute confusion, referred to as delirium. Interviewing family members or significant others may be necessary because clients with dementia may be unaware of their symptoms. Assessment should include the onset, duration, progression, and course of symptoms, as well as a complete functional status assessment.

Neuropsychological Tests

Neurologists or psychologists may administer several types of neuropsychological tests to determine the extent of the impaired cognition and to measure changes over time. The type of test used is based on the ability of the client.[18]

A common neuropsychological test is the **Mini Mental State Exam (MMSE)**. The MMSE assesses five major cognitive areas, including orientation, registration, attention and calculation, recall, and speech-language-reading.

The MMSE test requires the ability to read. For clients who are unable to read, a test called the set test may be used. In the **set test**, the client is asked to name ten items in each of four sets: fruits, animals, colors, and twins. The client receives one point for each item out of 40 possible points. A score above 25 indicates the client does not have dementia.

> View an example MMSE test: The Mini Mental State Examination (MMSE) PDF.

Another cognitive screening tool that does not require the ability to read is the **clock drawing test**. The client is provided with a piece of paper with a pre-drawn circle approximately 10 cm in diameter and told that the circle represents the face of a clock. The person is asked to write numbers within the circle so that it looks like a clock and then add arms to the clock to show a desired time, such as "ten minutes after eleven." See Figure 9.15[19] for an

18. Kumar, A., Sidhu, J., Lui, F., et al. (2024). *Alzheimer Disease (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568805/

19. "Superior-pattern-processing-is-the-essence-of-the-evolved-human-brain-fnins-08-00265-g0004.jpg" by Mattson M is licensed under CC BY 3.0

illustration of the clock drawing test with results from clients with different states of AD.

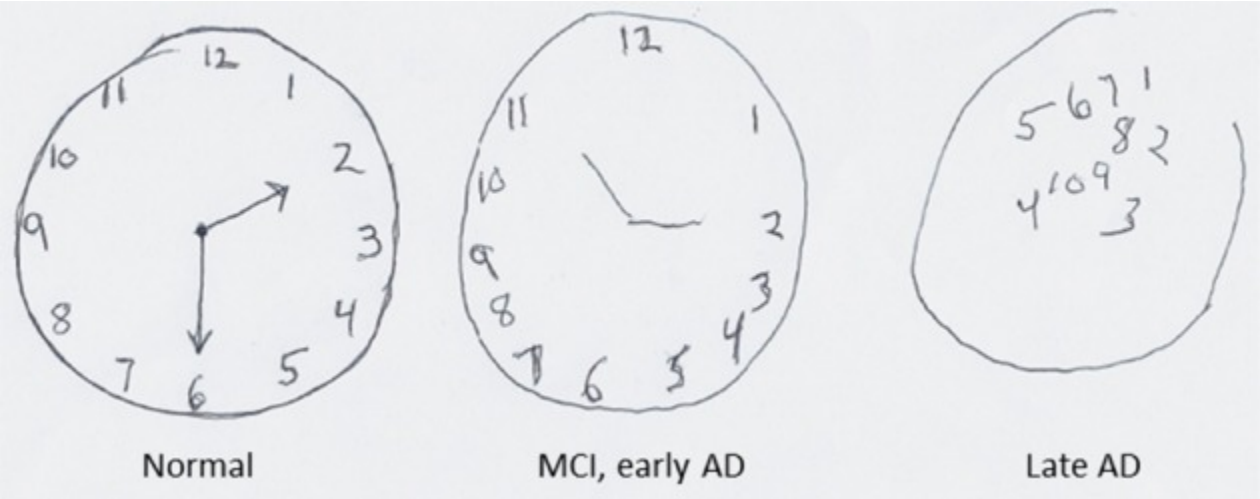


Figure 9.15 Example of a Clock Drawing Test

Laboratory and Diagnostic Tests

A definitive diagnosis of Alzheimer's disease can only be made by autopsy and examination of brain tissue showing the presence of neurofibrillary tangles and neuritic plaques. However, recent progress has been made in measuring these brain changes with diagnostic tests. For example, abnormal levels of beta-amyloid and tau can be measured in cerebrospinal fluid (CSF), and positron emission tomography (PET) can produce images showing where beta-amyloid and tau have accumulated in the brain.[20,21] See Figure 9.16[22] for

20. Lennon, J. C., Aita, S. L., Bene V. A. D., Rhoads, T., Resch, Z. J., Eloi, J. M., & Walker, K. A. (2021). Black and White individuals differ in dementia prevalence, risk factors, and symptomatic presentation. *Alzheimer's & Dementia. 18*(8), 1461-1471. https://doi.org/10.1002/alz.12509

21. Alzheimer's Association. (2024). *Veterans and Alzheimer's disease*. https://portal.alzimpact.org/media/serve/id/5b219da2644f5

22. "PET_Alzheimer.jpg" by US National Institute on Aging, Alzheimer's Disease Education and Referral Center is licensed in the Public Domain.

an image of a PET scan of a person with Alzheimer's disease showing loss of function in the temporal lobe.

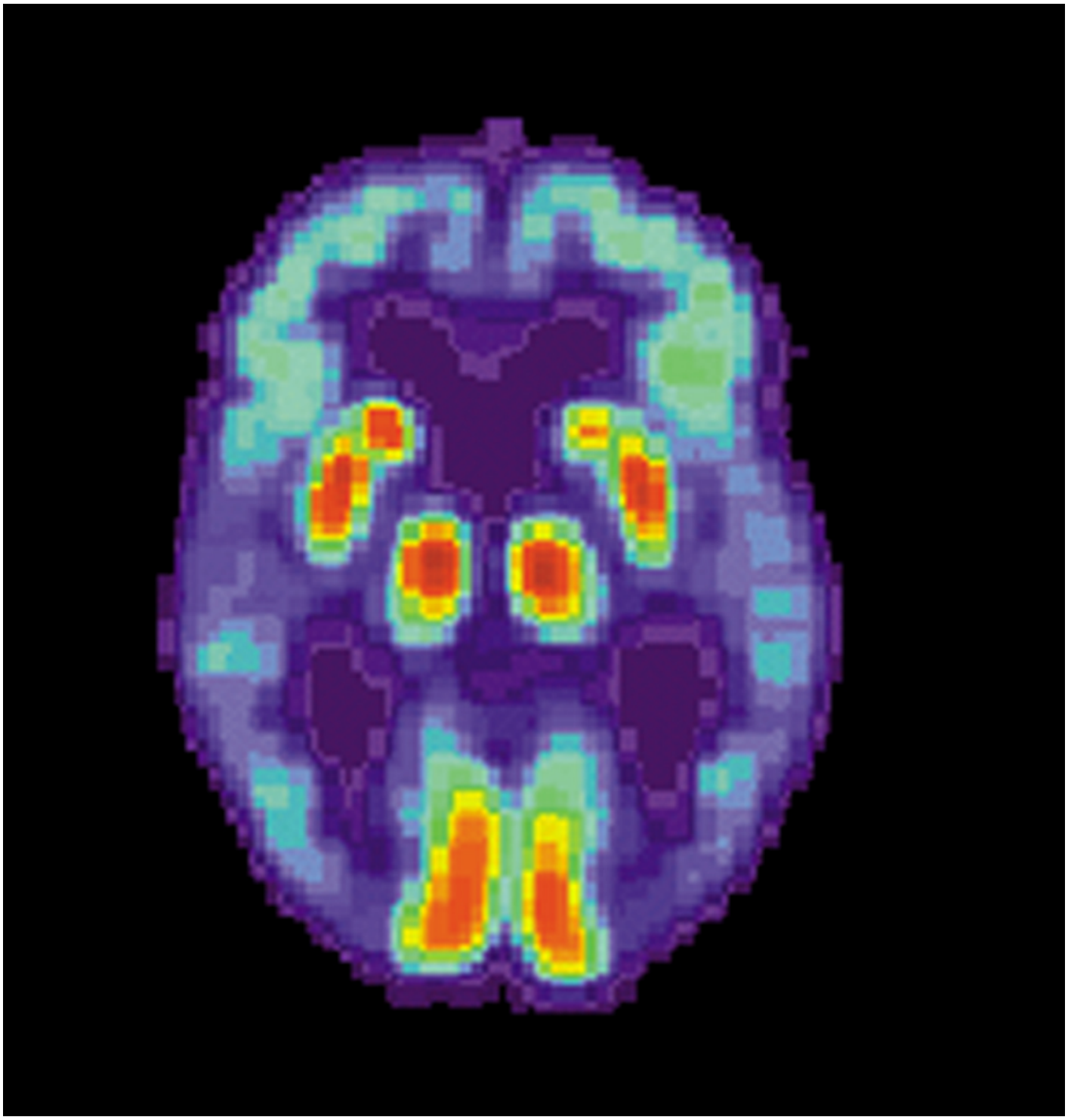


Figure 9.17 PET Scan of a Brain with Alzheimer's Disease

BLOOD TESTS

Vitamin B12 and thyroid hormone blood tests are often performed to rule out

other causes of cognitive impairment. Liver function blood levels may also be performed to rule out encephalopathy caused by liver disease.

Nursing Diagnoses

Common nursing diagnoses for clients with AD include the following[23]:

- Disturbed Thought Process
- Chronic Confusion
- Impaired Memory
- Risk for Falls
- Risk for Injury
- Impaired Verbal Communication
- Anxiety
- Chronic Sorrow
- Self-Care Deficit: Bathing
- Self-Care Deficit: Dressing
- Self-Care Deficit: Feeding
- Impaired Physical Mobility
- Disturbed Sleep Pattern
- Social Isolation
- Caregiver Role Strain

Outcome Identification

The overall goal for clients with Alzheimer's disease is to maintain a safe environment due to cognitive impairment with a high risk for falls and injury. Other goals include promoting independence in self-care activities, reducing anxiety and agitation, improving communication and socialization, promoting adequate nutrition and sleep, and providing caregiver support.

Sample outcome criteria include the following:

23. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

- *The client will maintain optimal memory and cognitive function for as long as possible to maintain their quality of life.*
- *The client will remain free from injury and accidents at home by providing a safe environment.*
- *The client will maintain adequate nutritional intake to support general health and well-being.*
- *The client will engage in social activities to promote effective coping with chronic illness.*
- *Caregivers will identify three stress-reduction techniques after a teaching session.*

Interventions

Medical Interventions

Although there is no cure for AD, there are treatment options available that may slow the progression of the disease and manage common symptoms. Collaboration with occupational and physical therapists can help the client retain general strength and remain as independent as possible with performing their activities of daily living. Incorporating adaptive devices such as walkers, grab bars, commodes, and eating utensils can assist clients to maintain as much independence as possible with toileting, bathing, ambulating, and eating. Referrals to dieticians or nutritionists can also help modify their diet with nutritional supplements to support optimal physiological health.

MEDICATION THERAPY

There are two types of medication classes used to treat Alzheimer's disease: those that slow disease progression by targeting the underlying biology of the disease and those that help manage symptoms of the disease.

- Amyloid-targeting agents work by attaching to and removing beta-amyloid, the protein that accumulates into plaques. Different medications work differently at different stages of plaque development, but they all

work best during the early stages of the disease, providing clients more time to participate in daily life activities independently.

- Cholinesterase inhibitors treat symptoms related to memory, thinking, language, judgment, and other thought processes. They prevent the breakdown of acetylcholine and support communication between nerve cells.
- Glutamate regulators improve memory, attention, reasoning, language, and ability to perform simple tasks. The medications work by regulating the activity of glutamate, which assists in helping the brain process information.
- Orexin receptor antagonists are approved to treat symptoms of insomnia associated with AD. This medication inhibits the activity of orexin, a neurotransmitter involved in the sleep-wake cycle.
- Psychotropic drugs are reserved for clients with AD who have dementia psychosis. These drugs are considered chemical restraints because they decrease mobility and the client's self-management ability. For example, atypical antipsychotics such as risperidone and olanzapine and anticonvulsants such as carbamazepine and valproic acid may be prescribed for severe aggressive agitation. Agency policy and The Joint Commission's safety standards should be followed concerning the use of these chemical restraints.

Medications used to treat Alzheimer's disease are summarized in Table 9.5a and Table 9.5b.[24]

Table 9.5a. Medications That Slow the Progression of the Disease

Medications	Side Effects	Nursing Considerations
Amyloid-targeting Agents Aducanumab Lecanemab	Temporary swelling in the brain, headaches, dizziness, nausea, vision changes, and falls.	People with genetic risk factors are at higher risk for brain swelling and should be screened prior to its use.

24. Alzheimer's Association. (n.d.). *Medications for memory, cognition, and dementia-related behaviors*. https://www.alz.org/alzheimers-dementia/treatments/medications-for-memory

Table 9.5b. Medications to Treat Symptoms

Medications	Side Effects	Nursing Considerations
Cognitive Symptoms Cholinesterase Inhibitors Donepezil (approved for all stages of AD) Rivastigmine and Galantamine (approved for mild to moderate AD)	Generally well-tolerated. Common side effects include nausea, vomiting, loss of appetite, and increased frequency of bowel movements. May cause bradycardia.	Monitor heart rate and for dizziness. Use cautiously in clients with heart disease.
Cognitive Symptoms Glutamate Regulators Memantine	Side effects include headache, confusion, dizziness, and constipation.	Implement fall precautions and a bowel management program as indicated.
Sleep Symptoms Orexin Receptor Antagonists Suvorexant	Risk for impaired alertness and motor coordination, worsening of depression or suicidal thinking, sleep paralysis, and compromised respiratory function.	Monitor for suicidal ideation and respiratory distress.
Psychosis Symptoms: Severe Aggressive Agitation Atypical Antipsychotics: Risperidone and Olanzapine Anticonvulsants: Carbamazepine and Valproic acid	Decrease mobility and the client's self-management ability.	Considered chemical restraints; follow agency policy and The Joint Commission's safety standards.

- Read more information about donepezil in the "Acetylcholinesterase Inhibitors" section of the "Autonomic Nervous System" chapter of Open RN *Nursing Pharmacology, 2e*.
- Read more information about "Antipsychotics" and

"Anticonvulsants" in the "Central Nervous System" chapter of Open RN *Nursing Pharmacology, 2e*.

ALTERNATIVE TREATMENTS

In the United States there are many non-FDA approved herbal remedies and dietary supplements advertised to delay or prevent AD. Although eating a healthy diet may lower the risk of cognitive decline and dementia, there are no proven supplements or foods that prevent or treat the disease. As with all supplements, the health care provider should be aware of their use to prevent side effects or interactions with prescribed medications.

Nursing Interventions

Nursing interventions for clients with AD focus on maintaining safety, optimal functioning, and independence in self-care activities for as long as possible. Depending on the symptoms and stage(s) the client is experiencing, interventions are tailored to the client's situational needs. Other interventions include providing cognitive and memory therapy, reducing anxiety and agitation, improving communication, promoting adequate nutrition, supporting bowel/bladder continence, balancing rest and activity, and educating/supporting family caregivers.

Many factors, including physical illness and environmental variables, can exacerbate or worsen the manifestations of AD. Clients with AD typically have other health problems such as renal disorders, arthritis, cardiovascular disease, and pulmonary conditions, as well as changes with hearing and vision. Managing these other problems as part of the nursing plan of care can improve the client's functional ability. See Table 9.5c for a summary of nursing interventions for clients with AD.

Table 9.5c. Nursing Interventions for Clients with Alzheimer's Disease

Manage Cognitive Dysfunction

- Use redirection or distraction to calm an agitated client, such as providing snacks, taking a car ride, sitting on a porch swing or rocker, listening to favorite music, watching videotapes, looking at family photographs, or walking. Repetitive activities, music, massage, aromas, or favorite objects can also be soothing to clients.
- Ask a family member to stay with the client to help calm them.
- Minimize environmental distractions and noise.
- Ensure prescribed glasses and hearing aids are worn.
- Maintain daily structure and routine. Explain changes in routine before it occurs and remind the client right before change occurs.
- Clocks and single-date calendars may be helpful for clients who are still oriented to time.
- Place daily outfits on hangers so the client can choose which outfit to wear.
- Use a calm voice and demeanor.
- Use reminiscence therapy while assisting the client with ADLs or other treatment. For example, refer to photographs or personal items in the room and encourage the client to talk about long-term memories.
- Avoid pictures of animals or decorations that could be misinterpreted as harmful.
- Assist the family to inquire and seek legal counsel for guardianship or durable medical and financial power of attorney.
- In severe dementia, use validation therapy and acknowledge the client's feelings and concerns rather than reality orientation, which does not work and can increase agitation. However, do not reinforce the situational belief. For example, if a client is looking for their father, ask what the father looks like but avoid encouraging the belief that their father is living.
- Clients with severe dementia require 24-hour supervision and total assistance with ADLs.

Prevent Injuries or Falls

- Keep the environment free of clutter and fall hazards.
- Maintain adequate lighting.
- Avoid stairs in a home environment.
- Encourage the caregiver to obtain an identification bracelet labeled with primary contact information for clients living in the community.
- Redirect the client if they want to do harmful activities.
- If the client tends to wander, encourage frequent supervised walks or participation in activities such as games, music, or art appropriate to their condition.
- If bedbound, reposition the client as needed and at least every one to two hours to prevent skin breakdown.
- If the client experiences seizures, implement seizure precautions and monitor for seizure activity.

Manage Incontinence

- Offer toileting every one to two hours to prevent incontinence.
- If incontinent, perform incontinence checks and pericare every one to two hours to prevent skin breakdown.

Promote Nutrition

- Encourage the client to select meal choices and snacks independently.
- Encourage finger foods for ease of handling.
- Maintain a pleasant mealtime without distress.
- Cut food into small pieces to avoid choking, if necessary.
- Thicken liquids, if needed.
- Provide adaptive utensils as needed.
- Assist with feeding as indicated.

Balance Activity and Rest

• Encourage daily physical activity to promote healthy sleep. • Provide scheduled exercise or active or passive range-of-motion exercise, depending upon the stage of the disease. • Discourage long periods of daytime sleeping because it interrupts sleep patterns.
Promote Communication
• Provide reminders or instructions with pictures and place them in an area where the client can see and read them. • Use simple one-step directions; demonstrate the task if necessary. • Provide choices but limit the number of choices because too many choices can overwhelm and frustrate the client. • If the client has limited ability to communicate, use direct questioning that requires a "Yes" or "No" answer. Anticipate the client's needs and interpret nonverbals as much as possible.

When clients with Alzheimer's disease are hospitalized, the unfamiliar surroundings and routine can worsen their confusion, resulting in combative behaviors. See the following box for specific nursing interventions for hospitalized clients with AD.

Nursing Interventions in Acute Care Settings for Clients with Alzheimer's Disease[25]

25. Quality and Safety Education for Nurses. (2023). *Geriatrics*. https://www.qsen.org/post/geriatrics

- Place the client in an area that allows for maximum observation.
- Provide appropriate supervision with frequent vision checks, especially during shift change.
- Use family members, friends, volunteers, or hospital sitters as needed for agitation.
- Identify clients who are most at risk for wandering upon admission.
- Avoid changing rooms to prevent increased confusion.
- Assess and treat for pain; use the PAINAD scale as appropriate.
- Keep the client away from stairs and elevators.
- Use reorientation or validation therapy as appropriate.
- Provide frequent toileting and incontinence care.
- Use bed and/or chair alarms and video monitoring, as available.
- Prevent overstimulation, excessive noise, and uninterrupted sleep as much as possible.
- Use soft music and nonglare lighting if possible.
- Avoid physical and/or chemical restraints.

Read more about the PAINAD scale at MD Calc's Pain Assessment in Advanced Dementia Scale (PAINAD) web page.

HEALTH TEACHING

In early stages of AD, the client may be cared for at home by family members with little necessity for external interventions. However, a referral to a case manager should be made soon after the diagnosis. The case manager performs a need assessment and helps provide health care resources throughout the continuum of care as the disease progresses.

Family caregivers who provide care for loved ones with moderate to severe AD can experience stress and burnout that can affect their personal health.

See the following box for health promotion strategies and teaching tips for caregivers.

Strategies to Reduce Family Member/Caregiver Stress[26]

- Develop and maintain realistic expectations for oneself and the loved one with Alzheimer's disease.
- Use resources from the Alzheimer's Association, including support groups or the toll-free hotline.
- Explore options for alternative health care settings early in the disease process for possible use later.
- Early in the disease process, establish advance directives for the client.
- Set aside time each day for rest away from the person with AD, if possible.
- Engage in self-care activities such as leisure time, hobbies, exercise, and relaxation techniques.
- Try to find positive aspects of the situation daily.
- Seek respite care.
- Seek out pastoral care or spiritual counseling, as desired.

- Review caregiver resources available at the Alzheimer's Association's website.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by

26. Tadi, P., Lui, F., Budd, L. A. (2023). *Acute Stroke (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568693/

reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.



RN Recap: Alzheimer's Disease

View a brief YouTube video overview of Alzheimer's disease[27]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3470#oembed-1

27. Open RN Project. (2024, June 23). *Health Alterations – Chapter 9 – Alzheimer's disease* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/mujU7yyBhDM?si=Kz1-5gqecsv0TmmF

9.6 Parkinson's Disease

Parkinson's disease (PD) is a common, progressive neurological movement disorder of older adults that eventually leads to disability. Parkinson's disease can be divided into five stages:

- **Stage 1 (Initial):** Unilateral limb involvement, hand and arm trembling, and mild weakness
- **Stage 2 (Mild Stage):** Bilateral limb involvement, resting tremor, **bradykinesia** (slow, shuffling gait), and mask-like facial expression
- **Stage 3 (Moderate):** Postural instability, increased gait irregularities, and pill-rolling tremor
- **Stage 4 (Severe): Akinesia** (the inability to voluntarily move muscles) and rigidity
- **Stage 5 (Total Dependence):** Total reliance on caregivers for ADLs

Pathophysiology

Parkinson's disease is associated with decreased levels of dopamine. In normal brain activity, the excitatory neurotransmitter acetylcholine and the inhibitory neurotransmitter dopamine relay messages to the motor centers in the brain where control of motor movement occurs. When these neurotransmitters are balanced, there is refined and coordinated movement, such as picking up a pencil and writing. However, decreased dopamine levels cause an imbalance with the excitatory neurotransmitter acetylcholine, affecting voluntary movement. The clinical symptoms of PD typically do not appear until dopamine levels decrease by 80%. The loss of dopamine also reduces the sympathetic nervous system stimulation of the heart and blood vessels, which can result in orthostatic hypotension, drooling, nocturia, and other autonomic symptoms.

RISK FACTORS

The cause of Parkinson's disease is not known, but risk factors include genetic predisposition, viral infections, atherosclerosis, head trauma, long-term use of antipsychotic medications, and environmental exposures. PD is typically diagnosed in clients in their sixties or seventies, but in some cases it can occur as early as 30 years of age. PD tends to affect more men than women, and there is increased risk with family history in first-degree relatives.

Health Disparities Related to Parkinson Disease

A recent study identified crucial gaps in care for people diagnosed with Parkinson's disease in the United States. The greatest disparities in care occur in women, people of color (those who identify as Asian, Black, Hispanic and Native American), and residents of rural areas. These disparities include lack of access to movement disorder specialists (expertly trained neurologists who can tailor treatments to each client), treatment of associated depression from mental health professionals, and access to supplemental therapies such as physical and occupational therapy, speech-language therapy, and mental health services.[1]

Assessment

PD typically has a gradual onset with progression of symptoms. Four primary symptoms of PD include the following[2]:

1. Parkinson's Foundation. (2023). *New Medicare study finds critical gaps and disparities in access to Parkinson's care*. https://www.parkinson.org/blog/awareness/care-access-disparities

2. National Institute of Neurological Disorders and Stroke. (n.d.). *Parkinson's disease*. https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

- Resting tremor
- Muscle rigidity
- Bradykinesia or akinesia
- Postural instability

Although PD is not a form of dementia, cognitive changes can occur later in the disease process, such as dementia or psychosis.

The most common reason people initially seek medical care is due to a **resting tremor**. Resting tremors disappear with purposeful, voluntary movement, but become apparent when the person's extremities are motionless. Eventually, the tremor becomes a repetitive, constant, slow-turning motion between the forearm, hand, and thumb, commonly known as **pill-rolling**, as if the person is rolling a pill between the fingers. The pill-rolling tremor is present at rest and often increases as the client walks, concentrates, or experiences anxiety.[3]

View a supplementary YouTube video[4] on pill rolling: Pill Rolling Resting Tremor | Parkinson Disease.

Muscle rigidity refers to resistance to passive limb movement. Cogwheel rigidity is seen frequently with PD, characterized by a jerky rhythmic tone on passive muscle stretching. The muscles remain constantly tense and contracted so that the person may feel achy and stiff. The rigidity becomes

3. National Institute of Neurological Disorders and Stroke. (n.d.). *Parkinson's disease*. https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

4. Extensive Medicine. (2023, December 19). *Pill rolling resting tremor | Parkinson disease*. [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=7Q1G3llwAPs

evident when another person tries to move the individual's arm, which will move only in short, jerky movements. Muscle rigidity is present early in the disease and progresses over time, causing the client to require assistance with ADLs and ambulation. The facial muscles may also experience muscle rigidity, causing a mask-like appearance with wide-open, fixed, staring eyes. In later stages of PD, muscle rigidity can lead to difficulty with chewing and swallowing as the pharyngeal muscles become involved, placing the client at risk for aspiration and malnutrition. Uncontrolled changes in speech patterns are also common symptoms. Clients may speak very softly, slur or repeat words, hesitate before speaking, project a monotone voice, or exhibit a rapid speech pattern.[5]

Bradykinesia refers to slowness of initiation of movement, and akinesia refers to a lack of voluntary movement. For example, clients may have difficulty initiating movements, such as rising from a chair to stand.[6]

Postural disturbances become apparent as loss of reflexes occur. A client with PD typically stands with their head bent forward and walks with a propulsive gait. This characteristic posture is caused by the forward flexion of the neck, hips, knees, and elbows. They tend to compensate for this postural disturbance by moving their feet forward under the body's center of gravity, referred to as **shuffling gait**. Clients with PD are at high risk for falls due to

5. National Institute of Neurological Disorders and Stroke. (n.d.). *Parkinson's disease*. https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

6. National Institute of Neurological Disorders and Stroke. (n.d.). *Parkinson's disease*. https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

this postural disturbance and lack of balance.[7] See Figure 9.17[8] for illustrations of postural disturbances of clients with various stages of PD.

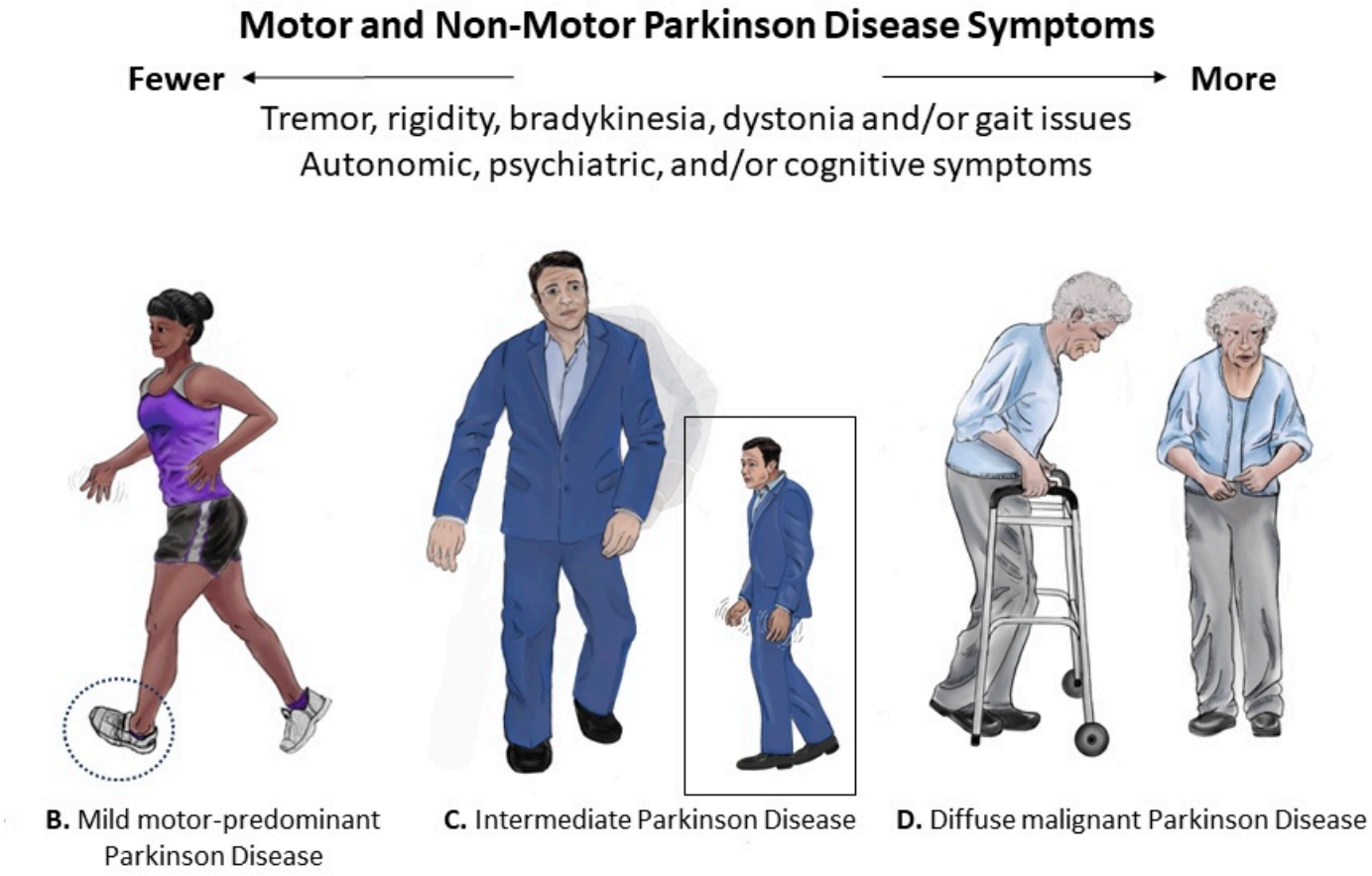


Figure 9.17 Common Postures Associated With the Stages of Parkinson's Disease

7. National Institute of Neurological Disorders and Stroke. (n.d.). *Parkinson's disease*. https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

8. "Modern_Parkinson%27s_Disease_Image_Cropped.jpg" by Erica Rodriguez (artist), Michael S. Okun (author), cropped by User:Dustfreeworld is in the Public Domain.

View an animation[9] of the characteristic gait of a person with Parkinson's disease: Abnormal Gait Exam: Parkinsonian Gait Demonstration.

In addition to the four classic symptoms of PD, autonomic symptoms such as excessive sweating, orthostatic hypotension, urinary retention, constipation, and sexual dysfunction may also occur. Mood and personality changes may occur, such as depression, psychosis, dementia, sleep disturbances, and auditory or visual hallucinations. Cognitive changes can also affect the judgment and decision-making of a person with PD. See Figure 9.18[10] for an illustration of motor and nonmotor impairments that may occur in clients with Parkinson's disease.

9. "Abnormal_Gait_Exam_Parkinsonian_Gait_Demonstration.gif" by unknown author, via MakeAGIF is in the Public Domain

10. "Bradykinesia" by Meredith Pomietlo is a derivative of "Parkinson_disease_symtpoms.png" by CarrotsMitHummus licensed under CC BY-SA 4.0

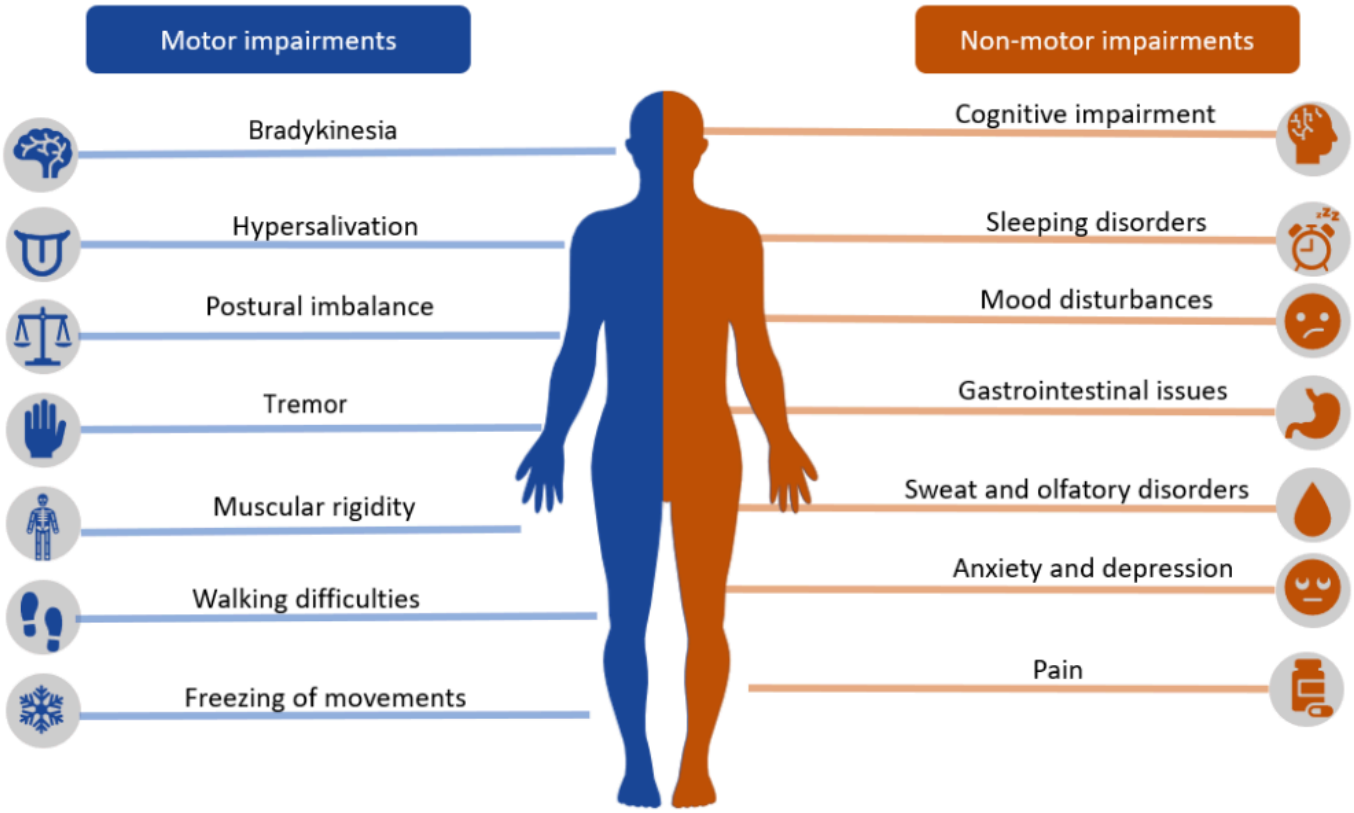


Figure 9.18 Motor and Non-motor Manifestations of Parkinson's Disease

Common Labs and Diagnostic Tests

There are no diagnostic tests that specifically diagnose Parkinson disease. Providers diagnose PD if the client has at least two of the four cardinal symptoms previously discussed. Other potential neurologic diseases are eliminated with the following tests:

- Blood tests may be ordered to rule out other disorders that may be causing the symptoms.
- Single photon emission computed tomography (SPECT) may be ordered to rule out other nervous system disorders. It can also detect a loss of dopamine-producing neurons.
- Analysis of cerebrospinal fluid may show a decrease in dopamine levels.
- Brain scans such as CTs and MRIs are performed to rule out other nervous system disorders.

Nursing Diagnoses

Priority nursing diagnoses for clients with PD focus on impaired mobility, cognitive function, communication, and gastrointestinal function. Common nursing diagnoses include the following[11]:

- Impaired Physical Mobility
- Impaired Swallowing
- Chronic Confusion
- Impaired Memory
- Activity Intolerance
- Impaired Verbal Communication
- Risk for Falls
- Constipation

Outcome Identification

Overall goals for clients with Parkinson's disease include improving mobility, functioning, and independence in performing ADLs; preventing falls and injury; promoting optimal bowel elimination; maintaining acceptable nutritional status; achieving effective communication and positive coping mechanisms; and teaching the client and their family on the disease process and self-care strategies to manage symptoms and improve the overall quality of life. Sample outcome criteria include the following:

- *The client will remain free of complications related to immobility.*
- *The client will maintain adequate nutritional intake with a BMI in the normal range.*
- *The client will not experience aspiration.*
- *The client will remain free of injuries.*
- *The client will use methods of communication to make needs known to*

11. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

caregivers after the teaching session.
- *The client will verbalize three strategies to effectively cope with chronic disease after the teaching session.*

Interventions

Medical Interventions

Because there is no cure for PD, medical management focuses on alleviating symptoms and improving the client's quality of life. Medical interventions are tailored to an individual's symptoms, disease severity, age, and lifestyle.

MEDICATION THERAPY

Medications are the most common medical intervention, with the goal to increase dopamine levels or mimic dopamine effects in the brain. Medications must be closely monitored to prevent long-term side effects and complications.

Levodopa is the most effective medication used to treat PD. Levodopa is converted to dopamine in the brain and provides some symptom relief. Levodopa is commonly prescribed in combination with carbidopa to maximize its benefits. These medications are most beneficial in the first few years of treatment. However, over time, their benefits begin to lessen, and side effects such as confusion, hallucinations, depression, and sleep disturbances can develop.

After approximately 5 to 10 years of chronic use, the client may develop undesirable side effects from these medications referred to as dyskinesia. **Dyskinesia** refers to abnormal involuntary movements such as facial grimacing, rhythmic jerking movements of hands, lip-smacking, and head bobbing. Clients on chronic medications are also at risk for drug tolerance, where therapeutic effects do not last as long as they did previously. Treatment of dyskinesia involves reducing the dose, changing the drug or frequency of administration, or requesting a drug holiday. During a drug holiday, the client does not receive any medication for PD for up to ten days. Additional medications such as baclofen for muscle spasms or sublingual

atropine for excessive drooling may be administered. During the drug holiday, the client is closely monitored for dyskinesia and PD symptoms, and the symptoms are documented.

Other medications prescribed for symptom relief include MAO-B inhibitors, anticholinergics, antivirals, dopamine agonists, COMT inhibitors, and antidepressants. See Table 9.6 for an overview of medications used to treat PD.

Table 9.6. Antiparkinson Medications[12]

12. National Institute of Neurological Disorders and Stroke. (n.d.). *Parkinson's disease*. https://www.ninds.nih.gov/health-information/disorders/parkinsons-disease

Medication	Nursing Considerations and Side Effects
Antiparkinson's Agent Carbidopa/Levodopa	Initial side effects of levodopa-carbidopa may include nausea, low blood pressure, restlessness, and drowsiness. Side effects of long-term or extended use of levodopa may include hallucinations, psychosis, and dyskinesia.
Anticholinergic Therapy Trihexyphenidyl Hydrochloride Benztropine Mesylate	Controls tremor and assists with drooling by counteracting the neurotransmitter acetylcholine. Typically, poorly tolerated in older adults. May increase intraocular pressure. Male clients with BPH are monitored for urinary retention.
Antiviral Therapy Amantadine Hydrochloride	Improves symptoms related to akinesia, and tremor. Usually well-tolerated, but side effects may include mood changes, confusion, depression, hallucinations, orthostatic hypotension, and headache.
Dopamine Agonists Bromocriptine Mesylate Pergolide Ropinirole Hydrochloride Pramipexole	Useful before initiating carbidopa or levodopa therapy or when added after carbidopa or levodopa lose their effectiveness. Adverse effects include lightheadedness, hypotension, diarrhea, and psychiatric effects.
Catechol-O-Methyltransferase (COMT) Inhibitors Entacapone Tolcapone	May increase duration of action when given in combination with carbidopa or levodopa. Block an enzyme that breaks down levodopa, making it more available to convert to dopamine in the brain.

Tricyclic Antidepressants Amitriptyline Hydrochloride	Used for the anticholinergic and antidepressant effects. Dosing is usually ⅓ to ½ the typical dose in clients with PD.
Selective Serotonin Reuptake Inhibitors (SSRIs) Fluoxetine Hydrochloride	Effective for treating depression but may aggravate symptoms of Parkinson's disease.
Atypical Antidepressants Bupropion Hydrochloride	Effective for treating depression but may aggravate symptoms of Parkinson's disease.
Monoamine Oxidase Inhibitors (MAOIs) Selegiline Rasagiline Zydis Selegiline HCL	Used in combination with a dopamine agonist to postpone the initiation of carbidopa or levodopa therapy. Adverse effects are similar to that of levodopa. Teach clients taking MAOIs to avoid foods, beverages, and drugs that contain tyramine, such as cheese; aged, smoked, or cured foods; and not to drink beer or red wine to prevent headache and life-threatening hypertension. If the drug is discontinued, follow restrictions for 14 days after the last dose.

PHYSICAL, OCCUPATIONAL, AND SPEECH THERAPY

Because shuffling gait, postural instability, and other muscle problems are major problems for clients with PD, collaboration with physical and occupational therapists is important in early stages of the disease. Physical therapists plan and implement programs to prevent falling and maintain flexibility and mobility through range-of-motion exercises, muscle stretching, and physical activity. Teaching clients how to safely use ambulatory assistive devices is also provided. Occupational therapists teach clients how to use adaptive devices, such as specialized eating utensils. These rehabilitation services encourage clients to participate as much as possible in their ADLs while ensuring the environment is safe.

Speech and language pathologists (SLP) help treat clients with speech and

swallowing difficulties. SLPs teach clients how to perform exercises to strengthen the muscles used for swallowing, speaking, and breathing. Depending on the client's level of functioning, the SLP develops a communication plan and assists with alternative methods of communication such as a communication board, mechanical voice synthesizer, computer, or handheld mobile device.

SURGICAL MANAGEMENT

Surgery may be performed when medications fail to provide symptom management. Common surgeries are stereotactic pallidotomy and deep brain stimulation. During stereotactic pallidotomy, a probe is placed in the globus pallidus portion of the brain, destroying specific tissue and creating scar tissue. The scar tissue interrupts the overactive nerve signal transmission, reducing the brain activity in that area and helping to treat rigidity and reducing tremor.[13]

Deep brain stimulation involves implanting electrodes in the brain that are attached to a pulse generator. The generator device is placed under the skin and delivers an electric current to decrease dyskinesias and reduce the need for dopamine precursor medications. See Figure 9.19[14] for an illustration of deep brain stimulation.

13. University of Washington Medicine – Neurological Surgery. (n.d.). *Stereotatic treatments for Parkinson's disease*. https://neurosurgery.uw.edu/patients-and-family/what-we-treat/treatments/stereotactic-treatments-parkinsons-disease

14. "Deep_brain_stimulation.jpg" by http://www.nimh.nih.gov/health/topics/brain-stimulation-therapies/brain-stimulation-therapies.shtml is in the Public Domain

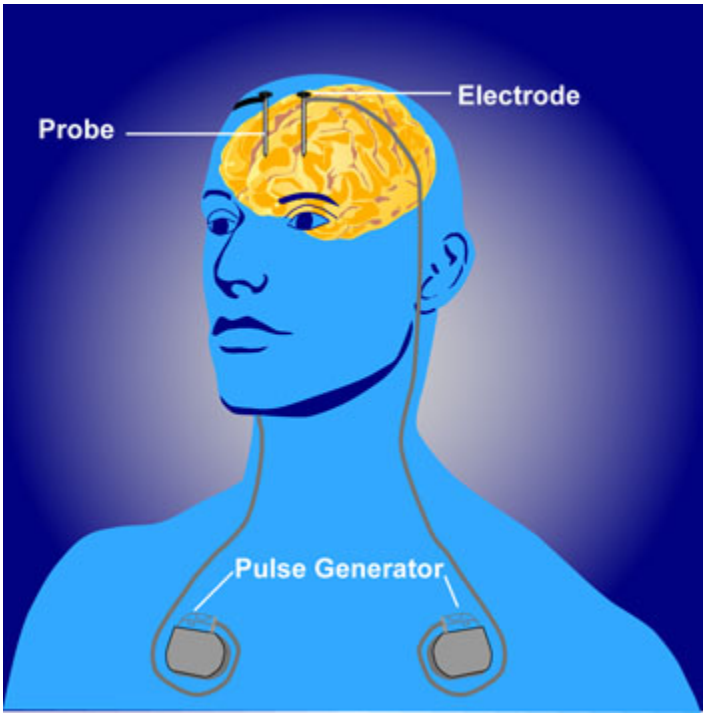


Figure 9.19 Deep Brain Stimulation Treatment

NUTRITIONAL MANAGEMENT

Consultation with a registered dietician or nutritionist is helpful to evaluate the client's food intake and their ability to swallow. If dysphagia is present, the SLP and dietician collaborate on the most appropriate diet for the client, such as a soft diet with thickened liquids or incorporation of supplement shakes. If the client is experiencing constipation, the dietician can also help adjust the diet.

Nursing Interventions

Nursing interventions follow a holistic approach when caring for clients with PD and play a crucial role in enhancing their quality of life. Interventions focus on enhancing mobility and self-care activities, improving communication, assisting with optimal nutrition intake, facilitating swallowing, and supporting effective coping strategies. Specific nursing interventions are summarized in the following box.

Nursing Interventions for Clients with Parkinson's Disease[15]

- Administer prescribed medications on schedule to maintain consistent therapeutic levels. Monitor for side effects, especially orthostatic hypotension, acute confusion, and hallucinations.
- Initiate fall precautions according to agency policy.
- Allow the client time to perform ADLs and provide assistance only as needed to promote independence.
- Implement interventions that prevent complications related to immobility such as pressure injuries, constipation, and contractures.
- Monitor the client's ability to chew and swallow, as well their food and fluid intake.
- Schedule appointments and activities late in morning or when clients are at their optimal levels of functioning to avoid rushing or fatigue.
- Collaborate with a dietician to provide nutritional, high-calorie foods to maintain strength and well-being.
- Allow the client extra time to respond to questions to promote effective communication. Encourage clients to speak slowly and clearly. Use alternative forms of communication, such as communication boards, as indicated by SLP.

15. Nunes, S. F. L., Alvarez, A. M., & Valcarenghi, R. V. (2022). Parkinson's disease in primary health care and nursing care: A scoping review. *Revista da Escola de Enfermagem da USP*. https://doi.org/10.1590/1980-220x-reeusp-2021-0367

- Collaborate with physical and occupational therapy to promote optimal mobility, physical activity, and independence in completing their ADLs.
- Focus on the client's strengths, recognizing that PD can lower one's self-esteem.
- Monitor for new signs of depression, anxiety, impaired cognition, insomnia, and sleep disturbances.

HEALTH TEACHING

Nurses provide health teaching to the client and their family members on the following topics:

- Instruct on safe medication administration and promptly report any adverse effects of medication, such as acute confusion and hallucinations.
- Teach how to prevent falls (remove rugs and clutter, use assistive devices).
- Teach the importance of focusing on the client's abilities and strengths and offer positive reinforcement when goals are met.
- Encourage the family and client to work collaboratively with the rehabilitation team to maintain optimal level of functioning.
- Provide education regarding symptom management, for example, increasing fluids and fiber for issues with constipation.
- Instruct on sleep enhancement such as avoidance of alcohol and caffeine, darkening lighting, and bedtime routine.
- Teach family, along with the dietician, about healthy and appropriate food choices to promote optimal nutrition.
- Encourage family and caregivers that many times the client cannot control symptoms of anxiety or depression and to seek assistance from health care providers, case managers, and support groups.
- Refer clients and family to local and national Parkinson's disease organizations to facilitate resources available for caregiver strain.

Caring for a client with PD can pose unique challenges for family members. It

is helpful to establish a case manager to ensure the psychosocial and physical needs are addressed. A case manager or social worker can also assist the family with financial and health insurance issues, as well as prepare for respite or long-term care.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.



RN Recap: Parkinson's Disease

View a brief YouTube video overview of Parkinson's disease[16]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3484#oembed-1

16. Open RN Project. (2024, June 23). *Health Alterations – Chapter 9 – Parkinson's disease* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/aeS6N_WwvEc?si=MLKhb_2M4Xl6Qpog

9.7 Seizures and Epilepsy

A **seizure** is abnormal transient discharges of neurons within the brain that are sudden, excessive, and uncontrolled. During a seizure, many neurons send signals at the same time, much faster than normal. This surge of excessive electrical activity may cause involuntary movements, sensations, emotions, and/or behaviors. The disturbance of normal nerve cell activity may cause a loss of awareness. Some people recover immediately after a seizure, while others may take minutes to hours to feel like themselves again. During this time, they may feel tired, sleepy, weak, or confused.[1]

Most seizures are idiopathic, with no known cause. Seizures can also be caused by other medical conditions, such as a brain tumor, high fever, or hyponatremia. **Epilepsy** is a chronic disorder that is defined by at least two unprovoked seizures occurring at least 24 hours apart and in which groups of nerve cells, or neurons, in the brain sometimes send the wrong signals and cause recurrent, unpredictable, and unprovoked seizures.

Status epilepticus refers to a seizure lasting more than five minutes or two more sequential seizures without full recovery of consciousness between the seizures. Seizures lasting more than five minutes damage neurons and are unlikely to end on their own, requiring immediate emergency medical care.[2]

Pathophysiology

Seizures are caused by an abnormality in electrical neuron activity, an imbalance of the neurotransmitter GABA, or a combination of both

1. National Institute of Neurological Disorders and Stroke. (n.d.). *Epilepsy and seizures*. https://www.ninds.nih.gov/health-information/disorders/epilepsy-and-seizures
2. National Institute of Neurological Disorders and Stroke. (n.d.). *Epilepsy and seizures*. https://www.ninds.nih.gov/health-information/disorders/epilepsy-and-seizures

conditions. When there is an imbalance between inhibition and excitatory conditions within the CNS, a seizure occurs.

View a supplementary YouTube video[3] on epilepsy from the Mayo Clinic: What is epilepsy? A Mayo Clinic expert explains.

Types of Seizures

Seizures are divided into three broad categories called partial (focal), generalized, and unclassified seizures. See an illustration of partial (focal) and generalized seizures in Figure 9.20.[4] Each of these categories will be further discussed in the following subsections.

3. Mayo Clinic. (2021, November 18). *What is epilepsy? A Mayo Clinic expert explains* [Video] YouTube. All rights reserved. https://www.youtube.com/watch?v=WjRIzsy97hk

4. "Informative poster of epilepsy" by brgfx, via Freepik is licensed under CC0

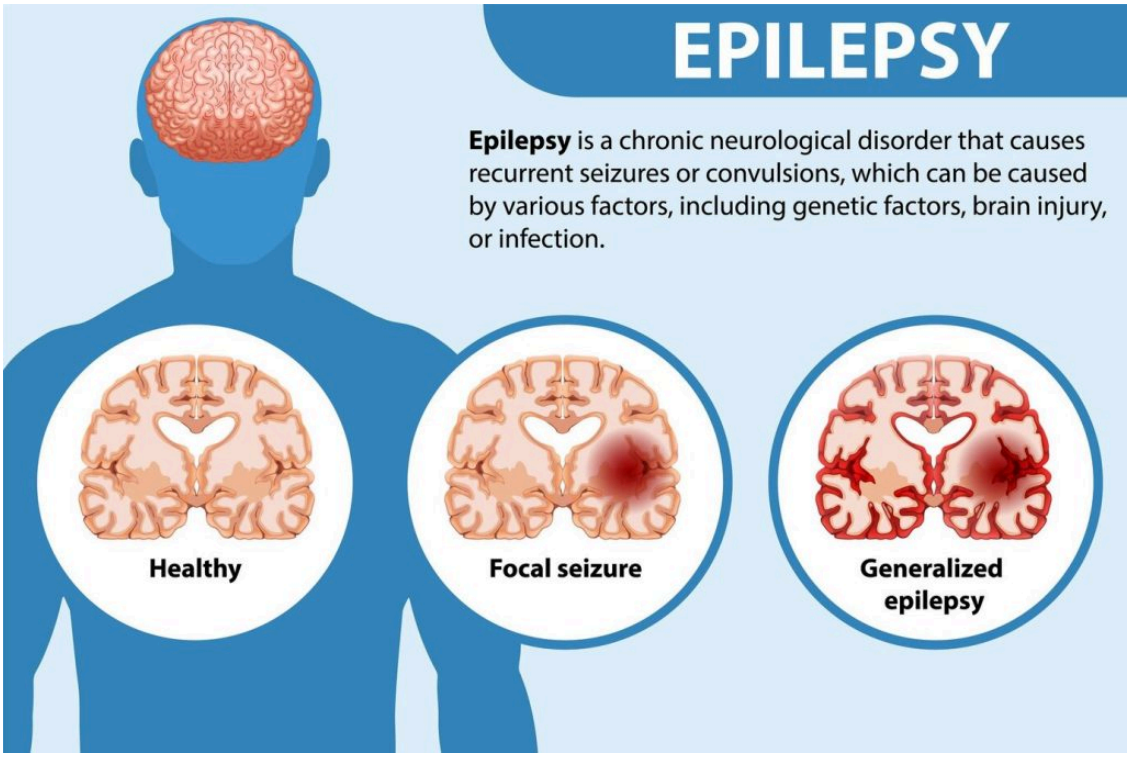


Figure 9.20 Partial (Focal) and Generalized Epilepsy

Partial Seizures

Partial seizures, also known as focal seizures, occur within one cerebral hemisphere of the brain. Partial seizures are further subdivided into two main classes called complex partial seizures and simple partial seizures. In some instances, a partial seizure can develop into a generalized tonic, clonic, or tonic-clonic seizure. Partial seizures are more common in adult clients and are generally less responsive to medical treatment than other types of seizures.

- **Complex partial seizures:** These seizures often occur in the temporal lobe and may be called psychomotor seizures due to the function of this part of the brain. Semi-coordinated, repetitive motor movements occur, and loss of consciousness may occur for one to three minutes. Clients are unaware of their environment and may wander at the beginning of the seizures. In the **postictal** period (time after the seizure), clients may have amnesia.
- **Simple partial seizures:** The client remains conscious throughout a simple partial seizure. An **aura** (unusual sensation) occurs before the

seizure and is often described as a “deja vu” feeling, a perceived offensive smell, or sudden onset of pain. The client may also experience one-sided movement of an extremity or usual sensations. Autonomic changes in heart, skin flushing, or epigastric pain may also occur.

Generalized Seizures

Generalized seizures involve abnormal electrical activity in both cerebral hemispheres of the brain. Generalized seizures are classified as tonic, clonic, tonic-clonic, myoclonic, and atonic:

- **Tonic:** Usually lasts for 30 seconds to several minutes and involves an abrupt increase in muscle tone, loss of consciousness, and possible changes in heart rate, blood pressure, and respirations.
- **Clonic:** Muscle contractions and relaxation last several minutes.
- **Tonic-clonic:** Last approximately two to five minutes; begins with a tonic phase with stiffening and rigidity of the muscles (typically of arms and legs) and then followed by immediate loss of consciousness and rhythmic jerking of all extremities. The client may bite their tongue and become incontinent of urine and feces.
- **Myoclonic:** A brief episode of jerking or stiffening of the extremities, either in muscle groups or isolated; contractions can be symmetrical or asymmetrical.
- **Atonic (akinetic):** A sudden loss of muscle tone for a few seconds and followed by postictal (period after seizure) confusion. Often, this type of seizure causes the person to fall, causing injury. This type of seizure is most resistant to drug therapy.

View a supplementary YouTube video[5] of tonic-clonic seizure: Tonic clonic seizure.

Unclassified Seizures

Unclassified seizures occur for no known reason so are also known as idiopathic. They compromise about half of all seizure activity and may have symptoms of both generalized or partial seizures. Primary epilepsy is not associated with any specific cause, but genetic factors seem to play a role. Secondary seizures are caused by other conditions, such as a brain tumor or trauma. Other potential causes of unclassified seizures include the following:

- Alcohol withdrawal
- Alzheimer's disease
- Strokes, heart attacks, and other cardiovascular conditions that deprive the brain of oxygen or cause bleeding in the brain
- Brain inflammation or swelling
- Infections such as meningitis, HIV-related infections, and viral encephalitis
- High fever
- Metabolic disorders
- Electrolyte disturbances (e.g., hypoglycemia, hyperkalemia, hyponatremia)

5. Epilepsy Toronto. (2016, January 19). *Tonic clonic seizure* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=FBEj9H42fa4

Phases of Seizures

Depending on the seizure category, it may occur in multiple phases:

- **Prodromal or preictal phase:** Sensations or behavior changes that precede a seizure
- **Aural phase:** A sensory warning that is similar each time a seizure occurs
- **Ictal phase:** The phase from the first symptoms to the end of seizure activity
- **Postictal phase:** The recovery period after the seizure

Seizure Triggers

Seizure triggers are conditions that can provoke seizures in people diagnosed with epilepsy and taking medications. Triggers include the following conditions[6]:

- Stress
- Increased physical activity
- Excessive fatigue
- Alcohol or caffeine consumption
- Dehydration or missing meals
- Exposure to toxins or poisons, including lead, carbon monoxide, illicit drugs, and very large doses of prescription medications
- Hormonal changes associated with the menstrual cycle
- Sleep deprivation
- Visual stimulation such as flashing lights or moving patterns

Assessment

Interviewing the client and/or family and obtaining a thorough history are

6. National Institute of Neurological Disorders and Stroke. (n.d.). *Epilepsy and seizures*. https://www.ninds.nih.gov/health-information/disorders/epilepsy-and-seizures

essential for management of care, including data such as how many seizures has the person had; how long they lasted; any pattern of occurrence; signs and symptoms before, during, and after a seizure; the presence of an aura; and if there was loss of consciousness. Ask if the client is currently taking any prescription drugs, herbal supplements, or using alcohol or drugs. Inquire if the client has any other medical conditions such as hypertension, diabetes, stroke, or history of head injury.

Common Laboratory and Diagnostic Tests

Diagnosis of seizure activity is made through a complete history and physical examination, as well as diagnostic testing. Diagnostic tests are ordered by health care providers to rule out possible causes of seizure activity and/or confirm a diagnosis of epilepsy. Common diagnostic tests include an electroencephalogram (EEG), CT scan, MRI, or a SPECT/PET scan. EEG monitoring can help determine the intrinsic cause of the seizure.

If a seizure occurs, blood tests, such as serum electrolyte levels, blood cell count, glucose, toxicology/drug screen, and levels of prescribed drugs such as phenytoin or phenobarbital, are typically performed to assess for possible causes. Review information about these tests under the "General Assessment of the Nervous System" section.

Nursing Diagnosis

Common nursing diagnoses for clients with seizures include the following[7]:

- Risk for Injury
- Risk for Impaired Swallowing
- Risk for Ineffective Airway Clearance
- Fear

7. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

- Anxiety
- Ineffective Coping
- Deficient Knowledge

Outcome Identification

Overall goals for clients with seizures and epilepsy focus on preventing seizures and injuries, as well as promoting effective coping and self-management of this chronic disease.

Examples of outcome criteria for clients with seizures include the following[8]:

- *After the teaching session, the client and their caregiver(s) will identify actions to take when a seizure occurs to maintain safety and prevent injury.*
- *After the teaching session, the client and their caregiver(s) will list three possible triggers that may cause a seizure to occur.*
- *After the teaching session, the client and their caregiver(s) will verbalize understanding of the treatment regimen to prevent seizure activity.*
- *After the teaching session, the client will list three preferred coping strategies to maintain emotional wellness.*
- *During a seizure, the client will maintain a patent airway.*

Interventions

Medical Interventions

The goals of medical treatment are to stop seizures when they occur as quickly as possible, ensure adequate cerebral oxygenation during seizure activity, and maintain a seizure-free state.

When a seizure occurs that requires medical treatment, medications such as IV lorazepam, diazepam, or midazolam may be administered as prescribed.

8. Epsy. (2023). *Nursing interventions for seizures.* https://www.epsyhealth.com/seizure-epilepsy-blog/nursing-interventions-for-seizures

Ongoing cardiac and respiratory monitoring (including continuous pulse oximetry) is performed to monitor for side effects of medications administered to stop the seizure. Additional information about medications is provided under the "Medication Therapy" subsection. If the airway is patent, oxygen may be administered via a nasal cannula or mask. However, if the client is exhibiting signs of airway obstruction, intubation may be performed with oxygen administered via the artificial airway. Suction is implemented, as needed, to remove excess secretions and maintain a patent airway. After a seizure occurs, antiepileptic medications such as levetiracetam, phenytoin, and phenobarbital may be prescribed to maintain a seizure-free state. IV infusion of fluids is usually prescribed to replace fluids and provide appropriate electrolyte replacement.

MEDICATION THERAPY

Current evidence does not support starting anti-seizure medications following a first-time seizure because it does not change the quality of life. However, clients who experience a seizure should see a neurologist within 15 days. Following a new onset seizure, clients are counseled about risk factors related to starting an anticonvulsant. Medication does not cure the disorder, so the objective of pharmacologic treatment is to achieve seizure control with minimal side effects.[9]

There are several medications available to control seizures. A single medication is typically prescribed to prevent seizure activity and then the dose is titrated until symptoms are resolved, the maximal dose is reached, or signs of drug toxicity occur. Phenytoin is one of the oldest anti-seizure medications that can also be administered IV for status epilepticus, but it must be administered slowly while the client is on cardiac monitoring due to its potential for arrhythmias.

For some anti-seizure medications, blood levels are routinely monitored to

9. Al Sawaf. A., Arya, K., Murr, N. I. (2023). *Seizure Precautions*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK536958/

prevent toxicity. Changing to another medication may be required if seizure activity is not controlled or drug toxicity occurs. Additionally, medication dosage and/or frequency of administration may require adjustment to meet the body's needs in times of illness, weight changes, or increased stress. A client should be educated to never stop taking the medication without consulting with the provider because doing so could cause increased frequency of seizures or status epilepticus.

The type of medication prescribed is based on the type of seizure and the safety/effectiveness of the medication(s). If prescribed medications are taken as directed, seizure activity can often be controlled. However, some clients with epilepsy do not respond to drug management and require surgery to reduce seizure frequency or provide complete seizure control. Table 9.7 summarizes common anticonvulsants, their side effects, and potential toxic effects.

Table 9.7. Common Anticonvulsants[10]

10. Subbarao, B. S., Silverman, A., Eapen, B. C. (2023). *Seizure Medications*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482269/

Medication	Dose-Related Side Effects	Toxic Effects
Carbamazepine	Drowsiness, unsteadiness, drowsiness, blurred vision, nausea/vomiting, or mild leukopenia.	**Stevens-Johnson syndrome** (a rare, serious disorder of the skin and mucous membranes), **toxic epidermal necrolysis** (extensive exfoliation of the epidermis and mucous membrane, which may result in sepsis and death), severe leukopenia, aplastic anemia, pancytopenia, and hepatitis
Oxcarbazepine	Dizziness, headache, ataxia, nausea, rash, double vision, tremor, somnolence, and/or hyponatremia. The latter effect is thought to be secondary to the syndrome of inappropriate secretion of antidiuretic hormone (SIADH) and may occur in 25-75% of clients.	Hepatotoxicity
Phenytoin	Arrhythmias, visual problems, gum enlargement, unclear articulation of speech, nystagmus (rapid, uncontrollable eye movements), abnormal hair growth, or decreased bone density.	Severe skin reaction, drowsiness, peripheral neuropathy, ataxia, and blood or bone marrow disorders.
Phenobarbital	Sedation, diplopia, irritability, or ataxia.	Anemia and skin rash
Lamotrigine	Drowsiness, somnolence, fatigue, weight gain, ataxia, or nausea.	Stevens-Johnson syndrome
Levetiracetam	Somnolence, fatigue, or dizziness.	Stevens-Johnson syndrome
Gabapentin	Fatigue, ataxia, weight gain, drowsiness, or dizziness.	Leukopenia and hepatotoxicity
Valproate	Nausea, vomiting, weight gain, tremor, hair loss, or menstrual irregularities.	Hepatotoxicity, skin rash, and nephritis
Topiramate	Fatigue, confusion, ataxia, anorexia, weight loss, depression, or somnolence.	Nephrolithiasis (kidney stones) and metabolic acidosis
Ethosuximide	Nausea, vomiting, headache, or gastric upset.	Skin rash, hepatitis, and systemic lupus erythematosus
Clonazepam	Behavior changes, alopecia, palpitations, or drowsiness.	Hepatotoxicity, thrombocytopenia, bone marrow failure, and ataxia

SURGICAL INTERVENTIONS

Surgery may be required for clients with epilepsy from intracranial tumors, cysts, abscesses, or vascular anomalies, or their seizures are unresponsive to medication therapy. If the seizure can be located to a specific, well-defined area of the brain, the area may be excised without producing significant neurologic deficits. This type of surgery is called a lobectomy.

As adjunct treatment to medications, a vagal nerve stimulator may be implanted below the clavicle. The device is connected to the vagus nerve in the cervical area and delivers electrical signals to the brain to reduce and/or control seizure activity.

Nursing Interventions

Nursing interventions for clients experiencing seizures focus on improving

safety and preventing injury, monitoring for potential complications, providing health teaching, and providing psychosocial support to enhancing coping mechanisms. The following box summarizes nursing interventions during and after a seizure.

Nursing Interventions During a Seizure[11]

- If a client experiences an aura prior to a seizure, attempt to get the client to a safe, private place.
- Provide privacy during a seizure.
- Ease the client to the floor if not currently in bed.
- If the client is in bed, remove extra pillows and raise the side rails.
- If the client is on the floor, protect the client's head with a pad and prevent it from hitting the floor.
- Loosen constrictive clothing and remove any eyeglasses.
- Push aside any furniture or objects that could cause client injury during the seizure.
- Do not attempt to open or pry the client's jaws if they are clenched in a spasm. Do not insert anything into the mouth because this may cause broken teeth and/or injury to mouth/tongue.
- Do not restrain the client during the seizure, and do not attempt to stop the client's movements.
- Record the start and end times of the seizure.
- If a client experiences status epilepticus, call for emergency assistance and notify the health care provider.

11. Al Sawaf. A., Arya, K., Murr, N. I. (2023). *Seizure Precautions*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK536958/

Administer oxygen per agency policy until help arrives.

- Observe for these items during the seizure:
    - Presence of aura
    - Changes in pupil size and any eye deviation
    - Level of consciousness
    - Presence of apnea, cyanosis, and drooling
    - Incontinence
    - Eye flutter or blinking
    - Tongue or lip biting
    - Lip smacking

Nursing Interventions After a Seizure

- Keep the client on their side to prevent aspiration.
- Ensure the airway is open and patent.
- Assess vital signs.
- Perform neurological checks.
- Allow the client to rest.
- Document observations made while the seizure was occurring.
- Monitor for increased frequency or duration due to potential of apneic periods that may occur during or immediately following a generalized seizure.
- Because there is often a period of confusion after a tonic-clonic seizure, maintain a safe environment.
- On awakening, reorient the client to the environment.
- If a client becomes agitated upon awakening, use calm, nonthreatening communication.
- Document the length of time it takes the client to return to a preseizure state.

When caring for a client with a history of seizures in an

inpatient setting, the nurse implements seizure precautions. Oxygen and suction equipment should be readily accessible at the bedside. Padded side rails may be implemented, based on agency policy. The bed should be kept in the lowest position.

HEALTH TEACHING

Providing health teaching to the client and their family members/caregivers promotes positive coping and self-care management. Health teaching should include the following topics:

- Reinforcing medication therapy information and the importance of not stopping medication without talking to the health care provider. Include written instructions for what to do if a dose is missed and to contact their health care provider if side effects occur. Reinforce the importance of routinely having therapeutic blood levels drawn as prescribed. Advise them to not take over-the-counter medications or supplements without first consulting with the health care provider.
- Wearing a medical alert bracelet or necklace to identify the presence of a seizure disorder.
- Attending follow-up appointments with their health care provider/neurologist as directed.
- Ensuring the family member or significant other knows how to respond in the event of seizure, including when to call emergency services and when to notify the health care provider.
- Following state laws concerning driving and operating machinery.
- Avoiding alcohol and excessive fatigue because these factors can trigger seizures.
- Eating a healthy, balanced diet; getting proper rest; and using stress management techniques to minimize risk of breakthrough seizures.
- Keeping a seizure diary and bringing it to follow-up medical appointments.
- Providing community resources and support for clients and their family

members, such as the Epilepsy Foundation.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.



RN Recap: Seizures and Epilepsy

View a brief YouTube video overview of seizures and epilepsy[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3502#oembed-1

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 9 – Seizures and epilepsy* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/N3HxkFsgABw?si=gsM6uA3okBxFuiNX

9.8 Meningitis

Meningitis is an infectious inflammatory process that involves the meninges, the protective membranes covering the brain and spinal cord. See Figure 9.21[1] for an illustration of the meninges.

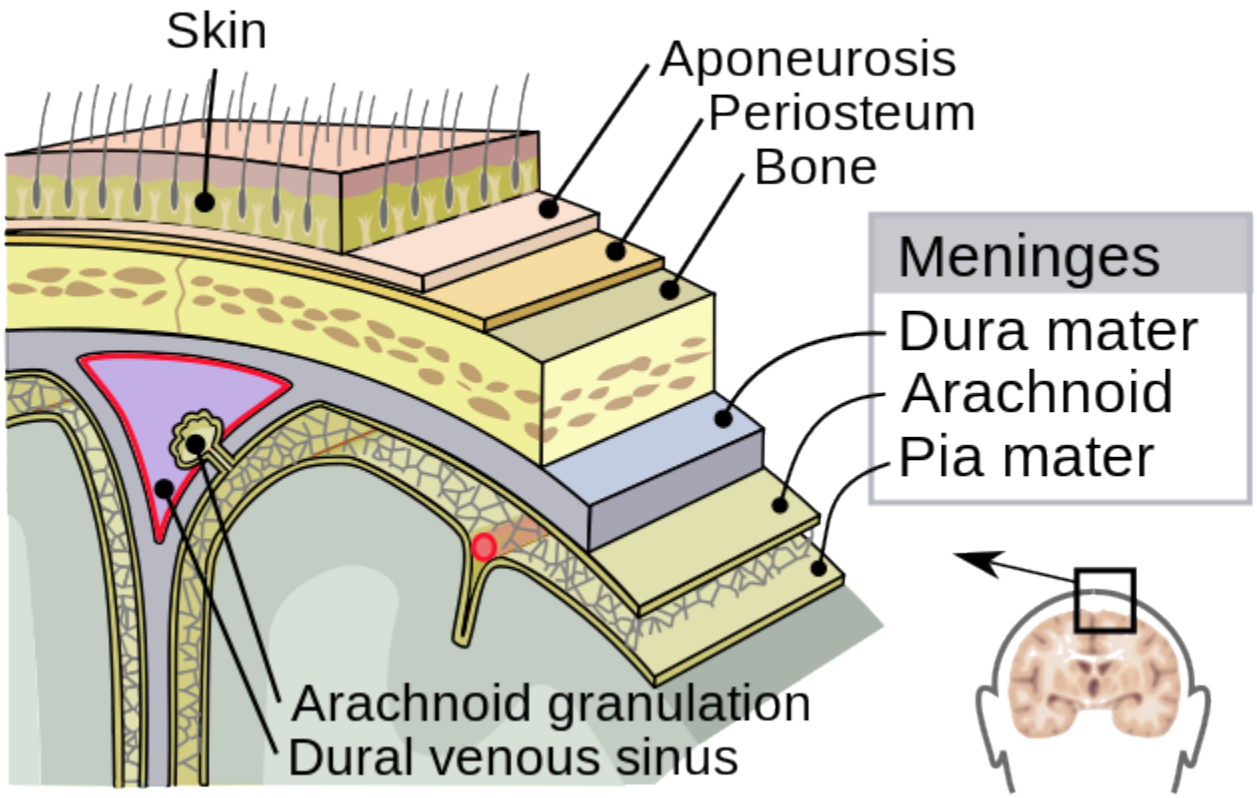


Figure 9.21 Meninges

Pathophysiology

Inflammation is commonly caused by a bacterial or viral infection. *Streptococcus pneumoniae* and *Neisseria meningitidis* (meningococcus) are the most common infecting organisms, followed by *Haemophilus influenzae* and *Group B streptococcus*. In some cases, inflammation may be caused by a

1. "Meninges-en.svg.png" by VG by Mysid, original by SEER Development Team [1], Jmarchn is licensed under CC BY-SA 3.0

fungus or parasite. Because the infection is so close to the brain and spinal cord, it can be life-threatening because of nerve damage, swelling within the brain, and increased intracranial pressure (ICP).

Bacterial meningococcal meningitis is a medical emergency due to a high mortality rate that can occur within 24 hours. Approximately 1 in 6 people who have meningococcal meningitis die. It is a highly contagious disease that can occur in densely populated communities, such as college campuses and military barracks.[2] For this reason, the meningococcal vaccination is strongly recommended for populations at risk.

Viral meningitis is commonly caused by herpes simplex virus-2, varicella zoster, paramyxovirus, and human immunodeficiency virus (HIV). The severity of the symptoms is correlated to the type of virus. Although the virus alters brain cell function, neurological defects are usually temporary, and full recovery is gained after the inflammation resolves.[3]

Meningeal infections generally occur in two ways, through the bloodstream or by direct transmission. The infection can spread in the bloodstream from infections of other organs, such as the heart and lungs. It can also occur from direct transmission, such as traumatic injury to the facial bones, sinusitis, otitis, brain abscess, or from invasive procedures (such as lumbar puncture).[4]

Risk Factors

Risk factors for bacterial meningitis include respiratory infection, otitis media, tooth abscesses, and mastoiditis because the bacteria can cross the epithelial membrane of the brain and enter the subarachnoid space. Individuals who

2. World Health Organization. (2023). *Meningitis*. https://www.who.int/news-room/fact-sheets/detail/meningitis
3. World Health Organization. (2023). *Meningitis*. https://www.who.int/news-room/fact-sheets/detail/meningitis
4. World Health Organization. (2023). *Meningitis*. https://www.who.int/news-room/fact-sheets/detail/meningitis

are immunosuppressed are also at increased risk, such as those on immunosuppressants, chemotherapy, chronic steroid therapy, or have HIV. Newborn babies are at risk from maternal infection with *Group B streptococcus*.[5]

Signs and Symptoms

Signs and symptoms of meningitis are based on its cause. Classic symptoms of bacterial meningitis include a severe headache, rigidity of the neck, high fever, acute onset confusion, phonophobia, photophobia, nausea/vomiting, and petechiae on the trunk and extremities. Later stages include hemiparesis and hemiplegia.[6] See Figure 9.22[7] for an illustration of the signs and symptoms of meningitis.

5. World Health Organization. (2023, April 17). *Meningitis*. https://www.who.int/news-room/fact-sheets/detail/meningitis
6. World Health Organization. (2023). *Meningitis*. https://www.who.int/news-room/fact-sheets/detail/meningitis
7. "Symptoms_of_Meningitis.svg.png" by Mikael Häggström is in the Public Domain

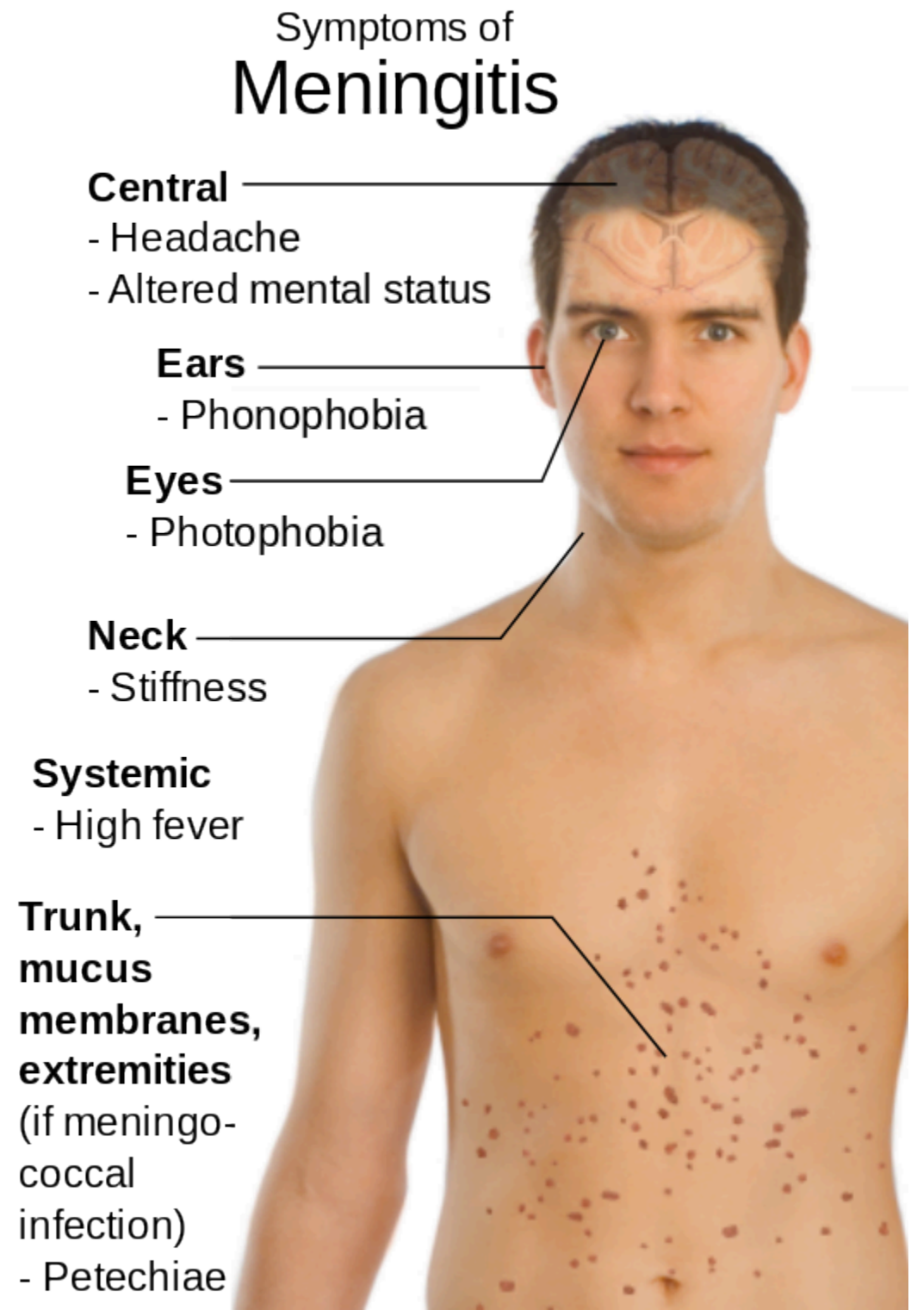


Figure 9.22 Signs and Symptoms of Meningitis

Assessment

Clients presenting with signs and symptoms of meningitis may be assessed for Kernig and Brudzinski signs. The **Brudzinski sign** is when neck flexion

causes the individual to automatically flex their hips and knees. The **Kernig sign** refers to pain that is elicited on passive extension of the client's knees. However, these findings occur in a small percentage of clients. It is also important to consider that a high fever may not occur in older adults or those who are immunosuppressed or taking antibiotics.

View supplementary YouTube videos[8,9] for symptoms of meningitis: Brudzinski's Sign and Kernig's Sign.

Other conditions can also occur due to meningitis. If inflammation spreads to the cerebral cortex, seizure activity may occur. Inflammation can also stimulate the hypothalamus to release antidiuretic hormone (ADH), resulting in hyponatremia due to increased water retention, further increasing the risk of elevated intracranial pressure (ICP).

Clients with meningitis are typically admitted to intensive care units for ICP monitoring. If left untreated, increased ICP can cause herniation of the brain, resulting in death.

Common Laboratory and Diagnostic Tests

Analysis of cerebrospinal fluid (CSF) is the classic diagnostic test for

8. Patient Examination Videos – Educor. (2022, April 14). *Brudzinksi's sign* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=-ueX6ZL6TPc

9. Patient Examination Videos – Educor. (2022, April 14). *Kernig's sign* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=XKu8FxO8i6I

meningitis. CSF testing commonly includes opening fluid pressure, white blood cell count, protein, and glucose.

Gram stains and cultures may be obtained from the throat, nose, and urine if associated infections are suspected. Blood cultures are often collected.

Blood tests include white blood cell count, liver enzymes, serum electrolytes, and HIV testing. X-rays may be performed of the chest, sinuses, and mastoids if associated infections are suspected. Clients older than 60 years, those with increased ICP, or those who are immunosuppressed may have a CT scan before a lumbar puncture is performed because of the risk of brain herniation.[10,11]

Nursing Diagnoses

Nursing diagnoses focus on neurologic dysfunction and tissue perfusion caused by the infectious, inflammatory process and may include the following[12]:

- Ineffective Cerebral Tissue Perfusion related to cerebral edema
- Ineffective Airway Clearance related to neuromuscular damage
- Hyperthermia related to infection
- Acute Pain related to increased intracranial pressure
- Interrupted Family Processes related to the critical nature of the situation and uncertain prognosis

10. Hersi, K., Gonzalez, F. J., Kondamudi, N. P., et al. (2023). *Meningitis (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568762/

11. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

12. Hersi, K., Gonzalez, F. J., Kondamudi, N. P., et al. (2023). *Meningitis (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568762/

Outcome Identification

Clients who have early recognition and treatment of meningitis tend to have good prognosis. Those who present with an altered state of consciousness have high morbidity and mortality. Nurses are key in facilitating prompt medical evaluation and initiation of prescribed treatment. Therefore, outcome identification for clients with meningitis include attaining adequate cerebral tissue performance either through prevention or reduction in increased ICP, maintaining normal body temperature, protecting against injury, enhancing coping measures, restoring normal cognitive functions, and preventing complications.

Sample outcome criteria for clients with meningitis include the following:

- *The client will maintain or restore motor, cognitive, and sensory function within 24 hours.*
- *The client will achieve a normal body temperature within 48 hours.*
- *The client will express relief from pain within two hours.*

Interventions

Medical Interventions

One of the most important interventions aimed at avoiding life-threatening complications from bacterial meningitis is prompt administration of broad-spectrum antibiotics until results from culture and Gram's stain testing are available. After results are reported, an appropriate anti-infective drug is prescribed to treat the specific type of meningitis. The treatment of bacterial meningitis typically requires two to three weeks of IV antibiotics.

Intravenous corticosteroids such as dexamethasone are also administered to clients with community-acquired bacterial meningitis to prevent hearing loss and other neurological complications. Other medications may be prescribed for associated conditions, such as mannitol to treat increased ICP and anticonvulsant medications to treat seizures.

Additionally, individuals who have been in close contact with a person

infected with *N. meningitidis* should receive prophylactic antibiotic treatment such as rifampicin, ciprofloxacin, or ceftriaxone.[13]

Nursing Interventions

Priority nursing interventions when caring for clients with meningitis are administering medication therapy and monitoring and documenting the client's neurologic status. Other nursing interventions include monitoring vitals, decreasing environmental stimuli, and raising the head of the bed to 30 degrees or more to decrease ICP. Increased ICP can cause increased blood pressure and decreased heart rate. Blood pressure may also change if syndrome of inappropriate antidiuretic hormone (SIADH) secretion develops. Additionally, clients with bacterial meningitis should be placed on droplet transmission precautions.

HEALTH TEACHING

Nurses teach clients that vaccines are the most effective way to protect against certain types of bacterial meningitis. Vaccines for three types of bacteria that can cause meningitis include the following[14]:

- Meningococcal vaccines help protect against *N. meningitidis*
- Pneumococcal vaccines help protect against *S. pneumoniae*
- Haemophilus influenzae serotype b (Hib) vaccines help protect against Hib

13. Center for Disease Control (n.d.) *Meningococcal: Public health response for outbreaks*. https://www.cdc.gov/meningococcal/php/public-health-strategy/index.html

14. Center for Disease Control (n.d.) *Meningococcal: Public health response for outbreaks*. https://www.cdc.gov/meningococcal/php/public-health-strategy/index.html

Adults and parents of children are encouraged to remain current on their recommended vaccination schedules to prevent meningitis.

- Read more about Immunization Schedules on the CDC website.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.



RN Recap: Meningitis

View a brief YouTube video overview of meningitis[15]:

One or more interactive elements has been excluded from this

15. Open RN Project. (2024, June 23). *Health Alterations – Chapter 9 – Meningitis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/nkI4vCUi0xI?si=4UV75koNifoVDq_B

version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3534#oembed-1

9.9 Cerebrovascular Accident

A **cerebrovascular accident (CVA)**, commonly referred to as a stroke, is a sudden interruption of blood flow to the brain that requires immediate emergency care. A spectrum of neurological deficits and potential complications can occur as a result of a CVA. Each year in the United States, there are more than 800,000 strokes. Stroke is a leading cause of death or serious long-term disability. Nearly three quarters of all strokes occur in people over the age of 65.

Diagnosing and treating a stroke is often referred to as "time is brain." With timely treatment, it is possible to save brain cells and greatly reduce the damage or death that can occur due to a stroke. Brain cells die because they stop getting the oxygen and nutrients needed to function, or they are damaged by sudden bleeding in or around the brain. Knowing the signs of stroke and calling 911 immediately can help save someone's life.[1]

Pathophysiology

There are two types of strokes called ischemic and hemorrhagic. An acute **ischemic stroke** is caused by a blockage or occlusion of a cerebral or carotid artery. This can be caused by plaque that has built up within the vessel, resulting in a thrombus or a blood clot that has traveled from another area of the body and lodged in the blood vessel, referred to as an embolism. An ischemic stroke is further categorized depending on the cause. CVAs caused by a thrombus are referred to as a thrombotic stroke, and CVAs caused by an embolism are called an embolic stroke. Thrombotic strokes account for more than half of all strokes and commonly occur because of atherosclerosis. An embolic stroke is caused by a thrombus or a group of thrombi that break away from one area of the body and travel through the arterial system via the

1. National Institute of Neurological Disorders and Stroke. (2023). *Stroke*. National Institutes of Health. https://www.ninds.nih.gov/health-information/stroke

carotid artery or through the arteries at the base of the skull. The most common source of the emboli is the heart. For example, emboli occur frequently in clients with atrial fibrillation, where tiny clots form within the atria of the heart and then break away and move into the brain's circulation.

The second type of CVA is a **hemorrhagic stroke**. With this type of stroke, the stability of a blood vessel in the brain is compromised, leading to rupture and bleeding. The blood accumulates into the brain tissue or subarachnoid space. As the blood presses against the tissue in the brain, it can increase intracranial pressure.[2]

Several factors can lead to a hemorrhagic stroke. Sustained elevated blood pressure can cause changes within the arterial wall, making it susceptible to rupture. If this occurs it can cause an intracerebral hemorrhage, leading to bleeding, which causes edema irritation and displacement of the brain tissue. A subarachnoid hemorrhage is more common and refers to bleeding in the space between the brain and the surrounding membrane (subarachnoid space). This bleeding is usually triggered by a ruptured aneurysm or arteriovenous malformation. An **aneurysm** is an abnormal bulging or ballooning that develops in a weak spot of the arterial wall, which may become so thin that it ruptures. The primary symptom is a sudden, severe headache, often described by clients as the worst headache they have ever felt.[3]

An **arteriovenous malformation** is a tangle of blood vessels that irregularly connects arteries and veins that can rupture, causing bleeding in the brain

2. National Institute of Neurological Disorders and Stroke. (2023). *Stroke*. National Institutes of Health. https://www.ninds.nih.gov/health-information/stroke

3. Mayo Clinic. (2024). *Subarachnoid hemorrhage*. https://www.mayoclinic.org/diseases-conditions/subarachnoid-hemorrhage/symptoms-causes/syc-20361009

and spinal cord. See Figure 9.23[4] for an illustration comparing ischemic and hemorrhagic strokes and Figure 9.24[5] for an image containing a radiographic image of a hemorrhagic stroke.

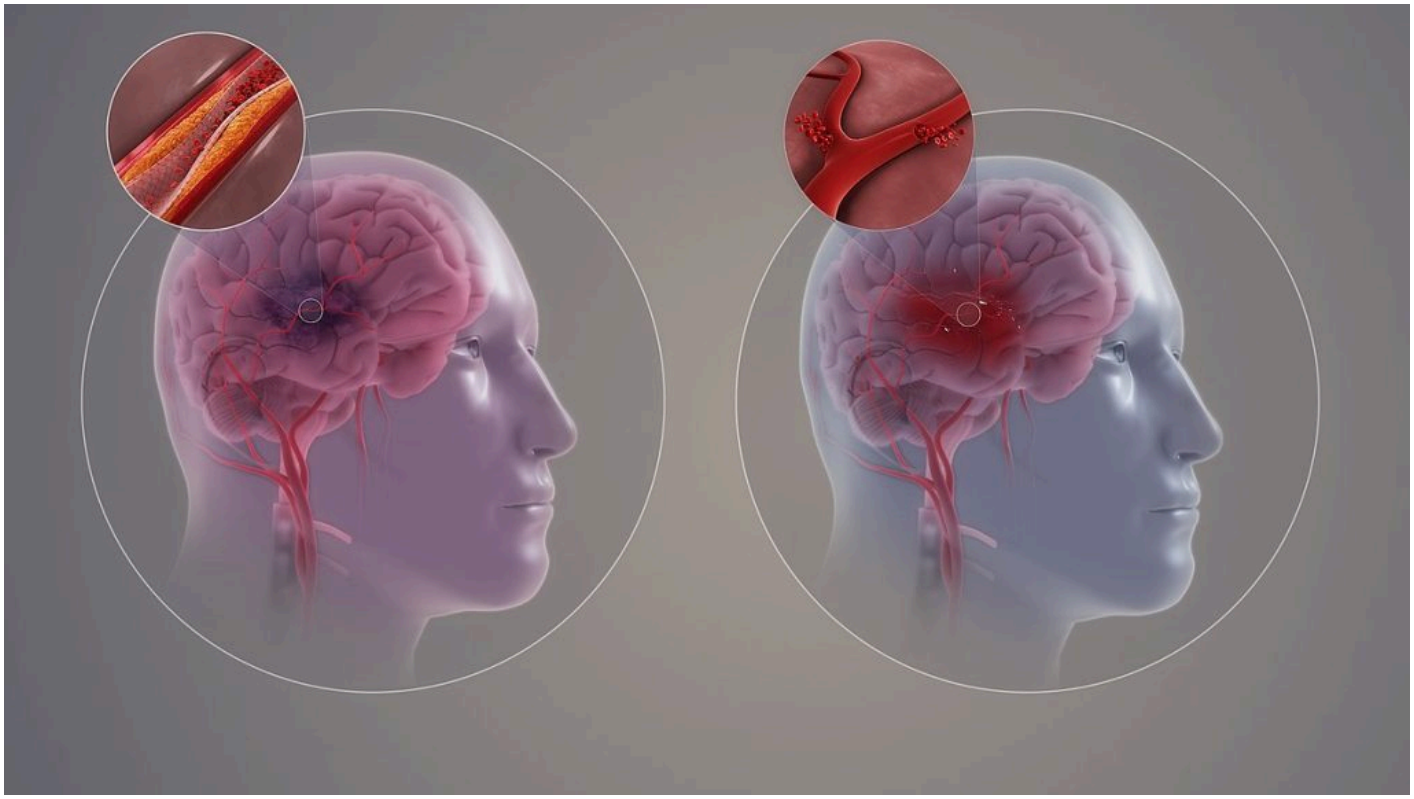


Figure 9.23 Comparison of Ischemia and Hemorrhagic Strokes

4. "Types_of_Stroke.jpg" by https://www.scientificanimations.com/ is licensed under CC BY-SA 4.0

5. "1602_The_Hemorrhagic_Stroke-02.jpg" by OpenStax College is licensed under CC BY 3.0

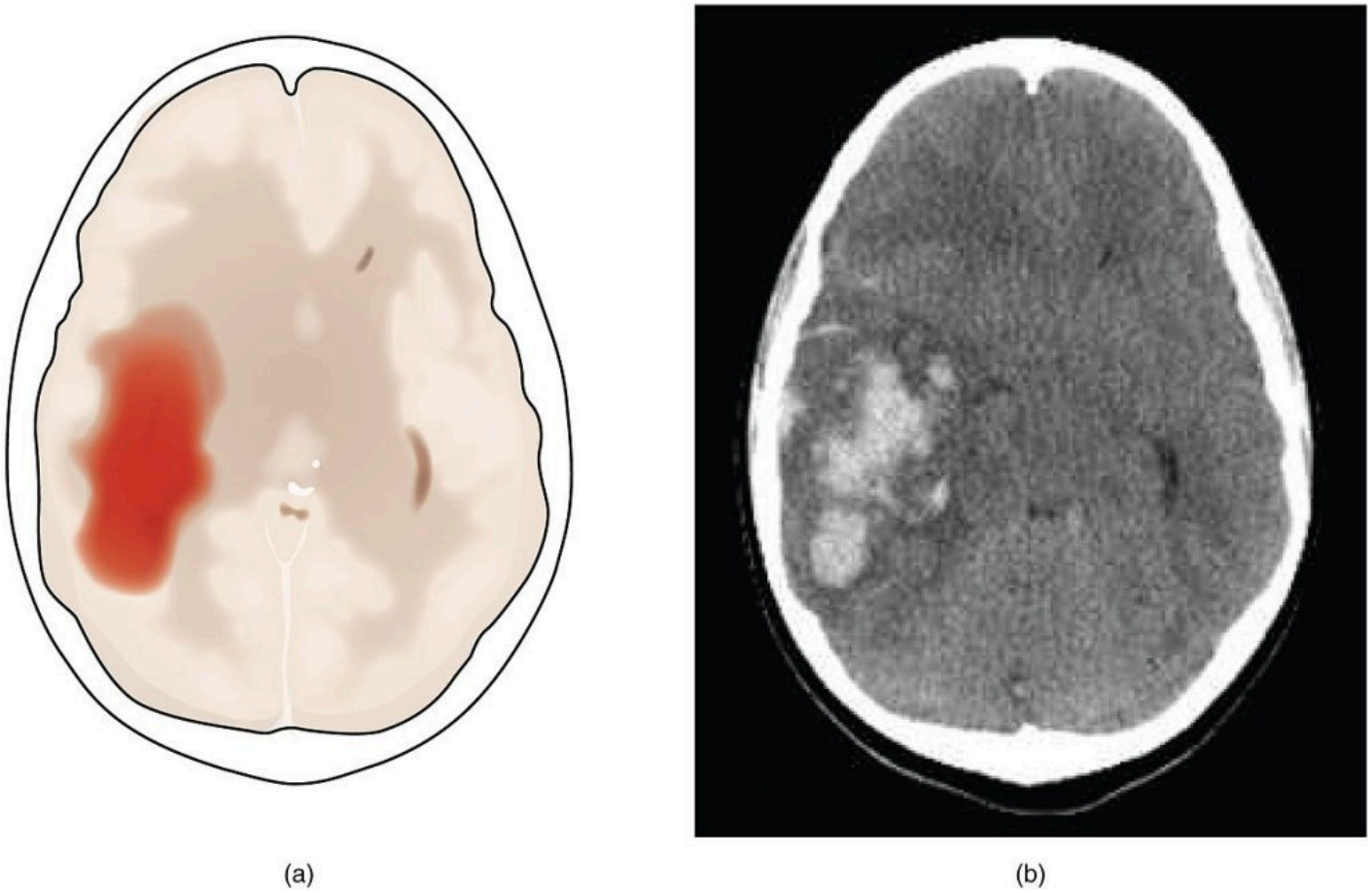


Figure 9.24 Hemorrhagic Stroke

Transient ischemic attacks (TIAs) are temporary periods of symptoms similar to a stroke, but irreversible damage to the brain cells do not occur. However, TIAs are considered warning signs of an impending stroke. With prompt diagnosis and treatment of TIAs, a CVA can be prevented.[6]

See Table 9.9 for a comparison of types of CVAs.

Table 9.9. Comparison of Types of CVAs

6. Mayo Clinic. (2024). *Transient ischemic attack*. https://www.mayoclinic.org/diseases-conditions/transient-ischemic-attack/symptoms-causes/syc-20355679

Clinical Presentation	Ischemic – Thrombolic	Ischemic – Embolic	Hemorrhagic
Progression	Symptoms follow a sequential manner or intermittently fluctuate between improvement and worsening	Abrupt development with steady progression	Abrupt development
Onset	Gradual within minutes to hours	Sudden	Typically sudden, but may be gradual if the cause is hypertension
Level of consciousness	Awake	Awake	Lethargic or comatose
Contributing or associated factors	Hypertension and atherosclerosis	Cardiac disease and atrial fibrillation	Hypertension, vessel disorders, or genetic factors
Preceding symptoms	TIA	TIA	Headache
Neurologic deficits	Deficits become apparent during the first few weeks, such as speech deficits, visual problems, and confusion	Most severe deficits are at onset, such as paralysis and expressive aphasia	Regional deficits may be severe
Duration	Improvements may occur over weeks to months, but permanent deficits are probable	Improvements may occur rapidly if the embolus is effectively treated	Duration is variable with possible permanent deficits

Assessment

If an evolving CVA is suspected, a rapid assessment is performed with rapid transport to a stroke center designated by The Joint Commission or other accredited organization for rapid treatment. If a client is already hospitalized for another medical condition, many hospitals have designated stroke teams and protocols that are immediately implemented.

The National Institutes of Health Stroke Scale (NIHSS) is a standardized tool that is commonly used to assess clients suspected of experiencing an acute cerebrovascular accident (i.e., stroke).[7] It is also used to quantify the severity of a stroke by assigning numbers to the symptoms, with higher numbers indicating more dysfunction. The three most predictive findings that occur during an acute stroke are facial drooping, arm drift/weakness, and abnormal speech. Use the box below to view the NIH stroke scale.

7. National Institutes of Health. (n.d.). *NIH stroke scale*. https://www.stroke.nih.gov/resources/scale.htm

View the NIH Stroke Scale at the National Institutes of Health.

View a supplementary YouTube video[8] about how to use the NIH Stroke Scale: Dr Hartmut Gross Teaches the NIH Stroke Scale.

A commonly used mnemonic regarding assessment of individuals suspected of experiencing a stroke is "BEFAST." BEFAST stands for Balance, Eyes, Face, Arm, Speech, and Time.

- **B**: Does the person have a sudden loss of balance?
- **E:** Has the person lost vision in one or both eyes?
- **F:** Does the person's face look uneven?
- **A:** Is one arm weak or numb?
- **S:** Is the person's speech slurred? Are they having trouble speaking or seem confused?
- **T:** Time to call for assistance immediately

Clients experiencing a hemorrhagic CVA often report "having the worst headache of my life" with sudden onset and no known cause. Other signs of hemorrhage may include nausea, vomiting, photophobia, and a stiff neck. Other common stroke symptoms are as follows:

- Sudden numbness or weakness of an arm or leg, especially on one side of the body
- Sudden confusion, trouble speaking, or understanding
- Sudden loss of vision or trouble seeing in one or both eyes

8. Mellick, L. B. (2015, April 22). *Dr Hartmut Gross teaches the NIH stroke scale* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=jRRzjygCjBE

- Sudden trouble walking, dizziness, or loss of balance or coordination

During the initial client presentation, nurses observe the client's level of consciousness (LOC) and administer the Glasgow Coma Scale. Review information about the Glasgow Coma Scale in the "General Assessment of the Nervous System" section.

Depending on the extent and location of the CVA, specific chronic signs and symptoms may occur. For instance, if a CVA occurs in the right cerebral hemisphere, visual and spatial awareness are affected, as well as possible personality changes, impulsivity, and poor judgment. Clients with left hemisphere involvement may have problems with speech, language, and analytic thinking. See the following box for other complications that can occur as a result of a CVA.

Potential Complications of a CVA

- Hemiparesis (one-sided weakness)
- Hemiplegia (one-sided paralysis)
- Dysphagia (difficulty swallowing)
- Paresthesias (sensory perception deficits such as numbness, tingling, unusual sensations)
- Ptosis (eye drooping)
- Nystagmus (eyes make repetitive, uncontrolled movements)
- Dysarthria (difficulty speaking because the muscles used for speech are weak)
- Aphasia (loss of ability to understand or express speech)
- Homonymous hemianopsia (loss of half of one's visual field)
- Apraxia (inability to perform tasks or movements when asked, even though the request or command is

understood)
- Agnosis (loss of the ability to understand meaning of stimuli)
- Visual and spatial deficits
- Amnesia (memory loss)
- Bladder incontinence
- Personality and behavior changes
- Vertigo (dizziness described as a sensation of motion or spinning)
- Confusion
- Coma

In terms of psychosocial assessment findings, client reactions may vary based on the type and location of the stroke. Assess for emotional lability (uncontrollable emotions), especially if the right side or frontal lobe of the brain has been affected. Sometimes, the client may laugh or cry unexpectedly or inappropriately in a manner they are unable to control.

View a supplementary YouTube video[9] on stroke: Stroke: It happens in an instant.

9. National Stroke Association. (2018, April 23). *Stroke: It happens in an instant* [Video]. YouTube. All rights reserved. https://youtu.be/5OF9qVxx9mo?t=13

Common Laboratory and Diagnostic Tests

A CT scan without contrast is typically the first diagnostic test performed for clients with a suspected CVA to determine if a hemorrhagic stroke is occurring.[10] If a hemorrhagic stroke is ruled out with a CT scan, tests are performed to identify potential causes of an ischemic stroke. For example, a carotid duplex/doppler ultrasound may be performed on the carotid arteries to assess for occlusion. A cardiac echocardiogram may be performed to assess for clots caused by atrial fibrillation. An MRI may be performed to assess for brain lesions. A cerebral angiogram may be performed to determine the blockage site.[11]

Blood tests such as prothrombin time (PT), international normalized ratio (INR), and activated partial thromboplastin time (aPTT) are performed to provide baseline information if fibrinolytic or anticoagulation therapy for an ischemic stroke is initiated. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Depending on the severity of the stroke and the reason for immediate treatment, airway, breathing, and circulation take priority. Common nursing diagnoses include the following[12]:

- Risk for Inadequate Cerebral Tissue Perfusion
- Decreased Physical Mobility

10. Shafaat, O., Sotoudeh, H. (2023). *Stroke Imaging*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK546635/

11. Tadi, P., Lui, F., Budd, L. A. (2023). *Acute Stroke (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568693/

12. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). N*ursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

- Impaired Verbal Communication
- Impaired Swallowing
- Unilateral Neglect
- Ineffective Coping
- Feeding, Bathing, or Dressing Self-care Deficit

Outcome Identification

After a client experiences a CVA, rehabilitation continues throughout the convalescent period, relying on a collaborative effort of a multidisciplinary team including nurses, physical therapists, occupational therapists, and speech therapists, as well as case managers. Overall goals include the following:

- Improved mobility
- Achievement or improvement in self-care
- Relief of sensory and perceptual deprivation
- Prevention of aspiration
- Bowel and bladder continence
- Improved thought processes
- Optimization of communication
- Maintenance of skin integrity
- Absence of complications or injury

Sample outcome criteria include the following:

- *The client will maintain intact skin integrity during hospitalization despite impaired mobility.*
- *The client will not aspirate food, fluids, or medications during hospitalization.*
- *The client will not fall during hospitalization.*
- *The client will demonstrate accurate use of assistive devices after the teaching session.*

Interventions

Medical Interventions

HEMORRHAGIC STROKE

The most common cause of hemorrhagic stroke is hypertension. Blood pressure is reduced gradually to 150/90 mmHg using a beta-blocker, ACE inhibitor, calcium channel blocker, or hydralazine. The role of surgery in hemorrhagic stroke is a controversial topic. Current research indicates emergency surgery for cerebellar hemorrhage greater than 3 cm in diameter, **hydrocephalus** (fluid accumulation in the brain), or brain stem compression. Minimally invasive procedures are also being investigated.[13]

ISCHEMIC STROKE

Medical treatments for clients with acute ischemic stroke include IV fibrinolytic therapy and endovascular interventions.

Medication Therapy

IV fibrinolytic therapy, also known as "clot-buster medication," is administered for specific clients experiencing an ischemic stroke who meet selective criteria. It is standard of practice to improve blood flow to the viable brain tissue around the infarction. IV alteplase is the only FDA-approved medication for acute ischemic stroke. Treatment is dependent on the timing of symptom onset and treatment initiation. The FDA recommends administration of IV alteplase within three hours of stroke onset and up to 4.5 hours in some

13. Unnithan, A. K. A., Das, J. M., Mehta, P. (2023). *Hemorrhagic Stroke*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK559173/

cases. However, alteplase is not administered for clients with the following contraindications[14]:

- Age over 80 years
- Use of anticoagulants
- History of stroke and diabetes

Ongoing drug therapy depends on the type and severity of the stroke and the neurologic dysfunction. The general purpose of ongoing drug therapy is to prevent further thrombotic or embolic episodes by prescribing antithrombotics and anticoagulants and to protect the neurons from hypoxia. An initial low dose of aspirin is recommended 24 to 48 hours after the onset of stroke, but it should not be administered within 24 hours after alteplase. A calcium channel blocker such as nimodipine may be prescribed to treat vertebral vasospasm after a subarachnoid hemorrhage. Stool softeners, antianxiety medications, and analgesics may also be prescribed for symptom management. Blood pressure medications may also be prescribed to treat underlying hypertension.

Surgical Management

Endovascular procedures may be performed for clients experiencing an ischemic stroke. The procedure improves perfusion by surgically removing the thrombus from the affected artery.

If a client is experiencing a hemorrhagic stroke caused by a cerebral aneurysm or an arteriovenous malformation (AVM), a procedure is performed by a neurosurgeon to stop the bleeding. Clients experiencing a hemorrhagic stroke are at risk for developing increased intracranial pressure (ICP) within the first 72 hours after onset due to edema within the brain.

See the following box for signs and symptoms of increased ICP.

14. Tadi, P., Lui, F., Budd, L. A. (2023). *Acute Stroke (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568693/

Manifestations of Increased Intracranial Pressure[15]

- Earliest sign of increased ICP is decreased level of consciousness
- Restlessness, agitation, confusion
- Headache
- Aphasia
- Change in speech pattern
- Nausea and vomiting
- Seizures (most likely in the first 24 hours post-stroke)
- Severe hypertension
- Bradycardia
- Abnormal posturing (late signs of severe brain damage):
    - Decerebrate (See Figure 9.25[16])
    - Decorticate (See Figure 9.26[17])

15. Peters, R. (2006). Ageing and the brain. *Postgraduate Medical Journal 82*(964), 84-8. https://doi.org/ 10.1136/pgmj.2005.036665

16. "Decerebrate Posturing" by Katherine Humphries is licensed under CC BY-NC-ND 4.0. Access for free at https://www.ncbi.nlm.nih.gov/books/NBK559135/.

17. "Decorticate Posturing" by Katherine Humphries is licensed under CC BY-NC-ND 4.0. Access for free at https://www.ncbi.nlm.nih.gov/books/NBK559135/.

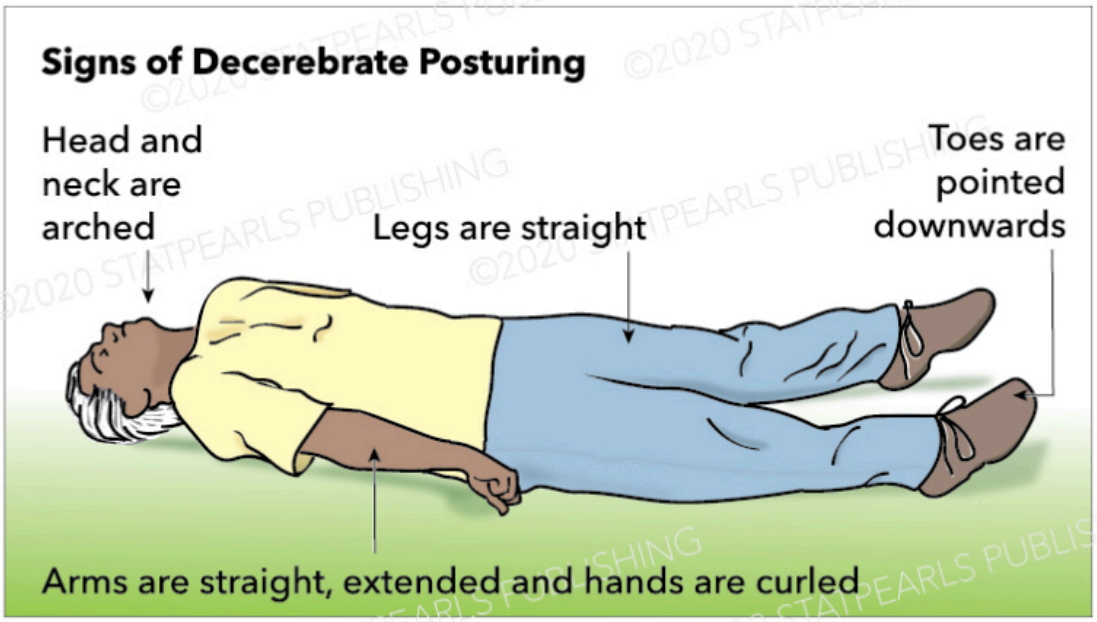


Figure 9.25 Decerebrate Posturing

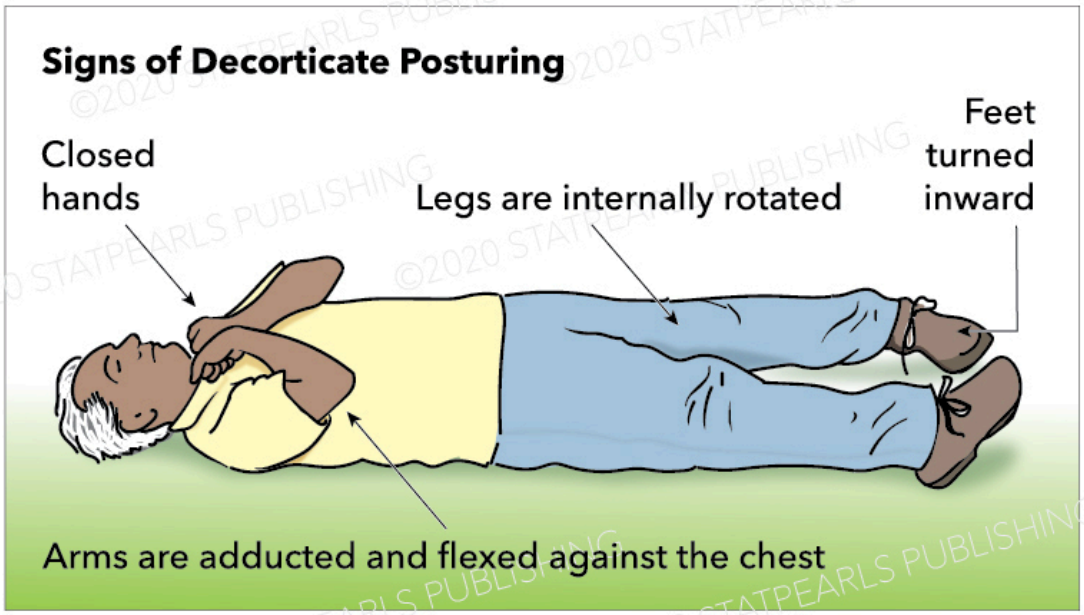


Figure 9.26 Decorticate Posturing

View a supplementary YouTube video[18] on abnormal posturing: Decerebrate vs Decorticate Posturing Rigidity Mnemonic & Pictures Nursing NCLEX

Nursing Interventions

During the acute treatment of a stroke, nursing interventions focus on maintaining physiological integrity and reducing the risk of complications. Nursing interventions during the acute phase of a stroke are provided in the following box.

Nursing Interventions During Acute Treatment of a Stroke[19]

- **Assessments**
  - Assess mental status, level of consciousness, and focused neurological assessments, including the Glasgow Coma Scale and pupil

18. RegisteredNurseRN. (2018, January 25). *Decerebrate vs Decorticate Posturing Rigidity Mnemonic & Pictures Nursing NCLEX* [Video]. YouTube. Reused with permission. All rights reserved. https://www.youtube.com/watch?v=jfj7vEmfmH4

19. Tadi, P., Lui, F., Budd, L. A. (2023). *Acute Stroke (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568693/

evaluation. Assess higher cognitive functions like speech, memory, and cognition.
    - Monitor airway patency, breathing pattern and respiratory status.
    - Frequently monitor vital signs.
    - Monitor for seizure activity.
    - Monitor cardiac rhythm.
    - Assess and monitor the ability to swallow.
    - Monitor the ability to void and for urine retention.
    - Assess and compare bilateral muscle strength and mobility.
    - Monitor electrolytes (sodium) and intake/output for signs of SIADH.

- **Interventions**

    - Provide a quiet environment with the head of the bed elevated 30 degrees.
    - Elevate bed rails to prevent falls.
    - Ensure call light is within reach or use a soft touch call assistive device.
    - Prevent constipation and straining with administration of stool softeners.
    - Follow deep vein thrombosis (DVT) prophylaxis protocol.
    - Implement aspiration precautions for dysphagia as indicated (HOB 45 degrees or higher, supervise eating, reduce distractions, and collaborate with speech therapy).
    - Reposition frequently to maintain circulation and prevent skin breakdown.
    - Prevent injury by not lifting the client using a

flaccid or affected arm.
- Provide range-of-motion exercises.
- Elevate affected arm or extremity to prevent dependent edema.
- Administer analgesics as prescribed.
- Approach client with a decreased field of vision on their side where visual perception is intact; place all visual stimuli on this side. Teach client to turn and look in the direction of the defective visual field to compensate for the loss; make eye contact with the client and draw attention to the affected side.
- If client received TPA or is on anticoagulants to prevent additional CVA, implement bleeding precautions.
- Collaborate with PT/OT/ST to optimize functioning.

If a client is experiencing increased ICP following a hemorrhagic stroke, nurses implement interventions to manage ICP. See related nursing interventions in the following box.

Interventions Associated With Managing ICP[20]

20. Pinto, V. L., Tadi, P., Adeyinka, A. (2023). *Increased Intracranial Pressure*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482119/

- Elevate the head of the bed to greater than 30 degrees or as determined by the health care provider and agency policy.
- Provide oxygen therapy to prevent hypoxia.
- Avoid sudden neck or hip flexion during repositioning because this can increase intrathoracic pressure, causing increased ICP.
- Keep the neck midline to facilitate venous drainage from the head.
- Avoid clustering nursing activities such as bathing, suctioning, or treatments. Multiple clustered activities can drastically raise ICP.
- Maintain a quiet, low stimulus environment.
- Closely monitor blood pressure, heart rhythm, oxygenation, blood glucose, and body temperature.
- Hyperoxygenate before and after suctioning if appropriate. (Hypercarbia can increase cerebral blood flow, contributing to increased ICP.)
- If sedatives are administered, they should be done so cautiously because they can mask neurological symptoms.

HEALTH TEACHING AND PROMOTION

Following care of an acute stroke, health teaching focuses on reducing modifiable risk factors for another stroke and improving long-term functioning. Prevention strategies include quitting smoking, controlling blood pressure, managing glucose levels within the healthy range, making healthy diet choices, reducing hyperlipidemia, increasing physical activity, and adhering to prescribed medication therapy.

In addition to teaching about modifiable risk factors, clients should also receive health teaching about the following topics:

- Teaching the causes of strokes

- Ensuring clients and caregivers understand the signs and symptoms of stroke to ensure timely evaluation in the event of a recurrent stroke
- Ensuring clients and caregivers understand potential complications of therapy, especially bleeding, if they are discharged on an anticoagulant
- Using assistive devices, as advised by the therapy teams, to prevent the risk of falls

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.



RN Recap: Cerebrovascular Accident

View a brief YouTube video overview on cerebrovascular accident[21]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3541#oembed-1

21. Open RN Project. (2024, April 24).*Health Alterations – Chapter 9 Nervous System – Cerebrovascular accident / Stroke [Video]. YouTube.* CC BY-NC 4.0 https://www.youtube.com/watch?v=r8WUnKbgQOU

9.10 Multiple Sclerosis

Multiple sclerosis (MS) is a chronic disease triggered by an immune-mediated response that leads to progressive demyelination in the CNS. MS is the most common disabling neurological disease among young adults between the ages of 20 to 50 years. MS tends to occur among whites of Northern European ancestry, but it can affect people of all ethnicities. MS affects women two to three times more than men. Although the exact reason for this gender difference is not known, hormonal influences are thought to play a part.

Pathophysiology

During MS, demyelination occurs. **Demyelination** refers to the loss or destruction of the myelin sheath. During demyelination, scar tissue forms and creates lesions. Myelin, commonly called the "white matter," consists of fatty and protein substances that surround and protect nerve fibers of the brain and spinal cord. As this protective functional layer is lost, the transmission of nerve impulses between the brain, spinal cord, and the rest of the body becomes impaired. This impairment causes a delay or blockage of impulse transmission, resulting in impaired mobility and sensory functions. Initially, in the disease process, the body attempts remyelination, and the clinical symptoms may decrease to some degree. However, new lesions often develop, leading to neuronal injury and muscle atrophy. See Figure 9.27[1] for an illustration of damaged myelin that occurs in MS.

1. "Myelin_sheath_damage_in_multiple_sclerosis.svg" by Mjeltsch is licensed under CC BY-SA 4.0

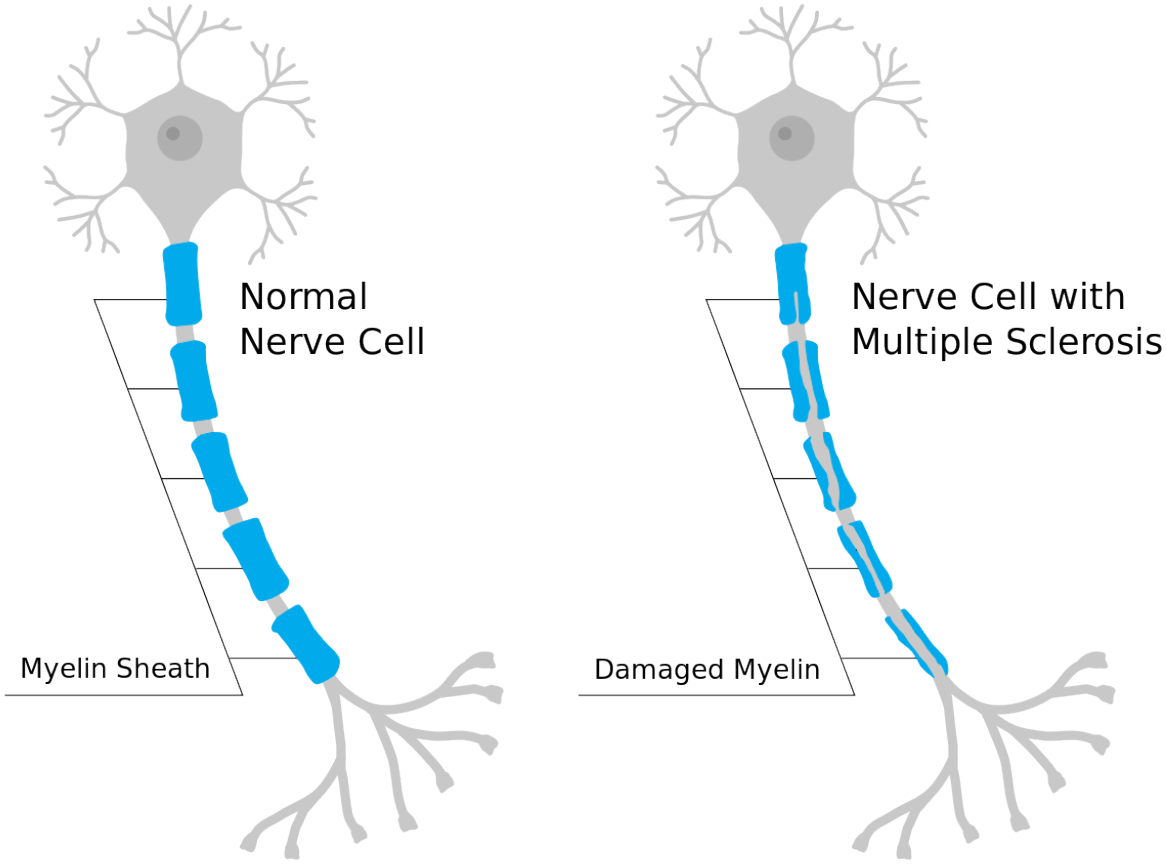


Figure 9.28 Damaged Myelin Sheaths in MS

The cause of MS is complex and entails several immune, infectious, and genetic factors. However, MS is thought to primarily be an autoimmune disease where the body's immune system mistakenly attacks the myelin in the brain and optic nerves, as well as the nerve cell bodies in the brain's gray matter.[2] Ultimately, the outermost layer of the brain, the cerebral cortex, shrinks in size, known as cortical atrophy.[3]

Infectious factors such as measles, human herpesvirus-6, and Epstein-Barr

2. National Institute of Neurological Disorders and Stroke. (n.d.). *Multiple sclerosis*. https://www.ninds.nih.gov/health-information/disorders/multiple-sclerosis

3. National Multiple Sclerosis Society. (n.d.). *What causes MS?* https://www.nationalmssociety.org/What-is-MS/What-Causes-MS

virus (EBV) may also be involved in the development of MS. Research indicates that a previous infection with EBV (the virus that causes mononucleosis) contributes to the risk of developing MS.[4]

Genetic factors can also contribute to the development of MS. The risk of developing MS increases if first-degree relatives (parents, siblings, and offspring) have been diagnosed with MS.[5]

MS occurs more frequently in populations that live farther from the equator. Low vitamin D levels in the blood have been identified as a risk factor for the development of MS. Sun exposure (the natural source of vitamin D) may help to explain the northern distribution of MS.

Smoking increases a person's risk for developing MS and is associated with rapid, severe disease progression. Smoking cessation before or after the onset of MS is associated with a slower progression of disability.

Types of MS

There are four major types of MS[6]:

- **Relapsing-remitting:** This is the most common type of MS. Exacerbations are "attacks" that cause new or worsening neurological symptoms. These attacks are also called relapses or exacerbations. They are followed by periods of partial or complete recovery (remission). In remissions, all symptoms may disappear, or some symptoms may continue and become permanent. However, during those periods of remission, the disease does not seem to progress.

4. National Multiple Sclerosis Society. (n.d.). *What causes MS?* https://www.nationalmssociety.org/What-is-MS/What-Causes-MS
5. National Multiple Sclerosis Society. (n.d.). *What causes MS?* https://www.nationalmssociety.org/What-is-MS/What-Causes-MS
6. National Multiple Sclerosis Society. (n.d.). *What causes MS?* https://www.nationalmssociety.org/What-is-MS/What-Causes-MS

- **Primary progressive:** This type causes a steady and gradual neurologic deterioration without remission of symptoms. Typically, clients do not manifest “acute attacks.”
- **Secondary progressive:** Some people develop a secondary progressive type after initially following the relapsing-remitting course. In the secondary progressive type, neurologic function and disability worsen progressively over time.
- **Progressive-relapsing:** This type is different from the relapsing-remitting type in that clients may have frequent relapses with partial recovery, but they do not return to baseline. Deterioration tends to occur over several years.

Assessment

Multiple sclerosis can act like many other neurologic diseases. There are a variety of potential manifestations of MS based on the location of the lesions and any periods of remission. It is important to collect a thorough history regarding the progression of symptoms and if they are constant or intermittent or if they are becoming increasingly worse. Ask about any aggravating factors that may trigger symptoms, such as fatigue, stress, or temperature extremes. In most instances, symptoms of MS are vague and nonspecific particularly in the early stages. Common initial symptoms are unilateral visual loss and associated visual changes such as blurred vision, diplopia, nystagmus (uncontrolled, repetitive movements of the eyes), and sometimes patchy blindness. Other symptoms of MS are summarized in the following box. See Figure 9.28[7] for an illustration of common symptoms of MS.

7. “Symptoms_of_multiple_sclerosis.svg” by Mikael Häggström is in the Public Domain.

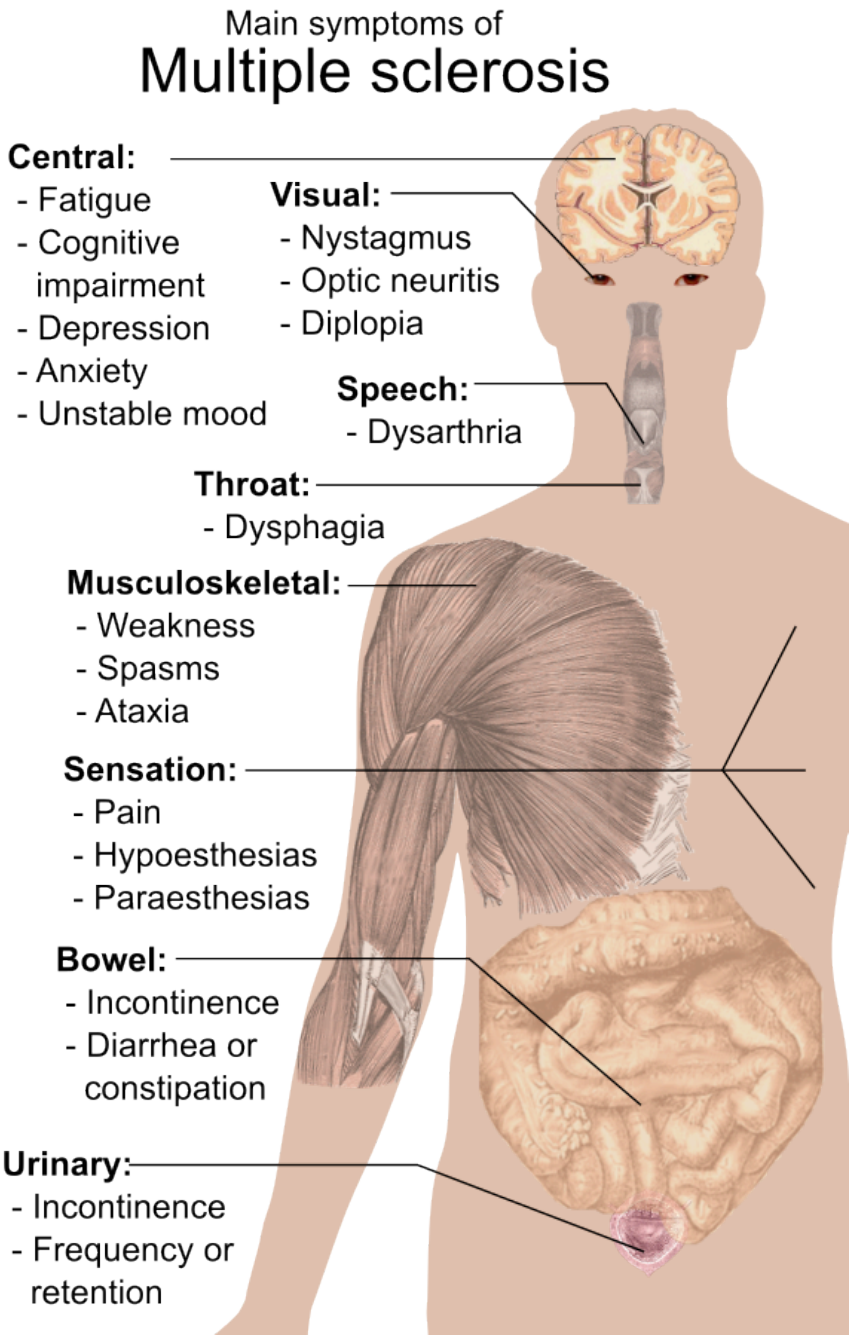


Figure 9.28 Symptoms of Multiple Sclerosis

Signs and Symptoms of MS

- Visual and eye disturbances

- Fatigue, often worse in afternoon hours
- Muscle weakness
- **Hypoesthesias** (numbness)
- **Paresthesias** (tingling, numbness, itching, or burning)
- Pain (if lesions are on sensory pathways)
- Muscle spasticity in the extremities
- **Ataxia** (lack of coordination)
- **Dysmetria** (inability to direct or limit movement)
- Intention tremors (tremors while performing an activity, compared to resting tremors that occur during Parkinson's disease)
- **Dysarthria** (difficulty speaking due to weak muscles)
- Tinnitus
- Vertigo
- Bowel and bladder dysfunction
- Partial or complete paralysis
- Alterations in sexual function, such as impotence
- Cognitive changes such as impaired judgment, memory loss, and decreased ability to problem solve
- Psychosocial or behavioral changes (depression, anxiety, irritability, euphoria, apathy, social isolation)

Common Laboratory and Diagnostic Tests

A combination of these tests is performed to diagnose MS in association with the client's clinical presentation:

- **Cerebrospinal fluid (CSF) analysis:** Abnormally elevated proteins, increased white blood cells, increased myelin basic proteins, and increased immunoglobulins (especially IgG).
- **MRI of the brain and spinal cord:** Lesion formation in at least two areas is diagnostic for MS.

- **Visual evoked potential test:** Noninvasively invoking a visual response identifies impaired transmission along the optic nerve pathway.

View an animated image[8] of monthly MRIs that demonstrate exacerbation and remission of lesions:



Nursing Diagnoses

Priority nursing diagnoses for clients with MS may include the following[9]:

- Impaired Physical Mobility

8. "Monthly_multiple_sclerosis_anim_bg.gif" by Gabby8228 (talk) is licensed under CC BY-SA 3.0

9. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). Nursing diagnoses: Definitions and classification, 2021-2023 (12th ed.). Thieme.

- Fatigue
- Activity Intolerance
- Impaired Communication
- Ineffective Coping
- Anxiety

Outcome Identification

Overall goals for clients with MS include optimal levels of physical, cognitive, and emotional functioning:

- Minimize the frequency and severity of symptoms and relapses associated with MS, including fatigue, muscle weakness, and sensory disturbances
- Improve or maintain the client's mobility and independence
- Promote emotional well-being
- Prevent complications such as falls, infections, and ulcers
- Enhance the overall quality of life for individuals with MS, encouraging them to participate in meaningful activities and relationships

Sample outcome criteria for clients with MS include the following:

- *The client will identify four strategies for managing fatigue after the teaching session.*
- *The client will participate in two recommended mobility treatment programs within the next month.*
- *The client will report an improved sense of energy scoring at least 5 on 1-10 energy rating scale (10 being the highest level of energy, 1 being the lowest level).*

Interventions

Clients with MS require multidisciplinary care due to the complexity of care and the variation of the disease and treatment.

Symptomatic management focuses on muscle spasticity, fatigue, bladder and bowel dysfunction, and ataxia. Physical and occupational therapy for

clients with MS include range-of-motion exercises, ambulation within their abilities, positioning, and transferring. Other interventions include cognitive-behavioral therapy and vocational rehabilitation.

Medical Interventions

MEDICATION THERAPY

There is no cure for MS; therefore, the goals of medical treatment are to prevent and treat acute exacerbations, delay the progression of the disease, and manage chronic symptoms. There are a variety of medications used to treat and control the disease progression in clients with MS. The majority of the medications are immunomodulators or anti-inflammatory drugs. Both types of medication can affect the immune system and increase their risk for secondary infection. Muscle relaxants may be prescribed to reduce muscle spasticity, which can contribute to pain. Paresthesias may be treated with anticonvulsants or tricyclic antidepressants. Constipation from bowel dysfunction may be treated with stool softeners and laxatives as part of a bowel management program. Bladder dysfunction may be treated with antispasmodics (such as baclofen) or bladder relaxing medications (such as oxybutynin and tolterodine). See Table 9.10 for a summary of common medications used to manage MS.

Table 9.10. Common Medications for Management of Multiple Sclerosis

Medication	Mechanism of Action
Interferon-beta preparations (immunomodulator)	Reduces progression of disease and has antiviral effects.
Glatiramer acetate	A synthetic protein similar to myelin used to decrease the number of plaques and increase time between relapses.
IV antineoplastic (mitoxantrone)	An anti-inflammatory agent used to resolve relapses and reduce neurologic disability.
IV monoclonal antibody (natalizumab)	Binds to WBCs to prevent further damage to the myelin.
Fingolimod, teriflunomide, and dimethyl fumarate	Protect brain and spinal cord cells by inhibiting immune cells and providing antioxidants.
Baclofen or tizanidine	Muscle relaxant used to reduce muscle spasticity.
Anticonvulsant (carbamazepine) or tricyclic antidepressant (amitriptyline)	Reduce paresthesia.
Propranolol and clonazepam	Treat cerebellar ataxia.
Corticosteroids	Treat acute relapses. Shorten duration by exerting anti-inflammatory effects and acting on T cells and cytokines.

PHYSICAL THERAPY, OCCUPATIONAL THERAPY, AND SPEECH THERAPY

Referral to physical therapy, occupational therapy, and speech therapy are part of the collaborative effort to provide therapies for optimal function. Occupational and physical therapists can develop exercise programs to assist the client with stretching and strengthening to manage spasticity and tremor. The occupational therapy can also assist the client with visual deficits with scanning techniques, modifications in environment, and use of an eye patch if diplopia is present. Speech therapists can help people who have difficulty speaking to communicate effectively and strengthen the muscles used in speech.

SURGICAL INTERVENTIONS

In severe cases, neurosurgery or deep brain stimulation may be performed to provide relief from tremors.

Nursing Interventions

As with medical management, therapeutic interventions and nursing actions for clients with multiple sclerosis focus on promoting optimal mobility and function, prevention of exacerbations and complications, management of symptoms, and achieving optimal well-being. See the following box for an overview of nursing interventions.

Nursing Interventions for Clients with MS[10]

10. Vera, M. (2024). *7 multiple sclerosis nursing care plans.* https://nurseslabs.com/multiple-sclerosis-nursing-care-plans/

- Encourage independent activity independence to stay active as long as possible to maintain their strength.
- Implement energy conservation techniques to manage fatigue. Encourage clients to cluster their activities and provide frequent rest periods to conserve their energy for important tasks. Keep frequently used items in familiar places.
- Provide health teaching on bowel and bladder training. Include scheduled toileting to minimize and avoid incontinence.
- Ensure adequate fluid intake of 2,000-3,000 mL/day.
- Check the temperature of bath water and heating pads. Encourage clients to lower the maximum temperature on water heaters at home to prevent burns.
- Implement fall precautions in the home (remove rugs and clutter).
- Encourage daily exercises, including stretching and strengthening.
- Encourage independent activity to stay active for as long as possible and to maintain strength.
- Assess skin breakdown that may occur due to immobility and incontinence.
- People with "heat-sensitive" MS may experience a temporary increase in symptoms when their body temperature rises, often due to fever, a warm environment, or after vigorous exercise. Cooling vests may be helpful for maintaining a normal body temperature.[11]

11. Multiple Sclerosis Association of America. (2024). *What is a "pseudoexacerbation?"* https://mymsaa.org/publications/ms-relapse-toolkit/pseudoexacerbation/

- Use eye patches for diplopia and alternate every few hours.
- Promote adequate rest and stress management techniques.
- Encourage participation in social activities to prevent social isolation.
- Refer to MS support groups to promote effective coping.

HEALTH PROMOTION & TEACHING

The effects of MS can be physically and mentally debilitating. Nurses provide support, education, and advocacy for clients and families affected by this disease. They each the client and their caregiver about the purpose of medications, side effects, and therapeutic response, and encourage calling the health care provider if questions or problems with medications occur.

Nurses also ensure the client understands techniques for self-care, daily life skills, and the use of any adaptive equipment. Information on bowel and bladder management, nutrition, and skin care is provided. MS affects the entire family mainly due to its unpredictability and uncertainty of the course, so nurses assist family members in identifying support systems and refer them to additional counseling as indicated.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.



RN Recap: Multiple Sclerosis

View a brief YouTube video overview of multiple sclerosis[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3569#oembed-1

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 9 – Multiple sclerosis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/39MQWk-h1B4?si=ZG9_2o0Kki1C1gYL

9.11 Myasthenia Gravis

Myasthenia gravis (MG) is a chronic, autoimmune neuromuscular disease that causes weakness in voluntary muscles, including those required for breathing and swallowing. Onset of symptoms can be rapid.[1]

Pathophysiology

A key concept to understand related to MG is cholinesterase. Cholinesterase is a family of enzymes that break down the neurotransmitter acetylcholine (ACh) into choline and acetic acid. This reaction is necessary to allow a cholinergic neuron to return to its resting state after activation.[2]

MG affects the neuromuscular junction. Within a normal working nervous system, a chemical impulse causes the neurotransmitter acetylcholine (Ach) to be released into the neuromuscular junction. Acetylcholine attaches to the receptor sites of a muscle and stimulates a muscle contraction. Acetylcholine continually binds to the receptor sites to sustain muscle contraction.

During MG, an autoimmune response causes antibodies to bind to muscle receptor sites. These antibodies block acetylcholine from binding to the muscle receptor sites, thus impairing the transmission of impulses across the neuromuscular junction and causing muscle weakness that worsens with physical activity. See Figure 9.29[3] for an illustration of antibodies (red Ys) binding to muscle receptor sites (light blue cavities on the pink muscle), thus

1. National Institute of Neurological Disorders and Stroke. (2023). *Myasthenia gravis.* National Institutes of Health. https://www.ninds.nih.gov/health-information/disorders/myasthenia-gravis

2. Colović, M. B., Krstić, D. Z., Lazarević-Pašti, T. D., Bondžić, A. M., & Vasić, V. M. (2013). Acetylcholinesterase inhibitors: pharmacology and toxicology. *Current neuropharmacology*, 11(3), 315–335. https://doi.org/10.2174/1570159X11311030006

3. "Wikipedia_Project_Myasthenia_gravis_(5).svg" by Libbyspek is licensed under CC BY-SA 4.0

preventing ACh (gray circles) from binding to the muscle receptors and triggering movement.

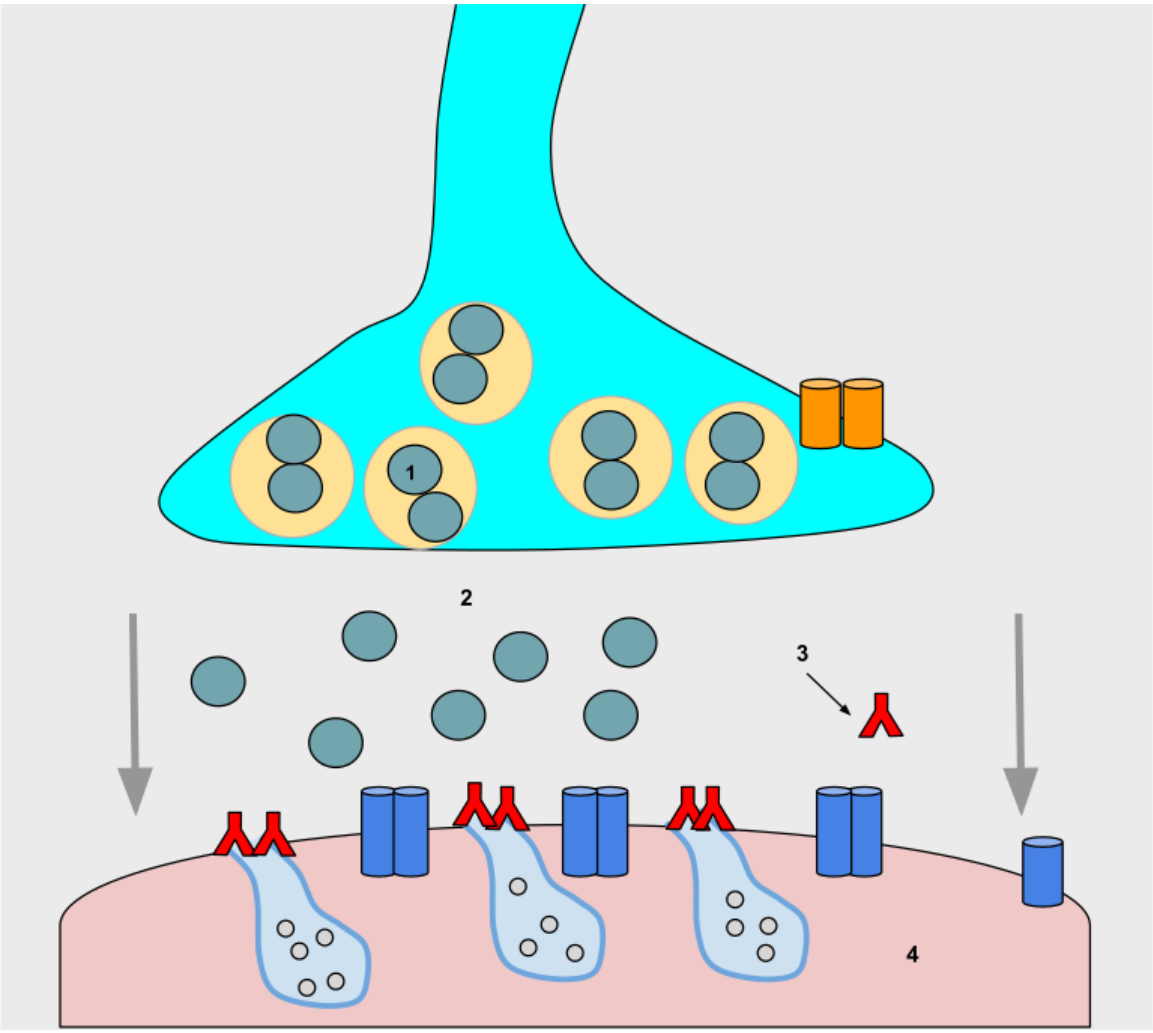


Figure 9.29 Antibody Binding to ACh Receptor Sites Causing Myasthenia Gravis

There is a relationship between the thymus gland and MG. Approximately 65% of people with MG have an abnormal thymus. The thymus is responsible for immunological self-tolerance, which is the capacity to recognize self versus nonself during immunological responses. It is suspected that this loss of the ability to recognize self versus nonself leads to the autoimmune attack on acetylcholine receptors that occurs during MG.[4]

4. American Association of Neuroscience Nurses. (2013). *Care of the patient with*

Assessment

The clinical course of MG is variable. Individuals may experience periods of exacerbation and remission of symptoms. MG is a chronic disease, and remissions are rarely permanent. Comprehensive nursing assessment of a client with MG includes a detailed medical history, symptom description, and ability to complete daily activities. The physical exam assesses voluntary muscles for muscle strength and fatigability to identify severity of specific muscle weakness and the degree of functional impairment.

Hallmark characteristics of MG include muscle weakness affecting the eyes, face, neck, jaw, respiratory, and extremity muscles. Weakness increases with repetitive use and improves after periods of rest or sleep. The following box summarizes common manifestations of MG.

Common Manifestations of MG[5]

Early symptoms are as follows:

- Eye muscles with **diplopia**, double vision, and **ptosis**, drooping of the eyelids. (See Figure 9.30[6] for an image of ptosis.)

myasthenia gravis. https://aann.org/uploads/Publications/CPGs/AANN14_CPGMysGravis.pdf

5. American Association of Neuroscience Nurses. (2013). *Care of the patient with myasthenia gravis*. https://aann.org/uploads/Publications/CPGs/AANN14_CPGMysGravis.pdf

6. "Ptosis_myasthenia_gravis.jpg" by Mohankumar Kurukumbi, Roger L Weir, Janaki Kalyanam, Mansoor Nasim, Annapurni Jayam-Trouth is licensed under CC BY 2.0

- Facial muscle weakness
- Generalized weakness

Ongoing symptoms include the following:

- **Dysphonia** (voice impairment) due to laryngeal muscle weakness
- Difficulty chewing foods
- **Dysphagia** (difficulty swallowing), causing high risk for aspiration
- Facial muscle weakness causing a characteristic "myasthenia snarl"
- **Dysarthria** (difficulty speaking because of weak muscles)
- Neck and limb muscle weakness
- Respiratory muscle weakness leading to breathing difficulty and possible respiratory failure
- Loss of bowel and bladder control

Exacerbations (worsening of symptoms) may be caused by an illness (e.g., viral or respiratory infections), fever, surgery, emotional stress, pregnancy, and drugs that affect neuromuscular transmission.

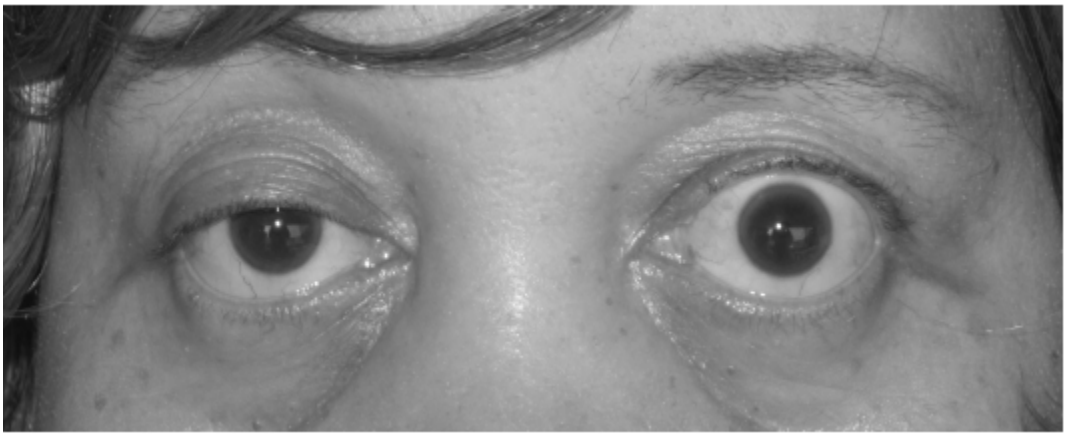


Figure 9.31 Ptosis

Potential Complications: Myasthenic Crisis and Cholinergic Crisis

Myasthenic crisis is a medical emergency with respiratory failure due to respiratory muscle weakness. Other signs and symptoms of myasthenia crisis include increased generalized muscle weakness; hypertension; loss of cough and gag reflex; tachycardia; and pale, cool skin. Treatment includes maintaining adequate respiratory function and may require intubation. Neostigmine may be administered.

Cholinergic crisis is respiratory failure resulting from a high dose of cholinesterase inhibitors. Other signs and symptoms of cholinergic crisis include generalized and increased muscle weakness; constricted pupils; bradycardia; increased secretions; diarrhea; abdominal cramping; and red, warm skin. Atropine may be administered and repeated if indicated, resulting in rapid improvement.

See Table 9.11a. for a comparison of myasthenic crisis and cholinergic crisis.

Table 9.11a. Symptoms of MG

Myasthenic Crisis	Cholinergic Crisis
Tachycardia	Bradycardia
Flaccid muscles (including respiratory muscles)	Same
Pale and cool skin	Red and warm skin
No GI changes	Diarrhea and abdominal cramps
No changes in secretions	Increased secretions
Improves on edrophonium diagnostic test	Worsens on edrophonium diagnostic test

Common Laboratory and Diagnostic Tests

Because MG affects acetylcholine, an acetylcholinesterase test, commonly referred to as a Tensilon test, is used to diagnose MG. The client is injected with an acetylcholinesterase inhibitor (AChE) called edrophonium chloride. This injection stops the breakdown of acetylcholine, thereby increasing its availability at the neuromuscular junction. The medication acts quickly, within 30 seconds, and only lasts up to 5 minutes. If the client experiences immediate improvement in muscle strength with the injection, it is considered a positive test for MG. If the client does not show transient

improvement in muscle strength or improvement of ptosis or respiratory symptoms, then the test results do not indicate MG. During this test, atropine should be available in the event that side effects occur. Side effects are rare but life-threatening and include bradycardia, asystole, and bronchoconstriction.[7]

An EMG may demonstrate a decrease in successive action potentials as the nerves are repetitively stimulated. Read more about the EMG test in the "General Assessment of the Nervous System" section. A CT scan or MRI may be performed to assess for thymus enlargement.

A blood test may be performed to determine if acetylcholine receptor antibodies are present.

Nursing Diagnosis

Myasthenia gravis is a chronic disease, so most clients are managed on an outpatient basis. However, they may be admitted to acute care if secondary conditions occur.

Common nursing diagnoses related to MG include the following[8]:

- Ineffective Airway Clearance related to weak oropharyngeal muscle contractions and decreased ability to cough and swallow
- Risk for Aspiration related to dysphagia and decreased gag reflex
- Fatigue related to disease process and muscular weakness
- Risk for Falls due to weakness and fatigue

7. Rousseff, R. T. (2021). Diagnosis of myasthenia gravis. *Journal of Clinical Medicine*. *10*(8), 1736. https://doi.org/10.3390/jcm10081736

8. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

Outcome Identification

Overall goals for clients with MG focus on functioning at an optimal level and reducing risk of complications. Sample outcome criteria include the following:

- *The client will demonstrate effective coughing after the teaching session.*
- *The client will demonstrate safe swallowing techniques after the teaching session.*
- *The client will maintain normal breath sounds.*
- *The client will verbalize three strategies to manage fatigue after the teaching session.*

Interventions

Medical Interventions

Medical management is directed at improving muscle function through the administration of anticholinesterase medications and by reducing and removing circulating antibodies. Clients with MG are managed on an outpatient basis unless hospitalization is required for managing symptoms or complications such as a myasthenic crisis or cholinergic crisis.

Common medications used to manage MG are summarized in Table 9.11b.

Table 9.11b. Medications Used to Treat MG

Medications	Mechanisms of Action and Nursing Considerations
Anticholinesterase Medications Pyridostigmine bromide Neostigmine bromide Neostigmine methyl sulfate	These drugs block the action of the enzyme anticholinesterase, producing improvement of symptoms. Medications must be given on time to maintain stable blood levels. Delays in administration may exacerbate muscle weakness. May be administered intravenously if the client cannot take oral medication.
Immunosuppressants Corticosteroids	Prescribed if there is no improvement in symptoms from the anticholinesterase drugs to suppressing the client's autoimmune response. Goal of therapy is to reduce the number of abnormal antibodies and prevent them from attaching to ACh receptor sites.
Nonsteroidal Immunosuppressants Azathioprine Cyclophosphamide	Prescribed to suppress autoimmune activity when clients do not respond to corticosteroid therapy. Inhibits T lymphocytes and reduces acetylcholine receptor antibodies. Can produce extreme immunosuppression and toxic side effects. Leukopenia and hepatotoxicity are serious adverse effects. Monitor white blood cell count and liver function tests.

Nonpharmacologic management includes **plasmapheresis** (plasma exchange). During plasmapheresis, the client's plasma and plasma components are removed, including the antibodies and then the cleansed plasma is returned to the client. This exchange produces a temporary reduction in the level of the acetylcholine circulating antibodies.

Surgical Management

Thymectomy (surgical removal of the thymus gland) may be performed to decrease the autoimmune response.

Physical, Occupational, Speech, and DietaryTherapy

Referral for physical, occupational, and speech therapy can provide a collaborative effort in meeting the complex needs of the client and ensure treatment directed at optimal functioning. Referrals to dieticians help improve nutritional intake for clients who have difficulty swallowing and eating.

Nursing Interventions

Nursing interventions for hospitalized clients with exacerbations of MG or myasthenia crisis are summarized in the following box.

Nursing Interventions for MG[9,10]

- Monitor the ability to adequately cough and deep breathe.
- Monitor for respiratory failure.
- Maintain suctioning and emergency equipment at the bedside.
- Monitor vital signs.
- Monitor swallowing ability to prevent aspiration.
- Provide nutritional support with small, frequent meals; soft foods; and high-calorie snacks. Encourage the client to keep their chin down when swallowing and to sit up when eating.
- Assess muscle strength.
- Provide teaching on conserving strength and balancing activity/rest periods.
- Plan short activities that coincide with times of maximal

9. Howard, J. F., Jr. (Ed.). (2009). *Myasthenia gravis: A manual for the health care provider*. https://myasthenia.org/Portals/0/Provider%20Manual_ibook%20version.pdf

10. American Association of Neuroscience Nurses. (2013). *Care of the patient with myasthenia gravis*. https://aann.org/uploads/Publications/CPGs/AANN14_CPGMysGravis.pdf

muscle strength.

- Encourage rest to reduce fatigue that may trigger a crisis.
- Reposition frequently to prevent pressure injuries.
- Monitor for myasthenic and cholinergic crisis.
- Provide artificial tears during the day. May use eye patch to prevent corneal damage.
- Administer anticholinesterase medications as prescribed.

HEALTH TEACHING

Nurses provide health teaching on health promotion to achieve optimal functioning and prevent complications from occurring. Topics include the following:

- Emphasize the importance of rest and avoidance of fatigue to prevent exacerbations. Be alert to other factors that can cause exacerbations, such as infection, surgery, pregnancy, and exposure to extreme temperatures.
- Instruct the client and family about drug actions and side effects.
- Some medications should be avoided or used cautiously because they can worsen symptoms, such as calcium channel blockers, certain classes of antibiotics, hormonal contraceptives, statins, antacids and laxatives that contain magnesium, and transdermal nicotine.
- Take medication in a timely manner. It is advisable to time the dose one hour before meals for optimal chewing and swallowing. Instruct the client to inform the dentist, ophthalmologist, and pharmacist of their MG diagnosis.
- Instruct clients about the symptoms that require emergency treatment.
- Encourage clients to locate a neurologist familiar with MG management.
- Advise clients to wear a medical bracelet identifying the diagnosis of MG. Suggest an “emergency code” to alert family if they are too weak to speak (such as ringing the phone twice and hanging up).
- Instruct the family about cardiopulmonary resuscitation techniques, performance of the Heimlich maneuver, and EMS activation.

- Refer the client to a vocational rehabilitation center for guidance for modifying the home or work environment, such as a raised seat and handrail for the toilet.
- Advise clients to schedule appropriate annual health screenings and maintain recommended vaccinations.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with a family member or other member of the client's interdisciplinary team.

View a supplementary Wikimedia video[11] on MG: Myasthenia-gravis.

11. Osmosis.org. (2016, December 12). *Myasthenia-gravis.webm* [Video]. Wikimedia. CC BY-SA 4.0. https://commons.wikimedia.org/wiki/File:Myasthenia-gravis.webm



RN Recap: Myasthenia Gravis

View a brief YouTube video overview of myasthenia gravis[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3611#oembed-1

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 9 – Myasthenia gravis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/Wbnvm2xCJPY?si=XO91PBIAwYcSdxHD

9.12 Other Nervous System Disorders

Amyotrophic Lateral Sclerosis

Amyotrophic lateral sclerosis (ALS), also known as Lou Gehrig's disease, is a neurological disorder that affects motor neurons and the control of voluntary muscle movement and breathing. As motor neurons degenerate and die, they stop sending messages to the muscles, causing them to weaken, twitch, and shrink. Eventually, the brain loses its ability to control voluntary movements, such as walking, talking, chewing, and breathing. However, cognitive abilities are not affected. Medications are available that may prolong survival, reduce the rate of decline, or help manage symptoms, but there is no known treatment to cure ALS.[1]

Autonomic Dysreflexia

Autonomic dysreflexia is a medical emergency that occurs in clients who have sustained a spinal cord injury above T6. It is manifested by an exaggerated autonomic reflex response that is most often triggered by bowel or bladder distension such as constipation, impaction or urinary retention, or tight or restrictive clothing.

See Figure 9.31[2] for an illustration of neuronal pathways disrupted/rerouted by complete spinal cord injury above the sixth thoracic (T6) spinal level associated with the development of autonomic dysreflexia evoked by pelvic visceral distension.

1. National Institute of Neurological Disorders and Stroke (n.d.). *Amyotrophic lateral sclerosis (ALS)*. https://www.ninds.nih.gov/health-information/disorders/amyotrophic-lateral-sclerosis-als

2. "AutoDys2019.jpg" by Felicia M. Michael, Samir P. Patel and Alexander G. Rabchevsky is licensed under CC BY 4.0

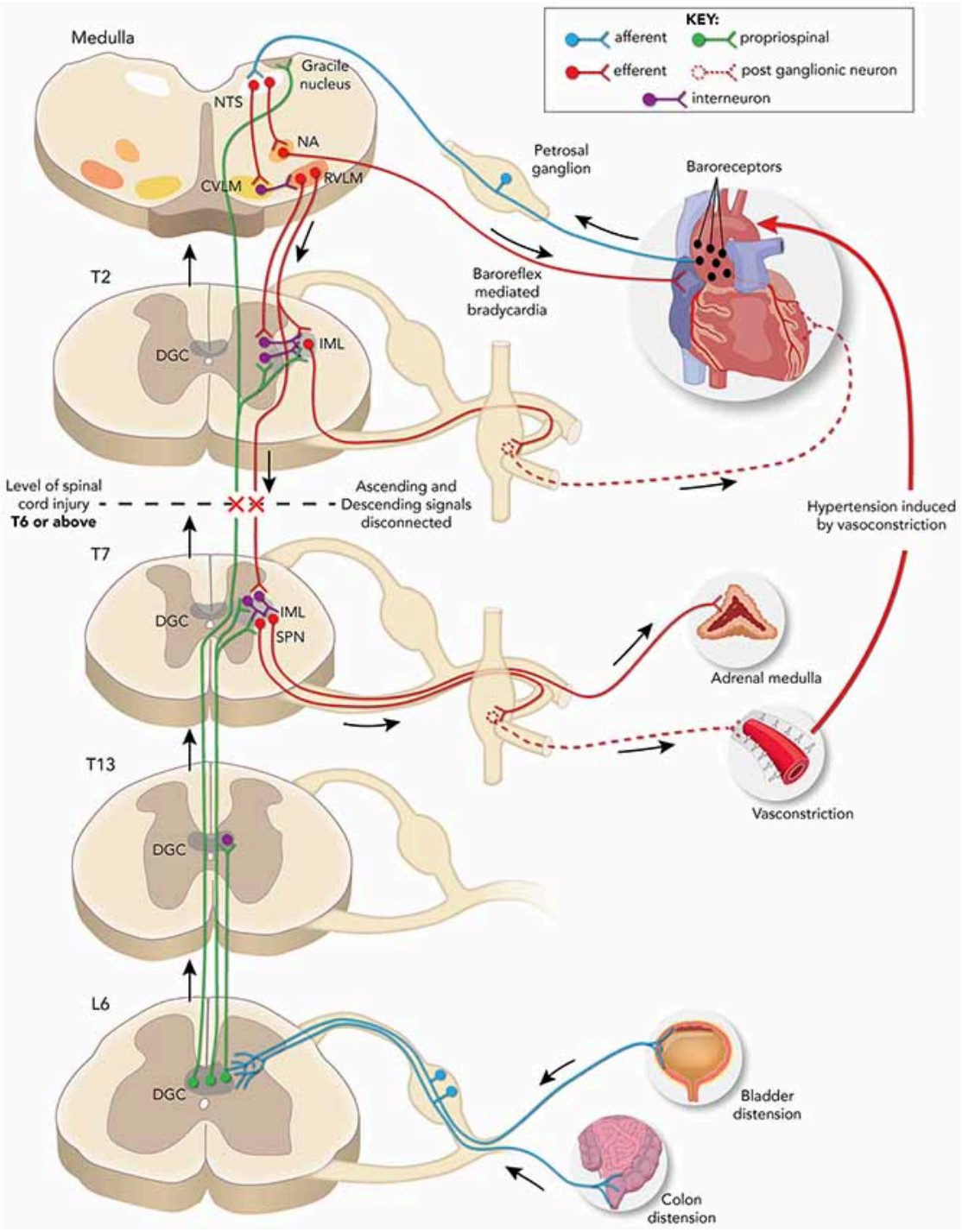


Figure 9.32 Autonomic Dysreflexia

Signs and symptoms of autonomic dysreflexia include the following:

- Severe headache
- Increased in blood pressure (hypertension)
- Bradycardia

- Flushing
- Profuse sweating

Management of autonomic dysreflexia focuses on removing the trigger, such as loosening restrictive clothing, emptying bowel or bladder, and elevating the head of the bed (while keeping correct body alignment).

Ongoing management includes frequent assessing of GI/GU systems, utilizing a kinetic bed to promote blood flow, providing range-of-motion exercise, applying sequential compression devices, protecting skin integrity, and promoting bowel and bladder training. Encourage the client to keep their bladder empty and their urine dilute and acidic to prevent urinary tract infection, a common cause of life-threatening sepsis.

View a supplementary YouTube[3] video on autonomic dysreflexia: Autonomic Dysreflexia.

Carpal Tunnel Syndrome

Carpal tunnel syndrome is a common neurological and musculoskeletal disorder that occurs when the median nerve, which runs from the forearm into the palm of the hand, becomes pressed or squeezed at the wrist. The median nerve passes through the carpal tunnel, a narrow, rigid passageway of ligament and bones at the base of the hand. The median nerve provides feeling to the thumb, index, middle finger, and part of the ring finger.

3. Dr. Matt & Dr. Mike. (2020, September 8). *Autnomic dysreflexia* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=eocOmytfg8s

Compression of this nerve causes the symptoms of numbness, tingling, weakness, and pain in these fingers.[4]

See Figure 9.32[5] for an illustration of carpal tunnel syndrome.



Figure 9.32 Carpal Tunnel Syndrome

Carpal tunnel syndrome may be diagnosed with a nerve conduction study that measures how quickly impulses are transmitted along a nerve. An electromyography test may also be used, where a fine needle is inserted into a muscle, and electrical activity is viewed on a screen to determine the severity of damage to the median nerve. Treatment includes wearing a splint at night while sleeping to keep the wrist straight and medications to reduce

4. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (n.d.). *Carpal tunnel syndrome*. https://www.niams.nih.gov/health-topics/carpal-tunnel-syndrome

5. "Carpal_Tunnel_Syndrome.jpg" by www.scientificanimations.com is licensed under CC BY-SA 4.0

inflammation in the carpal tunnel. If these treatments are not effective, carpal tunnel release surgery is performed to release pressure on the nerve.[6]

Guillain Barre Syndrome

Guillain-Barré syndrome (GBS) is a rare autoimmune disease that causes muscle weakness and sometimes paralysis. Early symptoms of GBS include weakness and tingling in both legs that progress to the arms and upper body. The weakness can increase to paralysis. Symptoms can progress over hours, days, or weeks. Most people start to recover two to three weeks after symptoms first start. Recovery may take as little as a few weeks or as long as a few years. Many people recover fully, but some have permanent nerve damage, and GBS can result in death if the respiratory muscles are affected.[7]

Infection with *Campylobacter jejuni*, a common cause of diarrhea, is also a common cause of GBS. Influenza and other viruses like cytomegalovirus and Epstein-Barr virus can also cause GBS.[8]

Treatment of GBS includes plasma exchange (a procedure that removes and replaces the liquid part of the blood) and high-dose immunoglobulin therapy.[9]

6. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (n.d.). *Carpal tunnel syndrome*. https://www.niams.nih.gov/health-topics/carpal-tunnel-syndrome
7. Center for Disease Control. (n.d.). *Campylobacter*: *Guillain-Barré syndrome*. https://www.cdc.gov/campylobacter/signs-symptoms/guillain-barre-syndrome.html
8. Center for Disease Control. (n.d.). *Campylobacter*: *Guillain-Barré syndrome*. https://www.cdc.gov/campylobacter/signs-symptoms/guillain-barre-syndrome.html
9. Center for Disease Control. (n.d.). *Campylobacter*: *Guillain-Barré syndrome*.

View a supplementary YouTube video[10] on Guillain-Barre syndrome: Understanding Guillain-Barré Syndrome.

Mental Health Disorders

Many mental health disorders, such as anxiety, bipolar disorder, obsessive compulsive disorder (OCD), and schizophrenia can be caused by imbalanced levels of neurotransmitters. Mental health disorders are treated with a combination of medications, psychotherapy, and support groups.

Read additional information about mental health disorders in Open RN *Nursing: Mental Health and Community Concepts*.

Migraines

A **migraine** is a type of headache characterized by recurrent attacks of moderate to severe throbbing and pulsating pain on one side of the head. Untreated attacks last from 4 to 72 hours. Additional symptoms such as nausea, vomiting, or sensitivity to light and sound may occur with a migraine. There are two main types of migraines called a classic migraine (with an aura) and a common migraine (without an aura). An aura is a group of neurologic

https://www.cdc.gov/campylobacter/signs-symptoms/guillain-barre-syndrome.html

10. Zero to Finals. (2021, January 10). *Understanding Guillain-Barré syndrome* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=KUEunZYZgII

symptoms considered a warning sign for the onset of a migraine and include the following[11,12]:

- Temporary blind spots or colored spots
- Blurred vision
- Eye pain
- Seeing stars, zigzag lines, or flashing lights
- Tunnel vision (only able to see objects close to the center of the field of view)

After a migraine, individuals often feel exhausted or confused for up to 24 hours.[13]

Pathophysiology

A migraine is caused by abnormal brain activity that can have several triggers. The causes of a migraine remain unclear, but medical experts believe it involves nerve pathways and chemical changes that affect blood flow in the brain and surrounding tissues.

Triggers of migraine headaches include the following[14]:

- Caffeine withdrawal

11. MedlinePlus [Internet]. (2023). *Migraine*. https://medlineplus.gov/ency/article/000709.htm
12. National Institute of Neurological Disorders and Stroke. (n.d.). *Migraine*. https://www.ninds.nih.gov/health-information/disorders/migraine
13. National Institute of Neurological Disorders and Stroke. (n.d.). *Migraine*. https://www.ninds.nih.gov/health-information/disorders/migraine
14. MedlinePlus [Internet]. (2023). *Migraine*. https://medlineplus.gov/ency/article/000709.htm

- Changes in hormone levels during a menstrual cycle or due to birth control pills
- Changes in sleep patterns, such as not getting enough sleep
- Drinking alcohol
- Exercise or other physical stress
- Loud noises or bright lights
- Missed meals
- Odors or perfumes
- Smoking or exposure to smoke
- Stress and anxiety
- Foods, such as chocolate, dairy foods (especially certain cheeses), onions, and peanuts and other nuts and seeds
- Foods with monosodium glutamate (MSG) or tyramine, such as red wine; aged cheese; smoked fish; chicken livers; figs; certain beans; meats containing nitrates (bacon, hot dogs, salami, cured meats); and processed, fermented, pickled, or marinated foods

Migraine headaches tend to first appear between the ages of 10 and 45 and occur more often in women than men. There may be a genetic component with family history being a risk factor. There are no specific diagnostic tests for migraines.[15]

Treatment

There is no cure for migraines. The goal of treatment is to prevent symptoms by avoiding triggers and immediately managing symptoms when they occur.

15. MedlinePlus [Internet]. (2023). *Migraine*. https://medlineplus.gov/ency/article/000709.htm

Treatment includes lifestyle changes, quick relief measures, medication therapy, biofeedback, and relaxation training.[16,17]

Lifestyle changes include the following[18]:

- Healthier sleep habits, such as getting enough sleep and going to bed at the same time each night
- Healthier eating habits, including not skipping meals and avoiding food triggers
- Managing stress
- Losing weight if overweight

Quick relief measures that can be implemented at the onset of a migraine include napping or resting with eyes closed in a quiet, darkened room; placing a cool cloth or ice pack on the forehead; and drinking lots of fluid, especially if the migraine is accompanied by vomiting. Small amounts of caffeine may help during early stages of a migraine.[19]

Medication therapy is divided into acute and preventative treatment. Acute medications are taken as soon as symptoms occur to relieve pain and restore function. Preventive treatment involves taking medications daily to prevent

16. MedlinePlus [Internet]. (2023). *Migraine*. https://medlineplus.gov/ency/article/000709.htm

17. National Institute of Neurological Disorders and Stroke. (n.d.). *Migraine*. https://www.ninds.nih.gov/health-information/disorders/migraine

18. MedlinePlus. (n.d.). *Migraine*. https://medlineplus.gov/ency/article/000709.htm

19. National Institute of Neurological Disorders and Stroke. (n.d.). *Migraine*. https://www.ninds.nih.gov/health-information/disorders/migraine

migraines or reduce their severity. Acute treatment for migraines may include the following medications[20]:

- Nonprescription analgesics or over-the-counter drugs such as ibuprofen, aspirin, or acetaminophen can ease mild to moderate pain. Combination analgesics involve a mix of medications such as acetaminophen and caffeine.
- Ergot derivative drugs bind to serotonin receptors on nerve cells and decrease the transmission of pain messages along nerve fibers. They are most effective during the early stages of migraine.
- Triptan medications are used for moderate to severe migraine pain. They increase serotonin levels in the brain, causing blood vessels to constrict and lowering the pain threshold.

Preventative treatment includes the following[21]:

- Anticonvulsants increase levels of certain neurotransmitters that dampen pain impulses.
- Beta-blockers and calcium channel blockers help stabilize blood vessel walls and prevent them from narrowing or widening, which affects blood flow to the brain and can cause a migraine.
- Antidepressants increase the production of serotonin and also may affect levels of other chemicals, such as norepinephrine and dopamine.
- Calcitonin gene-related peptide (CGRP) agents.
- Botulinum toxin type A (Botox) injections to reduce migraine attacks if they occur more than 15 days a month.
- Vitamins and minerals like riboflavin or magnesium.

20. National Institute of Neurological Disorders and Stroke. (n.d.). *Migraine*. https://www.ninds.nih.gov/health-information/disorders/migraine

21. National Institute of Neurological Disorders and Stroke. (n.d.). *Migraine*. https://www.ninds.nih.gov/health-information/disorders/migraine

Biofeedback and relaxation training can also be used to help individuals cope with and control the development of pain and the body's response to stress.

Spinal Cord Injury

A **spinal cord injury (SCI)** refers to damage to the bundle of nerves and nerve fibers that sends and receives signals from the brain. The spinal cord extends from the lower part of the brain down through the lower back. SCI can be caused by direct injury to the spinal cord or from damage to the vertebrae that surround the spinal cord. This damage can cause temporary or permanent changes in feeling, movement, strength, and body functions below the site of injury.[22]

Motor vehicle accidents and serious falls are the most common causes of SCI. Other causes include gunshot wounds, sports injuries, surgical injury, industrial accidents, and diseases and conditions that can damage the spinal cord. Risk factors include age (either between the ages of 16 and 30 or older than 65 for serious falls), alcohol use, and not wearing proper gear, such as a seat belt or protective sports equipment.

The symptoms of SCO depend on the extent and location of the injury. The higher up on the spinal cord an injury occurs, the greater affect on the body. For example, an injury higher on the spinal cord can cause **tetraplegia** (paralysis in most of the body and all limbs). An injury that occurs lower on the spinal cord may only affect the lower body and legs, referred to as **paraplegia**. Paralysis may occur immediately upon injury or develop over time from bleeding and swelling in the spinal cord resulting in cell death.[23]

22. National Institute of Neurological Diseases and Stroke. (n.d.). *Spinal cord injury.* https://www.ninds.nih.gov/health-information/disorders/spinal-cord-injury

23. National Institute of Neurological Diseases and Stroke. (n.d.). *Spinal cord injury.* https://www.ninds.nih.gov/health-information/disorders/spinal-cord-injury

> Read more information about "Paralysis" in the "Musculoskeletal System Alterations" chapter.

SCI may be described as complete or incomplete[24]:

- An **incomplete injury** means the spinal cord is still able to send some messages to or from the brain. People with incomplete injuries still have some feeling, function, and muscle control below the site of their injury.
- A **complete injury** means that there is no nerve communication below the injury site, so muscle control, feeling, and function below the injury are lost.

Medical tests for SCI are as follows[25]:

- Magnetic resonance imaging (MRI) can show brain and spinal trauma from injury, herniated discs (problems with the cartilage located between the vertebrae), vascular (blood vessel) irregularities, bleeding, inflammation that might compress the spine and spinal cord, and injury to the ligaments that support the cervical spine.
- Computerized tomography (CT) scans can detect bone fractures, bleeding, and **spinal stenosis** (narrowing of the spinal canal).
- X-rays can show vertebrae misalignment and fractures.

24. National Institute of Neurological Diseases and Stroke. (n.d.). *Spinal cord injury*. https://www.ninds.nih.gov/health-information/disorders/spinal-cord-injury

25. National Institute of Neurological Diseases and Stroke. (n.d.). *Spinal cord injury*. https://www.ninds.nih.gov/health-information/disorders/spinal-cord-injury

SCI can result in the following problems requiring treatment[26]:

- **Breathing problems:** About one third of people with an SCI will need temporary or permanent assistance breathing, and some require mechanical ventilation. Injury to the spinal cord between the C1-C4 can stop breathing because these nerves cause the diaphragm to move and the lungs to expand.
- **Pneumonia:** Respiratory complications are the leading cause of death in people with SCI, commonly as a result of pneumonia. Individuals requiring a mechanical ventilator are at increased risk of developing pneumonia. Pneumonia can often be preventing with aspiration precautions.
- **Circulatory problems:** Changes in circulation can lead to unstable blood pressure, arrhythmias, and blood clots due to blood flow stasis in the large veins in the legs. Anticoagulants and compression stockings help reduce the risk for blood clots.
- **Stiffness and changes in muscle tone:** Reflexes may become exaggerated over time in clients with SCI, causing muscle stiffness and an increase in muscle tone (spasticity) that may require special treatment. Muscles below the injury site may deteriorate when they are not used.
- **Autonomic dysreflexia:** Autonomic dysreflexia is a life-threatening reflex action that primarily affects clients with injuries to the neck or upper back. Symptoms may include flushing or sweating, a pounding headache, anxiety, sudden increase in blood pressure, vision changes, or goose bumps on the arms and legs. If possible, the person should be kept in a sitting position to keep blood flowing to the legs and feet and help reduce blood pressure. Read more about this condition in the "Autonomic Dysreflexia" subsection.
- **Pressure Injuries:** Pressure injuries may occur from continuous pressure

26. National Institute of Neurological Diseases and Stroke. (n.d.). *Spinal cord injury.* https://www.ninds.nih.gov/health-information/disorders/spinal-cord-injury

on the skin and reduced blood flow to the area, especially in clients with paraplegia and tetraplegia. Repositioning every one to two hours can prevent the development of pressure injuries.

- **Pain:** Some people with SCI develop **neurogenic pain**, an intense burning or stinging sensation that may be constant or intermittent. Neurogenic pain can be triggered by a variety of factors and may be felt in parts of the body that have otherwise lost sensation. Treatments to manage chronic pain include medications, acupuncture, spinal or brain electrical stimulation, and surgery.
- **Bladder and bowel problems:** Individuals with SCI may require a urinary catheter and a bowel management program with routine use of laxatives.
- **Sexual function:** Depending on the severity and location of the SCI, sexual function and fertility may be affected. A urologist and other specialists can suggest options to support sexual functioning and health.
- **Depression:** People living with SCI may develop depression due to lifestyle changes after the injury. Therapy and medicine can help treat depression and other mental health conditions.

Rehabilitation programs for people with SCI combine physical therapies and counseling designed to provide social and emotional support to optimize the person's independence and quality of life. The rehabilitation team may include social workers, physical and occupational therapists, nurses, psychologists, vocational counselors, nutritionists, a case worker, and other specialists.[27]

Traumatic Brain Injury

A **traumatic brain injury (TBI)** can be caused by a forceful bump, blow, or jolt to the head or body or from an object that pierces the skull and enters the brain. Some types of mild TBI, like a concussion, can cause temporary or

27. National Institute of Neurological Diseases and Stroke. (n.d.). *Spinal cord injury.* https://www.ninds.nih.gov/health-information/disorders/spinal-cord-injury

short-term problems with normal brain function, including problems with how the person thinks, understands, moves, communicates, and acts. A serious TBI can lead to severe, permanent disability or death.[28]

Symptoms of a TBI may include loss of consciousness, headache, blurred vision, unequal pupil size, nausea, vomiting, clear fluids draining from the nose or ears, photophobia, tinnitus, or other neurological symptoms. TBI is diagnosed using standardized concussion tools and diagnostic testing such as CT scans and MRIs, if necessary.[29]

There are many types of TBIs, including concussions, hematomas, skull fractures, and chronic traumatic encephalopathy[30]:

- **Concussion:** A concussion is a temporary, mild TBI that may take several months to heal. A concussion can be caused by a blow to the head, sports injury, fall, motor vehicle accident, weapons blast, or a rapid acceleration/deceleration of the brain within the skull, such as an infant being shaken.
- **Hematoma:** A hematoma refers to bleeding in and around the brain caused by a ruptured blood vessel. Different types of hematomas form depending on where the blood collects. For example, subdural hematomas are common in the elderly after experiencing a TBI from a fall. It involves bleeding below the dura mater, the membrane directly under the skull.
- **Skull fracture:** Skull fractures are cracks in one or more of the bones that

28. National Institute of Neurological Disorders and Stroke. (2023). *Traumatic brain injury (TBI).* National Institutes of Health. https://www.ninds.nih.gov/health-information/disorders/traumatic-brain-injury-tbi

29. National Institute of Neurological Disorders and Stroke. (2023). *Traumatic brain injury (TBI).* National Institutes of Health. https://www.ninds.nih.gov/health-information/disorders/traumatic-brain-injury-tbi

30. National Institute of Neurological Disorders and Stroke. (2023). *Traumatic brain injury (TBI).* National Institutes of Health. https://www.ninds.nih.gov/health-information/disorders/traumatic-brain-injury-tbi

form the skull. They can cause damage to the membranes, blood vessels, and brain under the fracture. Helmets and seat belts significantly help prevent skull fractures and TBI.

- **Chronic traumatic encephalopathy:** Chronic traumatic encephalopathy occurs in people with extraordinary exposure to multiple blows to the head, such as boxers and football players. It is a delayed consequence after many years and a progressive neurological disorder associated with symptoms that may include problems with thinking, understanding, and communicating; motor disorders (affecting movement); problems with impulse control and depression; confusion; and irritability.

Treatments are based on the cause and severity of the TBI. For example, mild concussions are commonly treated with rest and pain reliever medications, whereas severe TBIs may require surgery to drill a hole into the skull to drain fluids to relieve pressure inside the skull.[31]

31. National Institute of Neurological Disorders and Stroke. (2023). *Traumatic brain injury (TBI).* National Institutes of Health. https://www.ninds.nih.gov/health-information/disorders/traumatic-brain-injury-tbi

9.13 Learning Activities

Learning Activities

Stroke Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Sandra is a 66-year-old, Native American female brought to the emergency department by her husband. She awoke in the middle of the night and fell when she tried to walk to the bathroom because she could not control her left leg. In the Emergency Department, she was diagnosed with an acute ischemic stroke, but the actual time of the stroke was unknown.

Subjective Data:

- States left arm and left leg feel weak and numb
- Reports feeling depressed and anxious
- Concerned about having another stroke
- States she has not taken her medications for high cholesterol for many weeks and forgets to take her hypertension medications every day
- Reports a brief episode of left-sided weakness and tingling of the face, arm, and hand three months earlier, which she verbalizes "totally resolved" and for which she did not seek treatment

1. "Stroke Case Study" by Open RN is licensed under CC BY-NC 4.0

Objective Data:

- BP 180/110
- Left-sided arm weakness 3/5 and leg weakness 4/5
- Decreased sensation on the left side, particularly the hand
- Left homonymous hemianopsia
- BMI of 29
- Alert and oriented and able to verbally respond to questions appropriately but noticeable delay with verbal responses
- Appears tearful and anxious
- Requires help to perform ADLs

1. How does the Sandra's health history put her at risk for a stroke? How can the RN address the client's concerns and fears regarding the possibility of having another stroke?
2. What lifestyle modifications may Sandra have to make?
3. Is Sandra a candidate to receive tPA? Why or why not? Provide the rationale for your response.
4. What diagnostic tests and medications can you expect the client to receive?
5. How will homonymous hemianopsia affect Sandra's hygiene, ability to drive, eat, and participate community activities?
6. What additional assessments can the nurse make to develop interventions to help Sandra and her husband cope with this change in Sandra's health status?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=3712#h5p-47

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https://wtcs.pressbooks.pub/healthalts/?p=3712#h5p-48

“Epilepsy Quiz” by Open RN is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=3712#h5p-49

“Parkinson’s Disease Quiz” by Open RN is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=3712#h5p-54

“Case Study: Alzheimer’s Disease” by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

- Test your knowledge on nervous system disorders using this NCLEX Next Generation-style table highlight question. You may reset and resubmit your answers to this question an unlimited number of times.[2]



- Test your knowledge on nervous system conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[3]



- Test your knowledge on neurological conditions using this NCLEX Next Generation style case study.[4]



2. "Nervous System Table Highlight Question" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

3. "Pediatric Nervous System Bowtie" by Jennifer Hinz and OpenRN is licensed under CC BY-NC 4.0

4. "Neurological Case Study 1" by Kellea Ewen for OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on neurological conditions using this NCLEX Next Generation style case study.[5]



- Test your knowledge on neurological conditions using this NCLEX Next Generation style case study.[6]



Telehealth Scenarios

Telehealth is an innovative technology that can bridge the gap between health care professionals and clients, especially for clients who live in remote areas. Telehealth not only makes health care more accessible but can also provide continuity of care and prevent unnecessary hospitalizations. Nurses who provide telehealth services become digital communicators and educators, merging clinical expertise with empathy and effective online communication.

5. "Neurological Case Study 2" by Kellea Ewen for OpenRN is licensed under CC BY-NC 4.0

6. "Neurological Case Study 3" by Kellea Ewen for OpenRN is licensed under CC BY-NC 4.0

Practice using effective telehealth communication in the following scenarios with Dakotah Thunderhawk, a 75-year-old, Native American male who recently had a cerebrovascular accident and is recovering at home with left side weakness:[7]

- Dakotah Thunderhawk, Telehealth Visit 1: Post-hospitalization Follow-Up
- Dakotah Thunderhawk, Telehealth Visit 2: Identifying Learning Needs
- Dakotah Thunderhawk, Telehealth Visit 3: Evaluating Health Teaching

7. "Telehealth Scenarios" by Open RN are licensed under CC BY-NC 4.0

IX Glossary

Akinesia: The inability to voluntarily move muscles. (Chapter 9.6)

Alzheimer's disease (AD): The most common type of dementia, accounting for at least two thirds of cases of dementia in people aged 65 and older. (Chapter 9.5)

Amyotrophic lateral sclerosis (ALS): Also known as Lou Gehrig's disease; a neurological disorder that affects motor neurons and the control of voluntary muscle movement and breathing. (Chapter 9.12)

Aneurysm: An abnormal bulging or ballooning that develops in a weak spot of the arterial wall, which may become so thin that it ruptures. (Chapter 9.9)

Arachnoid: The meninge middle layer that is filled with fluid that cushions the brain. (Chapter 9.2)

Arteriovenous malformation: A tangle of blood vessels that irregularly connects arteries and veins that can rupture, causing bleeding in the brain and spinal cord. (Chapter 9.9)

Ataxia: Refers to lack of muscle control in the arms and legs that causes poor balance and coordination, which can result in trouble walking. (Chapter 9.3, Chapter 9.10)

Atonic (akinetic): A sudden loss of muscle tone for a few seconds and followed by postictal (period after seizure) confusion. (Chapter 9.7)

Aura: Unusual sensation occurs before the seizure and is often described as a "deja vu" feeling, a perceived offensive smell, or sudden onset of pain. (Chapter 9.7)

Aural phase: A sensory warning that is similar each time a seizure occurs. (Chapter 9.7)

Autonomic dysreflexia: A medical emergency that occurs in clients who have sustained a spinal cord injury above T6. (Chapter 9.12)

Bradykinesia: Slow, shuffling gait. (Chapter 9.6)

Brain stem: Connects the spinal cord to the brain. (Chapter 9.2)

Brudzinski sign: When neck flexion causes the individual to automatically flex their hips and knees. (Chapter 9.8)

Carpal tunnel syndrome: A common neurological and musculoskeletal disorder that occurs when the median nerve, which runs from the forearm

into the palm of the hand, becomes pressed or squeezed at the wrist. (Chapter 9.12)

Central nervous system (CNS): Includes the brain and the spinal cord. (Chapter 9.2)

Cerebellar function: Tested by assessing gait, balance, and coordination. (Chapter 9.3)

Cerebellum: The posterior part of the brain that controls fine motor skills. (Chapter 9.2)

Cerebrovascular accident (CVA): Commonly referred to as a stroke; a sudden interruption of blood flow to the brain that requires immediate emergency care. (Chapter 9.9)

Cholinergic crisis: Respiratory failure resulting from a high dose of cholinesterase inhibitors. (Chapter 9.11)

Chronic traumatic encephalopathy: Occurs in people with extraordinary exposure to multiple blows to the head, such as boxers and football players. (Chapter 9.12)

Clock drawing test: A neurological test in which the client is provided with a piece of paper with a pre drawn circle approximately 10 cm in diameter and told that the circle represents the face of a clock. The person is asked to write numbers within the circle so that it looks like a clock and then add arms to the clock to show a desired time. (Chapter 9.5)

Clonic: Muscle contractions and relaxation last several minutes. (Chapter 9.7)

Cognitive reserve: Refers to the brain's ability to make flexible and efficient use of networks of neuron-to-neuron connections that enable a person to continue to carry out cognitive tasks despite degenerative brain changes. (Chapter 9.5)

Complete injury: No nerve communication below the injury site so muscle control, feeling, and function below the injury are lost. (Chapter 9.12)

Complex partial seizures: These seizures often occur in the temporal lobe and may be called psychomotor seizures due to the function of this part of the brain. (Chapter 9.7)

Concussion: A temporary, mild TBI that may take several months to heal. (Chapter 9.12)

Cranial nerves: Directly connected from the brain to the periphery. (Chapter 9.2)

Dementia: A general term that refers to a decline in cognitive ability severe enough to interfere with a person's ability to complete their activities of daily living. (Chapter 9.5)

Demyelination: Refers to the loss or destruction of the myelin sheath. (Chapter 9.10)

Diplopia: Double vision. (Chapter 9.11)

Dura mater: The tough outermost membrane enveloping the brain and spinal cord. (Chapter 9.2)

Dysarthria: Unclear articulation of speech. (Chapter 9.7, Chapter 9.10, Chapter 9.11)

Dyskinesia: Uncontrollable movements. (Chapter 9.6)

Dysmetria: Inability to direct or limit movement. (Chapter 9.10)

Dysphagia: Difficulty swallowing. (Chapter 9.11)

Dysphonia: Voice impairment. (Chapter 9.11)

Epidural space: The potential space between the dura mater and vertebrae (spine). (Chapter 9.2)

Epilepsy: A chronic disorder that is defined by at least two unprovoked seizures occurring at least 24 hours apart and in which groups of nerve cells, or neurons, in the brain sometimes send the wrong signals and cause recurrent, unpredictable, and unprovoked seizures. (Chapter 9.7)

Generalized seizures: Involve abnormal electrical activity in both cerebral hemispheres of the brain. (Chapter 9.7)

Gingival hyperplasia: Gum enlargement. (Chapter 9.7)

Glasgow Coma Scale: A standardized tool used to objectively assess and continually monitor a client's level of consciousness when damage has occurred, such as after a head injury or a cerebrovascular accident (stroke). (Chapter 9.3)

Guillain-Barré syndrome (GBS): A rare autoimmune disease that causes muscle weakness and sometimes paralysis. (Chapter 9.12)

Hematoma: Bleeding in and around the brain caused by a ruptured blood vessel. (Chapter 9.12)

Hemorrhagic stroke: A type of stroke in which the stability of a blood vessel in the brain is compromised, leading to rupture and bleeding. (Chapter 9.9)

Hirsutism: Abnormal hair growth. (Chapter 9.7)

Hydrocephalus: Fluid accumulation in the brain. (Chapter 9.9)

Hypertonia: Spasticity. (Chapter 9.3)

Hypoesthesias: Numbness. (Chapter 9.10)

Hypothalamus: Coordinates the autonomic nervous system and the activity of the pituitary, controlling body temperature, thirst, hunger, and other homeostatic systems. (Chapter 9.2)

Hypotonia: Flaccidity. (Chapter 9.3)

Ictal phase: The phase from the first symptoms to the end of seizure activity. (Chapter 9.7)

Incomplete injury: The spinal cord is still able to send some messages to or from the brain. (Chapter 9.12)

Ischemic stroke: Stroke caused by a blockage or occlusion of a cerebral or carotid artery. (Chapter 9.9)

Kernig sign: Refers to pain that is elicited on passive extension of the client's knees. (Chapter 9.8)

Meninges: Three membranes that protect the brain and spinal cord called the pia mater, arachnoid, and dura mater. (Chapter 9.2)

Meningitis: An infectious inflammatory process that involves the meninges, the protective membranes covering the brain and spinal cord. (Chapter 9.8)

Migraine: A type of headache characterized by recurrent attacks of moderate to severe throbbing and pulsating pain on one side of the head. (Chapter 9.12)

Mini Mental State Exam (MMSE): A common neuropsychological test that assesses five major cognitive areas, including orientation, registration, attention and calculation, recall, and speech-language-reading. (Chapter 9.5)

Multiple sclerosis (MS): A chronic disease triggered by an immune-mediated response that leads to progressive demyelination in the CNS. (Chapter 9.10)

Muscle rigidity: Refers to resistance to passive limb movement. (Chapter 9.6)

Myasthenia gravis (MG): A chronic, autoimmune neuromuscular disease

that causes weakness in voluntary muscles, including those required for breathing and swallowing. (Chapter 9.11)

Myasthenic crisis: A medical emergency with respiratory failure due to respiratory muscle weakness. (Chapter 9.11)

Myelin sheath: Acts as insulation much like the plastic or rubber that is used to insulate electrical wires. (Chapter 9.2)

Myoclonic: A brief episode of jerking or stiffening of the extremities, either in muscle groups or isolated; contractions can be symmetrical or asymmetrical. (Chapter 9.7)

Myoclonus: Spasm of muscles. (Chapter 9.2)

Neurogenic pain: An intense burning or stinging sensation that may be constant or intermittent. (Chapter 9.12)

Neurons: Responsible for the communication that the nervous system provides. (Chapter 9.2)

Neuroreceptors: Receptors are specific for certain neurotransmitters, and the two fit together like a key and lock. (Chapter 9.2)

Neurotransmitters: Cause an impulse to be transferred to a neuroreceptor on another neuron, muscle fiber, or other structure. (Chapter 9.2)

Nystagmus: Rapid, uncontrollable eye movements. (Chapter 9.7)

Paraplegia: An injury that occurs lower on the spinal cord may only affect the lower body and legs. (Chapter 9.12)

Paresthesias: Tingling, numbness, itching, or burning. (Chapter 9.10)

Parkinson's disease (PD): A common, progressive neurological movement disorder of older adults that eventually leads to disability. (Chapter 9.6)

Partial seizures: Also known as focal seizures; occur within one cerebral hemisphere of the brain. (Chapter 9.7)

Peripheral nervous system (PNS): The remaining parts of the nervous system outside of the brain and spinal cord, including the cranial nerves that branch out from the brain and the spinal nerves that branch out from the spinal cord. (Chapter 9.2)

Pia mater: Meninge that serves as the delicate inner layer. (Chapter 9.2)

Pill-rolling: A repetitive, constant, slow-turning motion between the forearm, hand, and thumb. (Chapter 9.6)

Plasmapheresis: A process in which the client's plasma and plasma

components are removed, including the antibodies and then the cleansed plasma is returned to the client. (Chapter 9.11)

Postictal: Time after the seizure. (Chapter 9.7)

Postictal phase: The recovery period after the seizure. (Chapter 9.7)

Postural disturbances: Characteristic posture is caused by the forward flexion of the neck, hips, knees, and elbows. (Chapter 9.6)

Primary progressive MS: The type of MS that causes a steady and gradual neurologic deterioration without remission of symptoms. (Chapter 9.10)

Prodromal or preictal phase: Sensations or behavior changes that precede a seizure. (Chapter 9.7)

Progressive-relapsing MS: A type of MS in which clients may have frequent relapses with partial recovery, but they do not return to baseline. (Chapter 9.10)

Ptosis: Drooping of the eyelids. (Chapter 9.11)

Relapsing-remitting MS: The most common type of MS characterized by exacerbations that cause new or worsening neurological symptoms following by periods of partial or complete recovery. (Chapter 9.10)

Resting tremors: Tremors that disappear with purposeful, voluntary movement, but become apparent when the person's extremities are motionless. (Chapter 9.6)

Secondary progressive MS: A type of MS that develops following a relapsing-remitting course in which neurologic function and disability worsen progressively over time. (Chapter 9.10)

Seizure: The abnormal transient discharges of neurons within the brain that are sudden, excessive, and uncontrolled. (Chapter 9.7)

Seizure triggers: Conditions that can provoke seizures in people diagnosed with epilepsy and taking medications. (Chapter 9.7)

Set test: A neurological test for clients who are unable to read in which the client is asked to name ten items in each of four sets: fruits, animals, colors, and twins. (Chapter 9.5)

Shuffling gait: Compensatory movement for postural disturbance in which individuals move their feet forward under the body's center of gravity. (Chapter 9.6)

Simple partial seizure: A seizure in which the client remains conscious throughout. (Chapter 9.7)

Skull fracture: Cracks in one or more of the bones that form the skull. (Chapter 9.12)

Spinal cord injury (SCI): Refers to damage to the bundle of nerves and nerve fibers that sends and receives signals from the brain. (Chapter 9.12)

Spinal nerves: Named based on the level of the spinal cord where they emerge. (Chapter 9.2)

Spinal stenosis: Narrowing of the spinal canal. (Chapter 9.12)

Status epilepticus: Refers to a seizure lasting more than five minutes or two more sequential seizures without full recovery of consciousness between the seizures. (Chapter 9.7)

Stevens-Johnson syndrome: A rare, serious disorder of the skin and mucous membranes. (Chapter 9.7)

Subarachnoid space: The space between the arachnoid membrane and the pia mater. (Chapter 9.2)

Subdural space: A space between the dura and the arachnoid mater, containing a thin layer of serous fluid. (Chapter 9.2)

Sundowning: Increased confusion at night or when lighting is inadequate. (Chapter 9.5)

Tetraplegia: Paralysis in most of the body and all limbs. (Chapter 9.12)

Thalamus: The relay center for sensory and motor signals to the cerebral cortex. (Chapter 9.2)

Thymectomy: Surgical removal of the thymus gland. (Chapter 9.11)

Tonic: Usually lasts for 30 seconds to several minutes and involves an abrupt increase in muscle tone, loss of consciousness, and possible changes in heart rate, blood pressure, and respirations. (Chapter 9.7)

Tonic-clonic: Last approximately 2-5 minutes; begins with a tonic phase with stiffening and rigidity of the muscles (typically of arms and legs) and then followed by immediate loss of consciousness and rhythmic jerking of all extremities. (Chapter 9.7)

Toxic epidermal necrolysis: Extensive exfoliation of the epidermis and mucous membrane, which may result in sepsis and death. (Chapter 9.7)

Transient ischemic attacks (TIAs): Temporary periods of symptoms similar

to a stroke, but irreversible damage to the brain cells do not occur. (Chapter 9.9)

Traumatic brain injury (TBI): Can be caused by a forceful bump, blow, or jolt to the head or body or from an object that pierces the skull and enters the brain. (Chapter 9.12)

Unclassified seizures: Seizures that occur for no known reason so are also known as idiopathic. (Chapter 9.7)

Ventricles: Interconnected, fluid-filled cavities within the brain. (Chapter 9.2)

PART X

CHAPTER 10 MUSCULOSKELETAL SYSTEM ALTERATIONS

10.1 Musculoskeletal Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with musculoskeletal disorders (i.e., mobility)
- Explain the pathophysiology of musculoskeletal disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Consider use of common pharmacological and nonpharmacological measures for the client with musculoskeletal disorders
- Apply therapeutic communication in caring for the client with musculoskeletal disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=93#h5p-42

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Musculoskeletal disorders (MSDs) present a significant challenge in modern nursing care. As the health care industry shifts towards a holistic approach, nurses must integrate evidence-based practice, understand pathophysiology, and adopt a client-centered approach to care for clients with MSDs.

Musculoskeletal health is integral to one's overall well-being. However, a myriad of conditions can affect the musculoskeletal system, leading to disabilities and a diminished quality of life. In this chapter, we'll delve into several significant musculoskeletal disorders, including amputation, fractures, osteoarthritis, osteoporosis, and rheumatoid arthritis.

10.2 Review of Anatomy & Physiology of the Musculoskeletal System

Skeletal System Review

The skeletal system includes bones, joints, cartilages, and ligaments. It supports the body, facilitates movement with muscles, protects organs, produces blood cells, and stores and releases calcium to maintain homeostasis.[1] See Figure 10.1[2] for an illustration of the skeletal system. The skeletal system is subdivided into two major divisions called the axial skeleton and the appendicular skeleton. Each division is further discussed in the following sections, along with related medical terms.

1. National Cancer Institute. (n.d.). *Introduction to the skeletal system*. National Institutes of Health. https://training.seer.cancer.gov/anatomy/skeletal
2. "701 Axial Skeleton-01.jpg" by OpenStax is licensed under CC BY 3.0

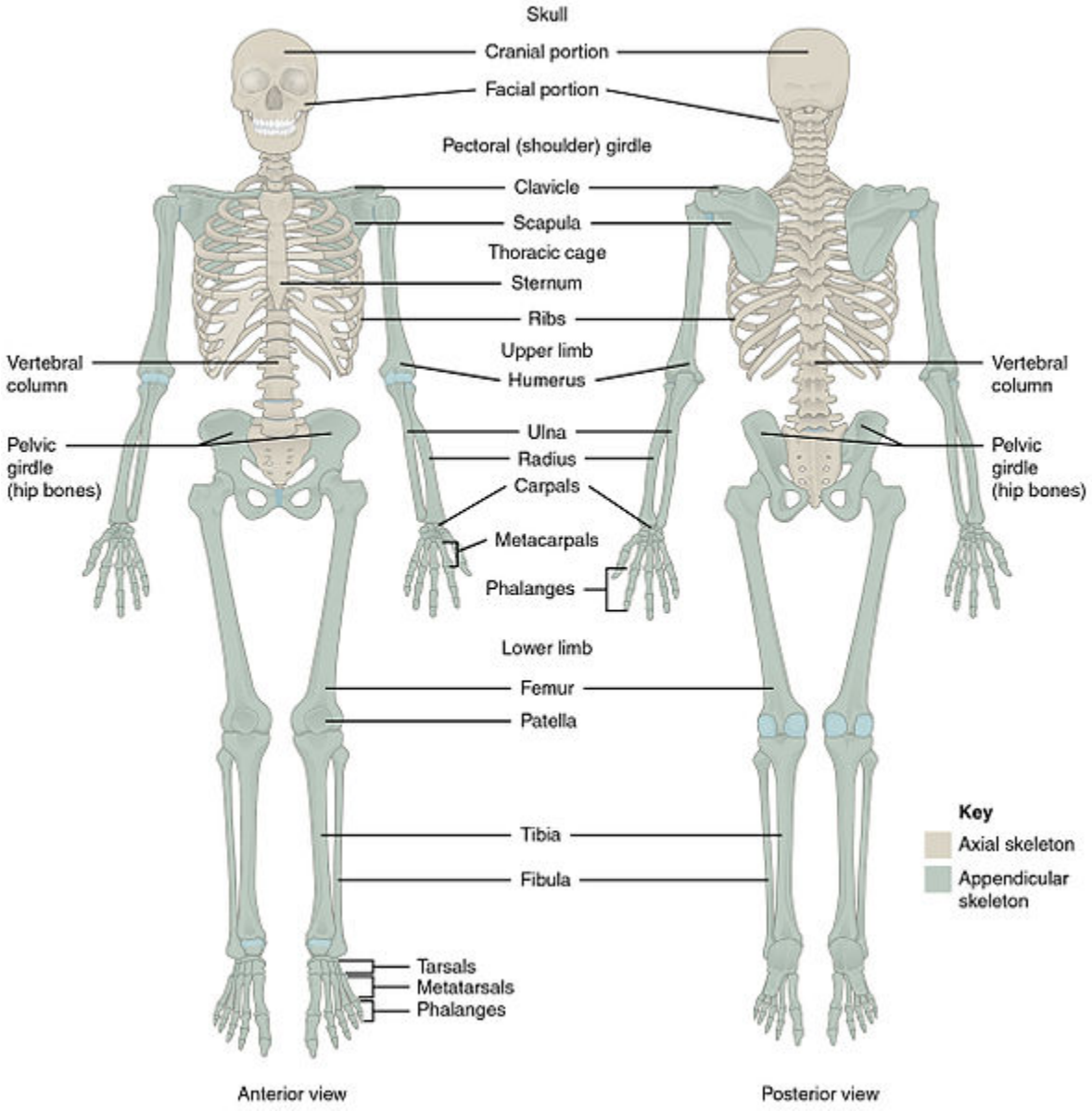


Figure 10.1 Axial and Appendicular Skeletal Systems

The Axial Skeleton

The axial skeleton forms the central axis of the body and includes the bones of the head, neck, chest, and back. It serves to protect the brain, spinal cord, heart, and lungs. It also serves as the attachment site for muscles that move the head, neck, back, shoulders, and hip joints. The axial skeleton includes the cranium, hyoid, vertebral column, and thoracic cage.[3]

3. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O.,

Cranium

The **cranium** is the bones that form the head, including the skull and the facial bones. It supports the face and protects the brain. See Figure 10.2[4] for an illustration of the anterior bones of the skull and the face.

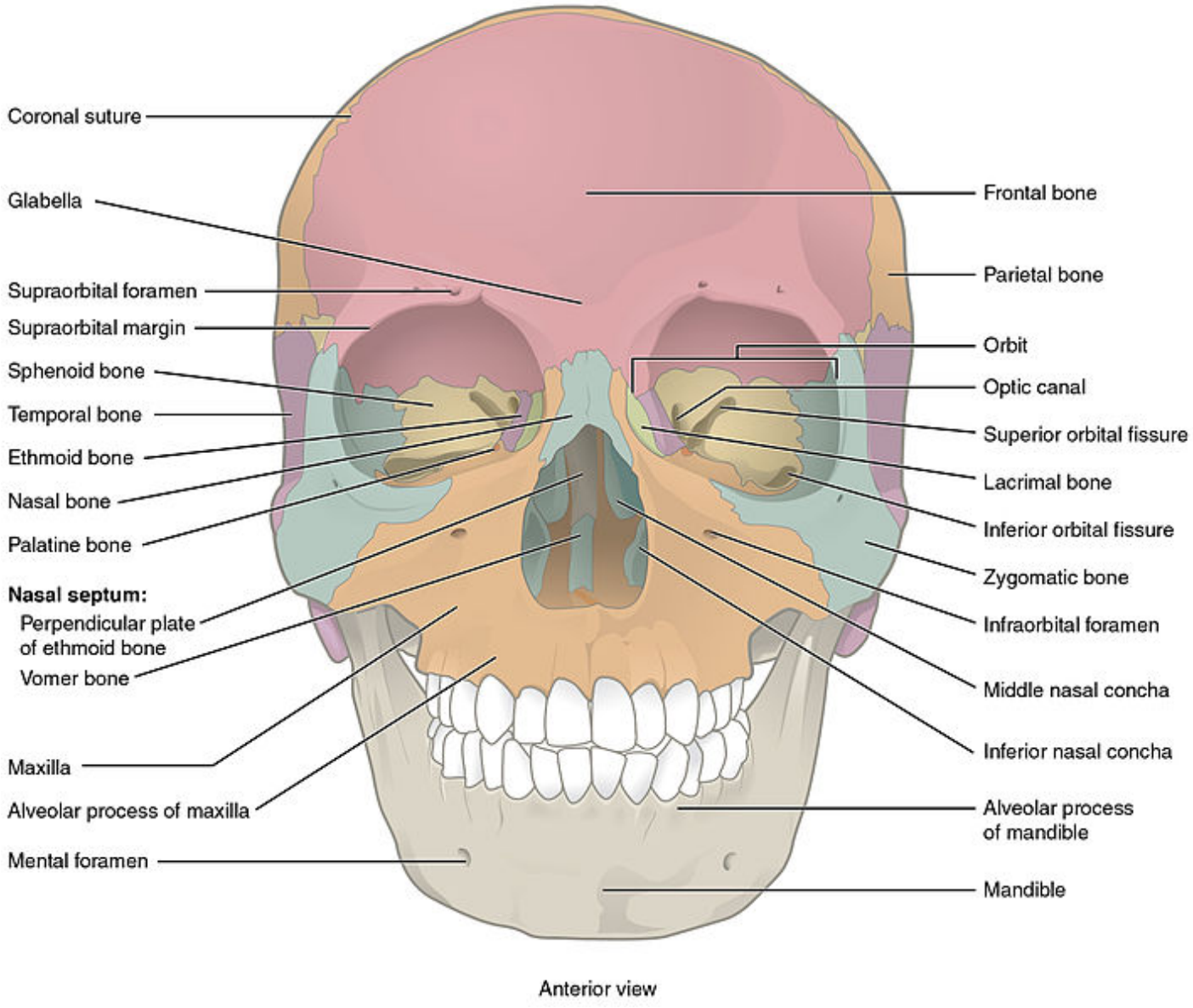


Figure 10.2 Bones of the Anterior Skull and Face

Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

4. "704_Skull-01.jpg" by OpenStax College is licensed under CC BY 3.0

The major bones of the skull include the following:

- **Frontal:** Forehead
- **Parietal:** Upper lateral sides of the skull
- **Temporal:** Lower lateral sides of the skull
- **Sphenoid:** Posterior eye sockets and part of the base of the skull
- **Ethmoid:** Part of the nose and base of the skull
- **Occipital:** Posterior skull and base of the skull (See Figure 10.3[5] for an image of the occipital bone.)

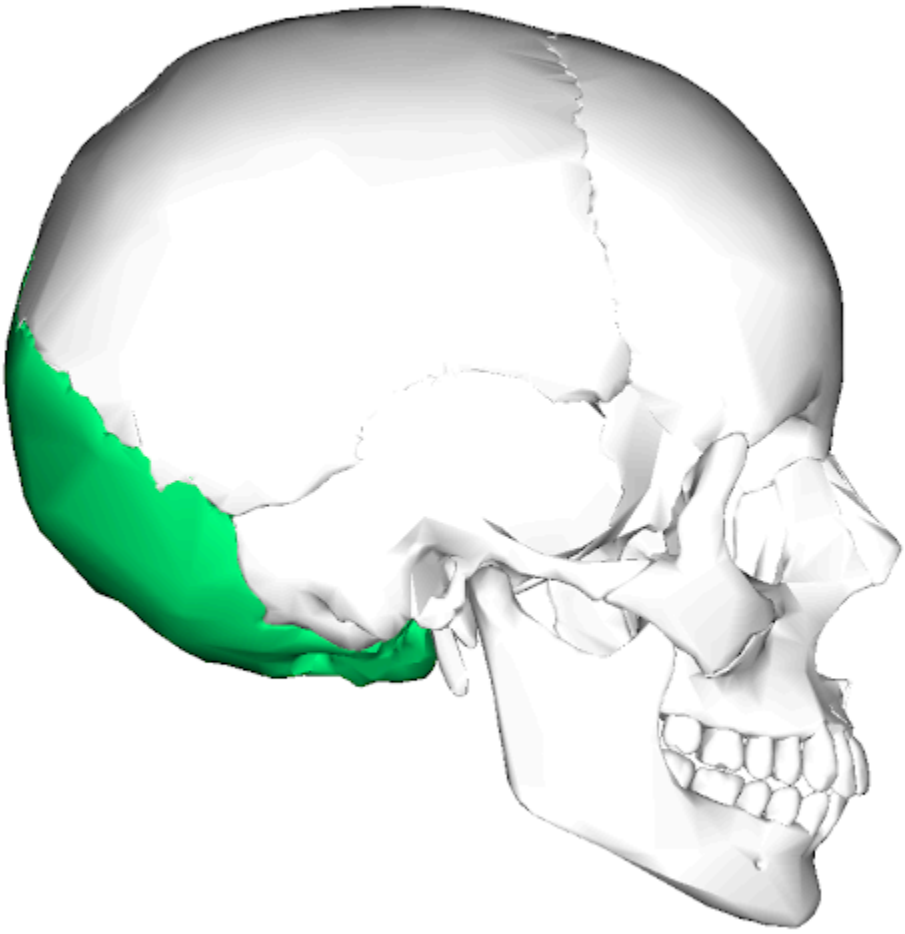


Figure 10.3 Occipital Bone

5. This work is derivative of "Occipital_bone_lateral4.png" by Anatomography is licensed under CC BY-SA 2.1

The facial bones form the upper and lower jaws, the nose, nasal cavity and nasal septum, and the orbit. The facial bones include 14 bones, with six paired bones and two unpaired bones. The paired bones are the zygomatic, maxillary, palatine, nasal, lacrimal, and inferior conchae bones. The unpaired bones are the vomer and mandible bones.

- **Zygomatic:** Pair of cheekbones
- **Maxillary:** Upper jaw and hard palate
- **Palatine:** Pair of L-shaped bones between the maxilla and the sphenoid that form the hard palate, walls of the nasal cavity, and orbital floor of the eye
- **Nasal:** Pair of bones that form the bridge of the nose
- **Lacrimal:** Walls of the inner orbit (i.e., eye socket)
- **Inferior conchae:** Lower lateral walls of the nasal cavity
- **Vomer:** Bone that separates the left and right nasal cavity
- **Mandible:** Lower jawbone and only movable bone of the skull

The **temporomandibular joint (TMJ)** is a hinge joint between the temporal bone and the mandible that allows for the opening, closing, protrusion, retraction, and lateral movement of the lower jaw.

Hyoid

The **hyoid** bone is an independent bone that does not contact any other bone and, thus, is not part of the skull. It is a small U-shaped bone located in the upper neck near the level of the inferior mandible, with the tips of the "U" pointing posteriorly. The hyoid serves as the base for the tongue above and is attached to the larynx and the pharynx below. Movements of the hyoid are coordinated with movements of the tongue, larynx, and pharynx during swallowing and speaking. See Figure 10.4[6] for an illustration of the hyoid bone.

6. "Hyoid Bone" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/7-2-the-skull

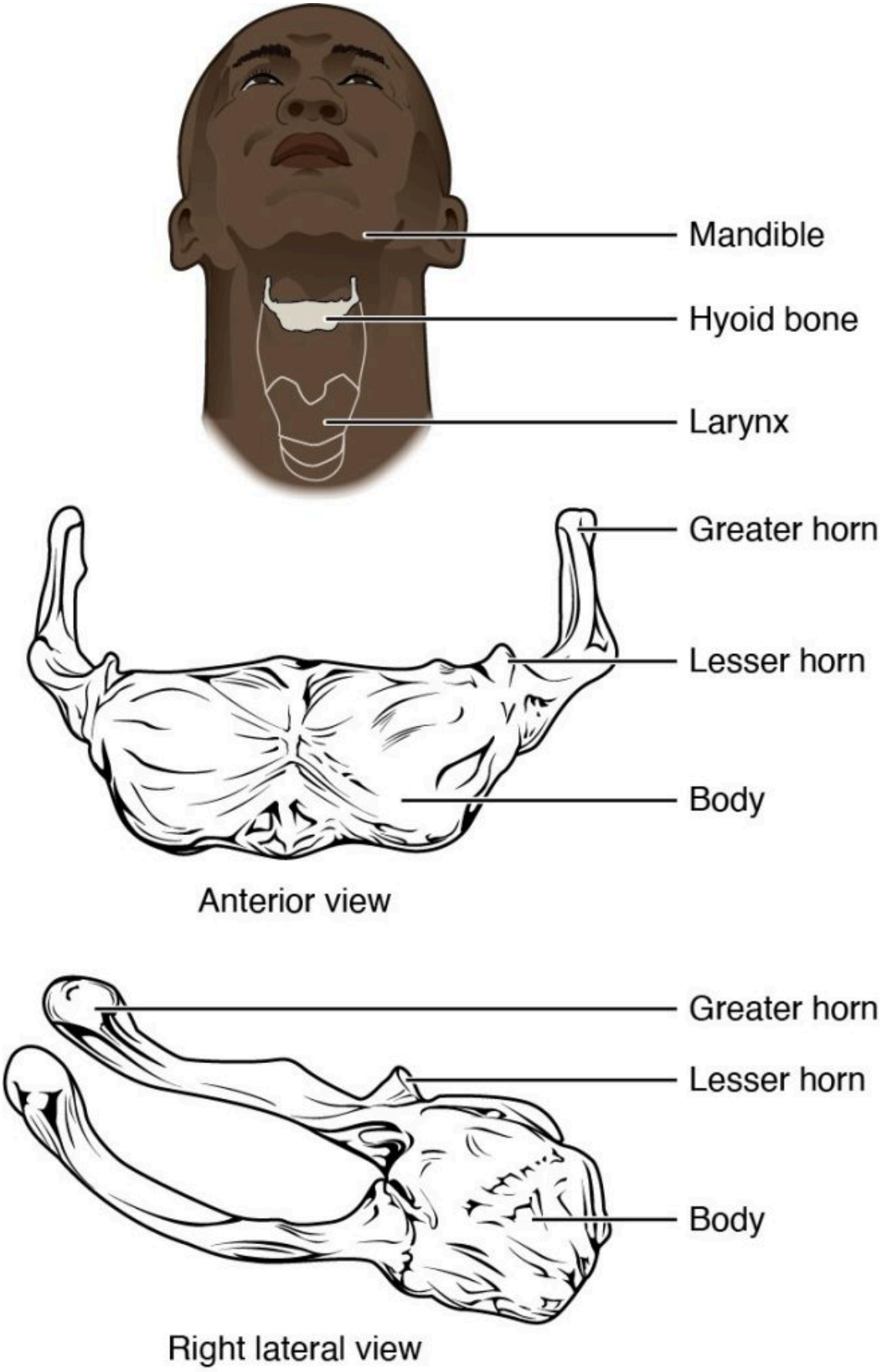


Figure 10.4 Hyoid

Vertebrae and Vertebral Column

The **vertebral column** consists of **vertebrae** that are separated by intervertebral disks. **Intervertebral disks** are made up of cartilage that act as shock absorbers and allow for flexibility in the spine. The spinal cord runs through the center of the vertebrae. See Figure 10.5[7] for an illustration of the parts of a vertebra. A **herniated disk** refers to a condition in which a disk protrudes beyond the normal confines of the vertebrae.

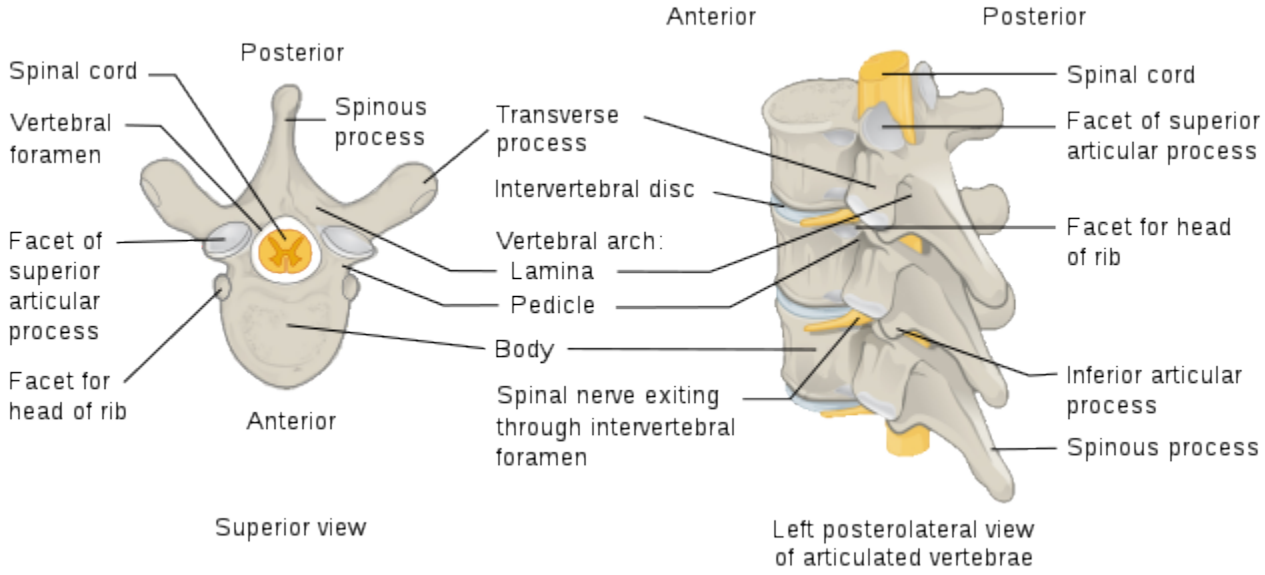


Figure 10.5 Vertebrae

Together, the vertebrae and intervertebral disks form the vertebral column, also known as the spinal column. It is a flexible column that supports the head, neck, and body and allows for their movements. It also protects the spinal cord, which passes down the back through openings in the vertebrae. View an illustration of the vertebral column in Figure 10.6.[8]

7. "718_Vertebra-en.svg" by Jmarchn is licensed under CC BY-SA 3.0

8. "Vertebral Column" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/7-3-the-vertebral-column

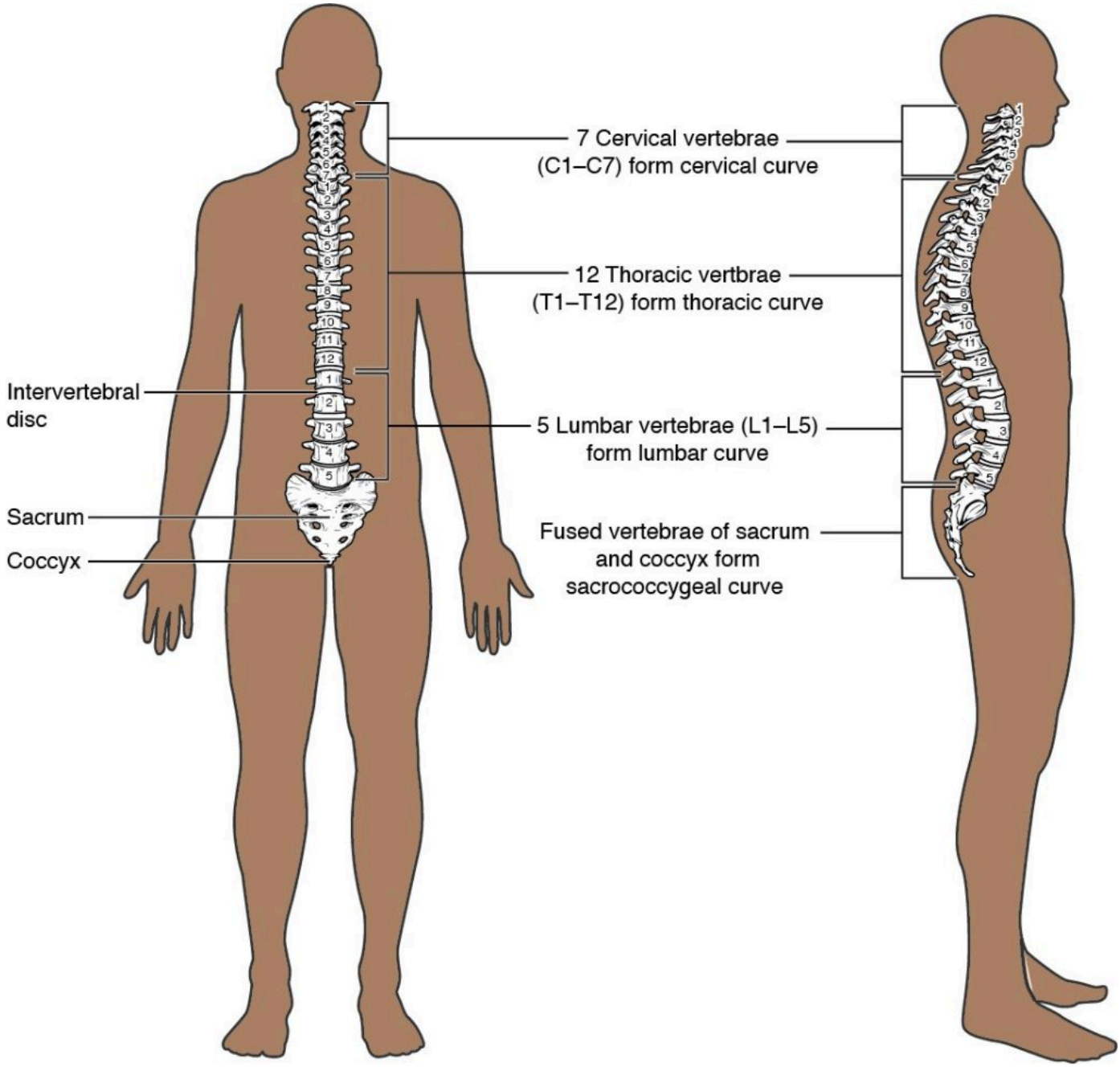


Figure 10.6 Vertebral Column

The vertebral column is normally curved, with two primary curvatures (thoracic and sacrococcygeal curves) and two secondary curvatures (cervical and lumbar curves).

VERTEBRAE REGIONS

The vertebrae are divided into five regions called the cervical, thoracic, lumbar, sacrum, and coccyx:

- **Cervical:** The first 7 vertebrae in the neck region, C1 to C7
- **Thoracic:** The next 12 vertebrae that form the outward curvature of the spine, T1 to T12
- **Lumbar:** The next 5 vertebrae that form the inner curvature of spine, L1 to L5
- **Sacrum:** The triangular-shaped bone at the base of the spine, formed by the fusion of five sacral vertebrae, a process that does not begin until after the age of 20 (See Figure 10.7[9] for an illustration of the sacrum.)
- **Coccyx:** The tailbone, formed by the fusion of four very small coccygeal vertebrae (See Figure 10.8[10] for an illustration of the coccyx.)

9. "Sacrum_-_anterior_view02.png" by BodyParts3D, made by DBCLS is licensed under CC BY 2.1 Japan

10. "Coccyx_-_anterior_view01.png" by BodyParts3D, made by DBCLS is licensed under CC BY 2.1 Japan

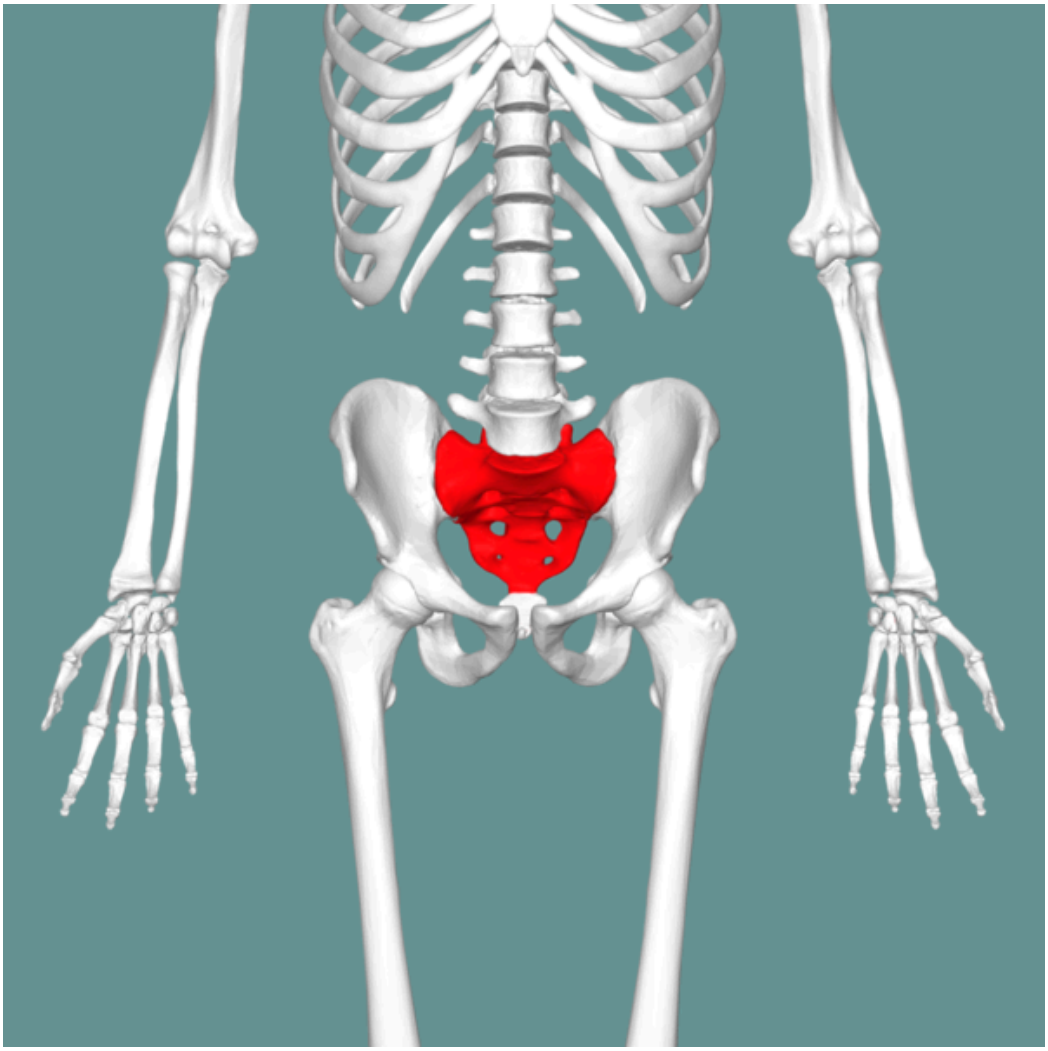


Figure 10.7 Sacrum

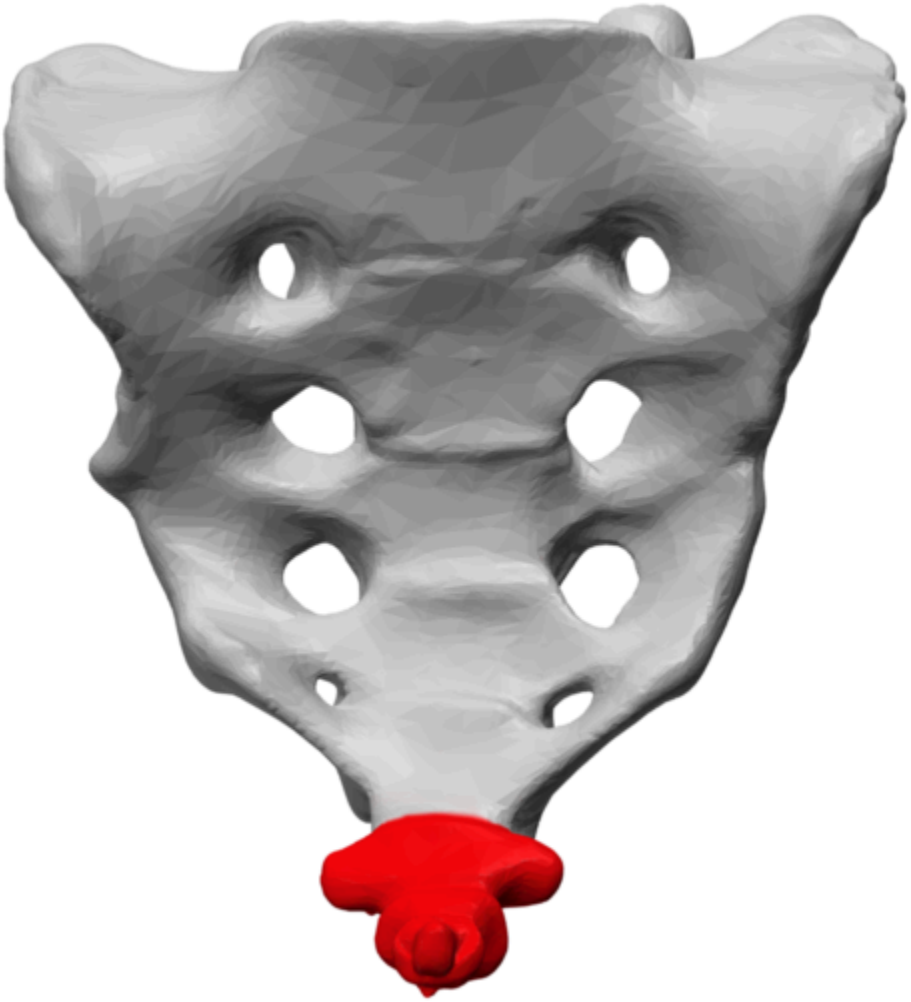


Figure 10.8 Coccyx

Thoracic Cage

The thoracic cage, commonly known as the rib cage, forms the chest (thorax). It consists of the sternum and 12 pairs of ribs, along with their costal cartilages. The ribs are anchored posteriorly to the 12 thoracic vertebrae

(T1–T12). See Figure 10.9[11] for an illustration of the thoracic cage. The thoracic cage protects the heart and lungs.

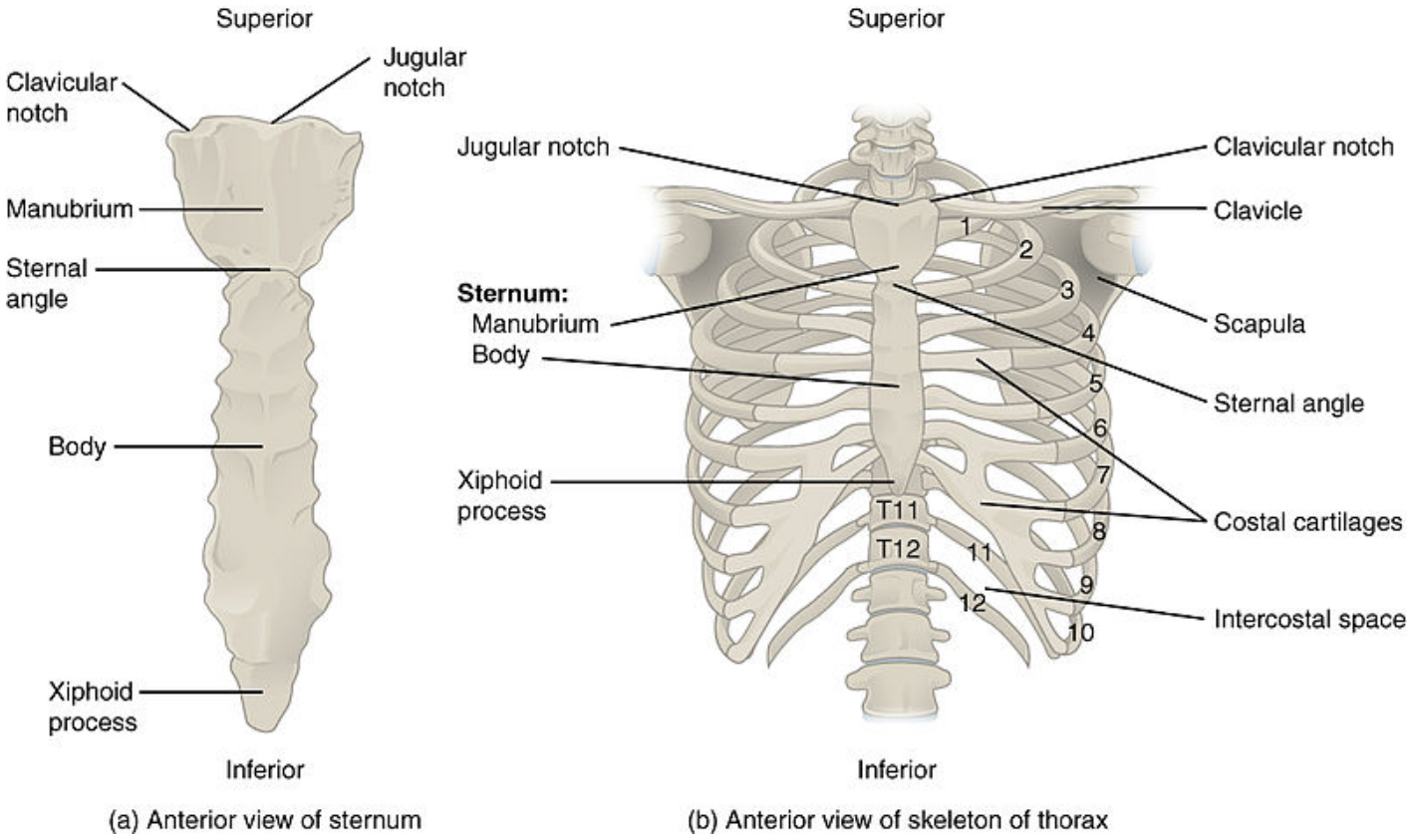


Figure 10.9 Thoracic Cage (a) Sternum and (b) 12 pairs of ribs

The **sternum**, also known as the breastbone, is divided into three parts:

- **Manubrium:** The upper portion of the sternum
- **Body:** The middle portion of the sternum
- **Xiphoid process:** The lower portion of the sternum made of cartilage

The 12 sets of ribs can be classified as true ribs, false ribs, and floating ribs:

- **True ribs:** Ribs 1-7 that are attached to the front of the sternum
- **False ribs:** Ribs 8, 9, and 10 that are attached to the cartilage that joins the sternum

11. "721_Rib_Cage.jpg" by OpenStax College is licensed under CC BY 3.0

- **Floating ribs:** Ribs 11 and 12 that are not attached to the front of the sternum

Intercostal means between the ribs. For example, people with labored breathing may experience intercostal retractions, where the muscles pull in between the ribs.

The Appendicular Skeleton

The appendicular skeleton includes the upper and lower limbs, plus the bones that attach each limb to the axial skeleton.[12]

Upper Limbs

The bones of the upper limbs include the bones of the arms, wrists, and hands. The shoulder attaches the upper limbs to the axial skeleton. See Figure 10.10[13] for an illustration of the upper limbs, shoulder, clavicle, and scapula.

12. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

13. "Human_arm_bones_diagram.svg" by LadyofHats Mariana Ruiz Villarreal is licensed in the Public Domain

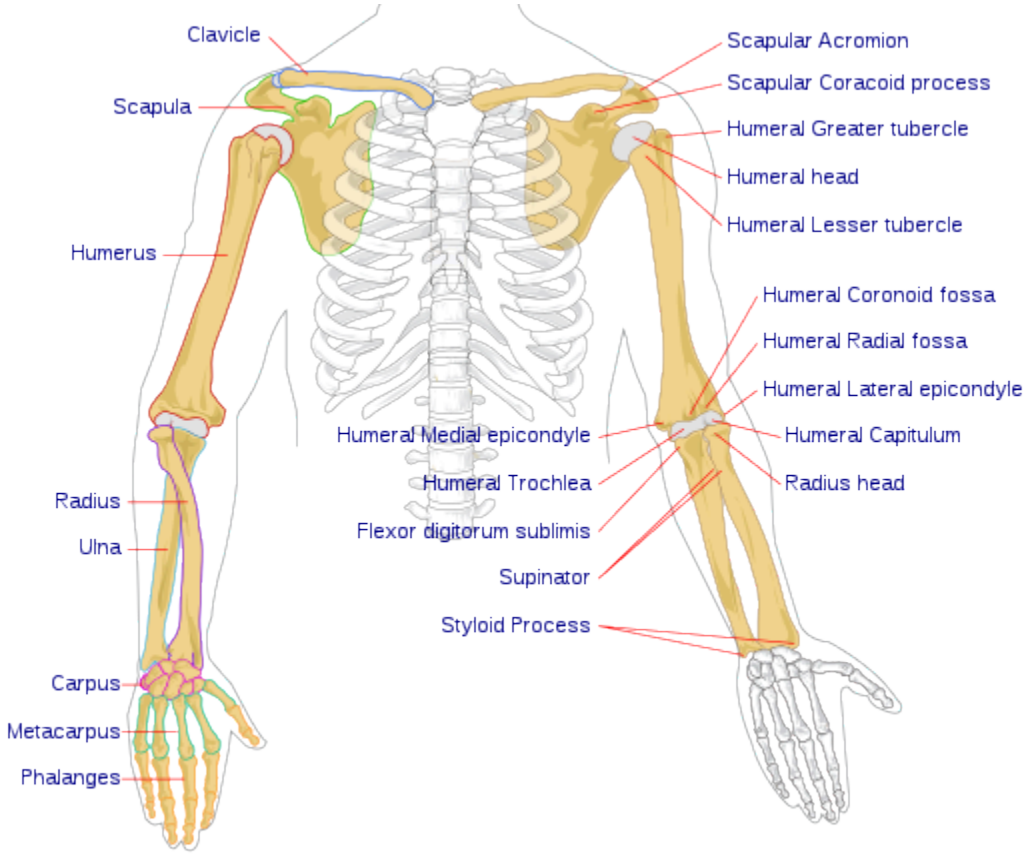


Figure 10.10 Upper Limbs and Shoulder

ARMS

There are three bones in each arm:

- **Humerus:** Upper arm
- **Radius:** The thumb side of the forearm
- **Ulna:** The fifth finger side of the forearm

View a supplementary YouTube video[14] on the radius and the ulna from UCDenver Anatomy Lab: Radius & ulna.

WRISTS, HANDS, AND FINGERS

See Figure 10.11[15] for an illustration of the bones of the wrist, hand, and fingers:

- **Carpals:** Wrist bones
- **Metacarpals:** Wrist bones
- **Phalanges:** Fingers (and toes)

A single finger is called a **phalanx** and is composed of three bones called the distal phalanx, medial phalanx, and proximal phalanx. The exception is the thumb, which only has two bones, the distal and proximal.

14. UCDenver Anatomy Lab 3244. (2014, August 31). *Radius & ulna* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=ThmvWFvHOmI

15. "541c7cf2586e9daaea40767bbc68011fdb8573b1.jpg" OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/8-2-bones-of-the-upper-limb

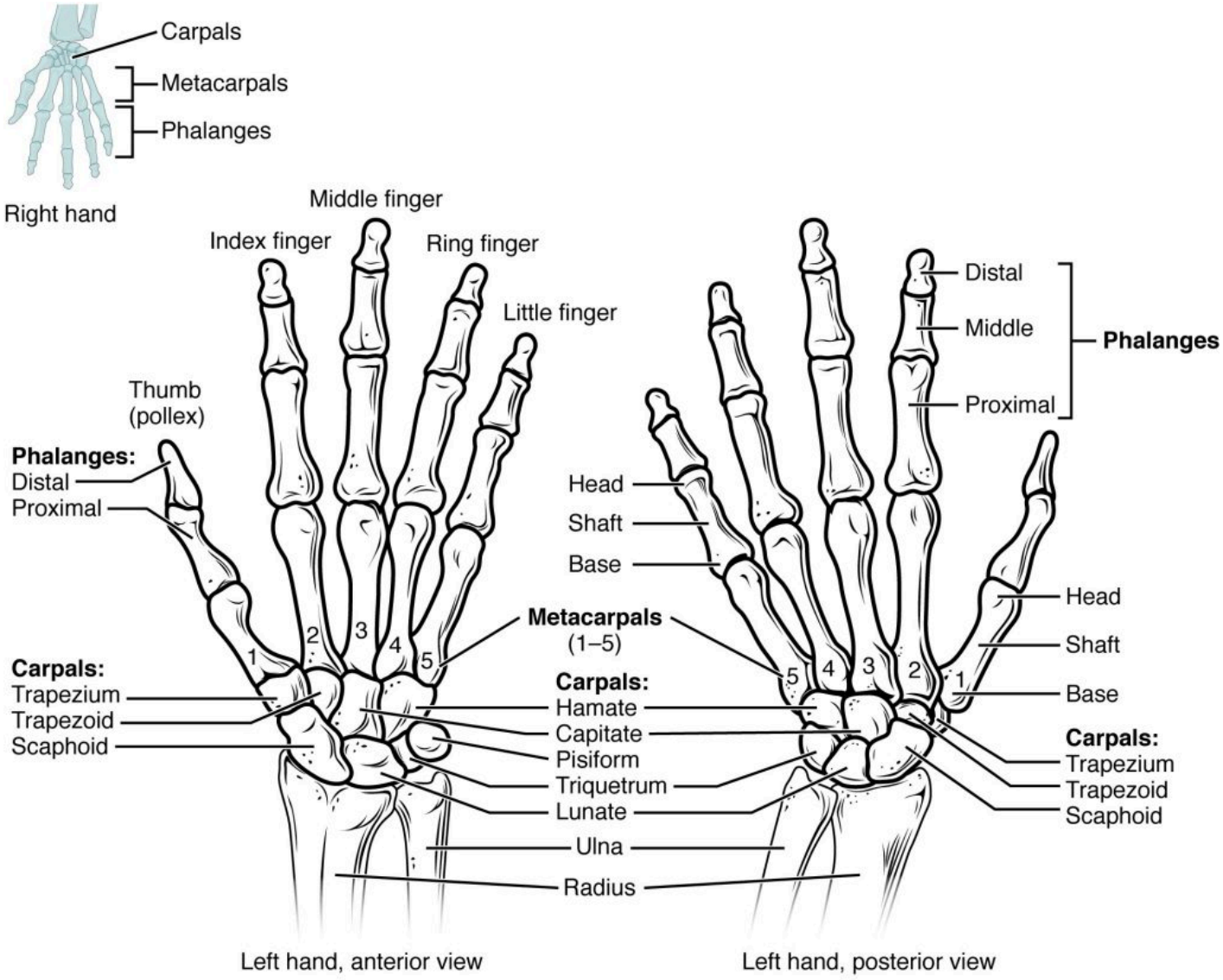


Figure 10.11 Bones of the Hands, Wrist, and Fingers

THE SHOULDER

Refer back to Figure 10.10 to view the bones of the shoulder that connect the arms to the axial skeleton and include the clavicle, scapula, and acromion:

- **Clavicle:** Connects the sternum to the scapula, also known as the collarbone
- **Scapula:** Shoulder blade
- **Acromion:** An extension from the scapula that forms the bony tip of the shoulder

Together, the clavicle, acromion, and spine of the scapula form a V-shaped

bony line that provides for the attachment of neck and back muscles that act on the shoulder, as well as muscles that pass across the shoulder joint to act on the arm.

Lower Limbs

The bones of the lower limbs include bones of the leg and the feet. The hip attaches the lower limbs to the axial skeleton.

LEG

See Figure 10.12[16] for an illustration of the leg bones, including the femur, patella, tibia, and fibula:

- **Femur:** Thigh bone, the longest and strongest bone in the human body
- **Patella:** Kneecap
- **Tibia:** The medial bone and main weight-bearing bone of the lower leg, commonly called the shin. The distal end of the tibia forms the **medial malleolus**, the bony protrusion on the medial side of the ankle.
- **Fibula:** The smaller, lateral bone of the lower leg. The distal end of the fibula forms the **lateral malleolus**, the bony protrusion on the lateral side of the ankle.

16. "Human_leg_bones_labeled.svg" by LadyofHats Mariana Ruiz Villarreal is licensed in the Public Domain

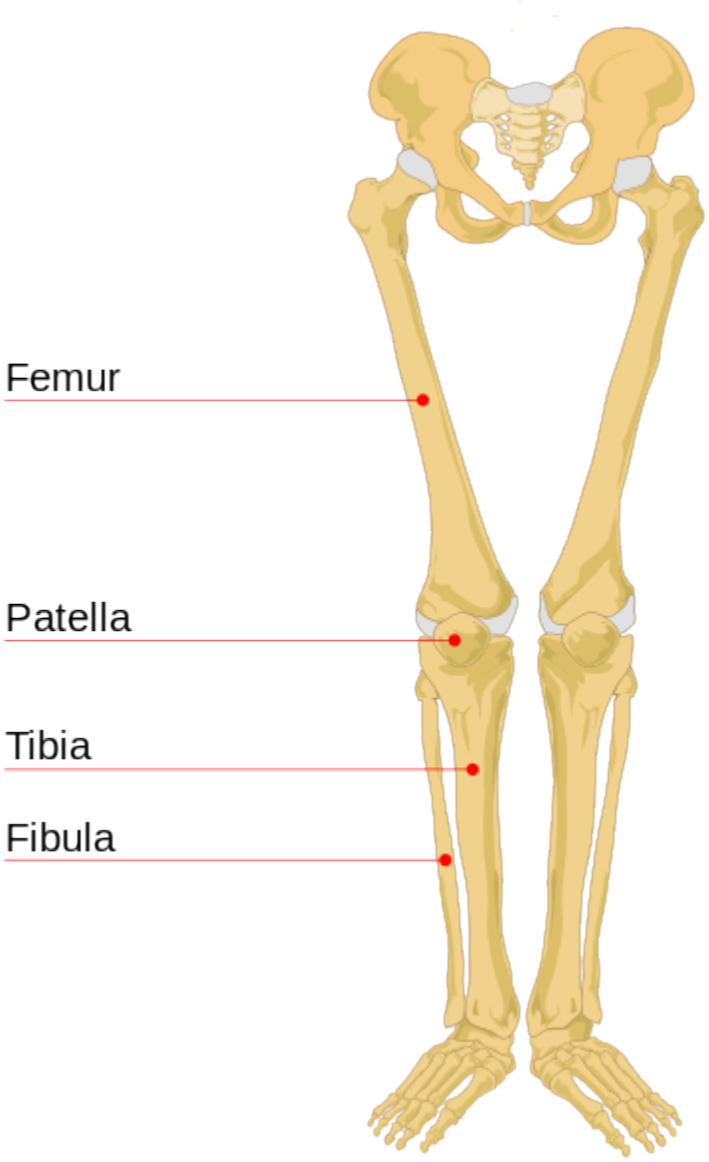


Figure 10.12 Leg Bones

FEET

See Figure 10.13[17] for an illustration of the bones of the ankles and feet. There are several foot bones, but the major bones include the tarsals, metatarsals, phalanges, and calcaneus:

- **Tarsals:** Bones of the posterior half of the foot

17. "812_Bones_of_the_Foot.jpg" by OpenStax College is licensed under CC BY 3.0

- **Metatarsals:** Bones of the anterior half of the foot
- **Phalanges:** Toes (and fingers). The **hallux** is the great toe.
- **Calcaneus:** Heel bone

Like the fingers, the toes are composed of three bones called the distal phalanx, medial phalanx, and proximal phalanx, with the exception of the great toe, which only has two bones, the distal and proximal.

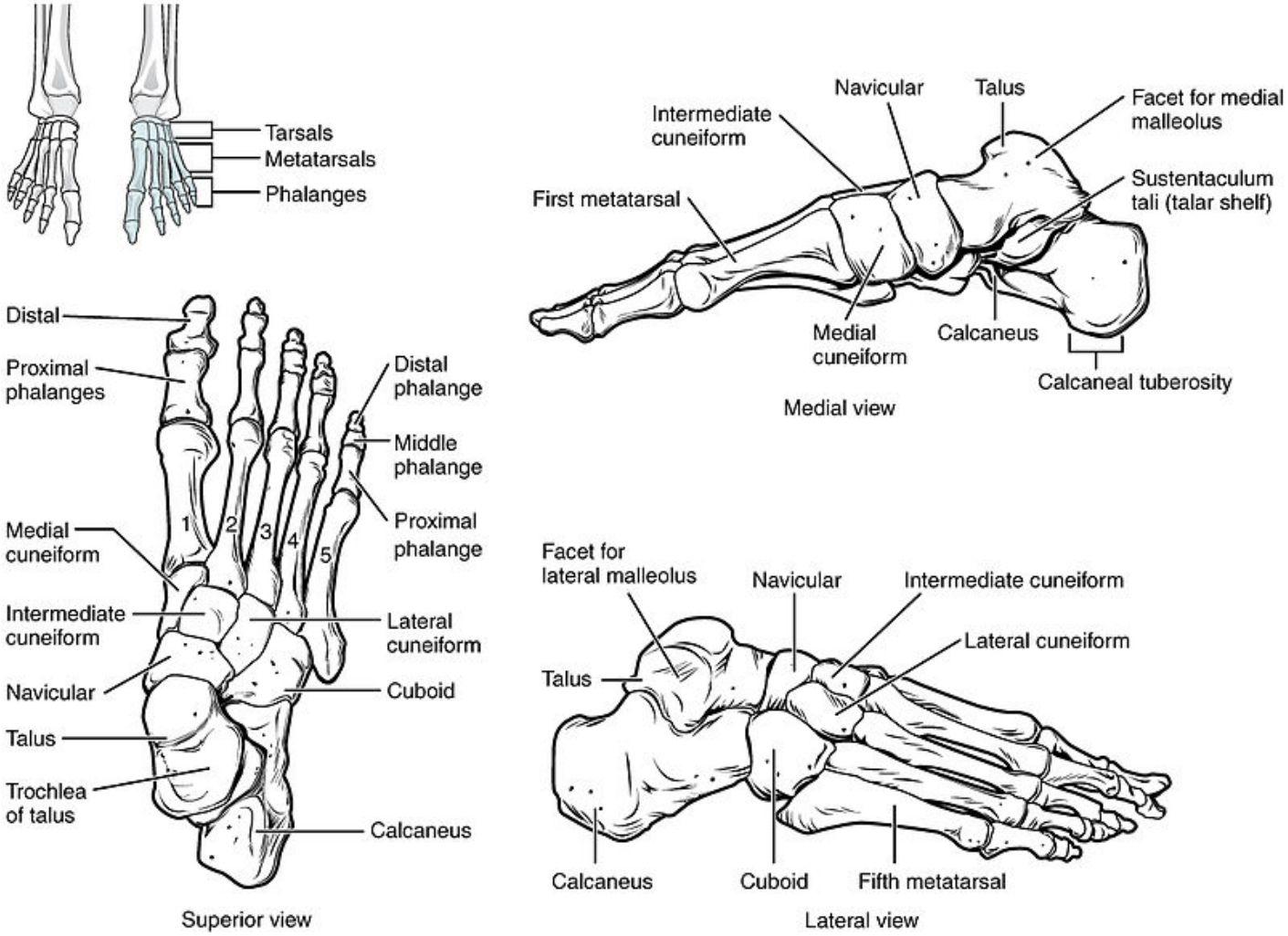


Figure 10.13 Bones of the Feet

THE HIP

The hip serves as the attachment point for each lower limb at the **acetabulum**, the large socket that holds the head of the femur. Each adult hip bone is formed by three separate pelvic bones, called the ilium, ischium, and pubis, that fuse together during the late teenage years.

The **ilium** is the superior region that forms the largest part of the hip bone. It is attached to the sacrum at the sacroiliac joint. The **ischium** forms the posteroinferior region of each hip bone and supports the body when sitting. The **pubis** forms the anterior portion of the hip bone. The pubis curves medially, where it joins to the pubis of the opposite hip bone at a specialized joint called the pubic symphysis. The pelvis, also referred to as the **pelvic girdle**, refers to this entire structure formed by the two hip bones: the sacrum and the coccyx. It surrounds the pelvic cavity and connects the vertebral column to the lower limbs.

See Figure 10.14[18] for an illustration of the hip and pelvis.

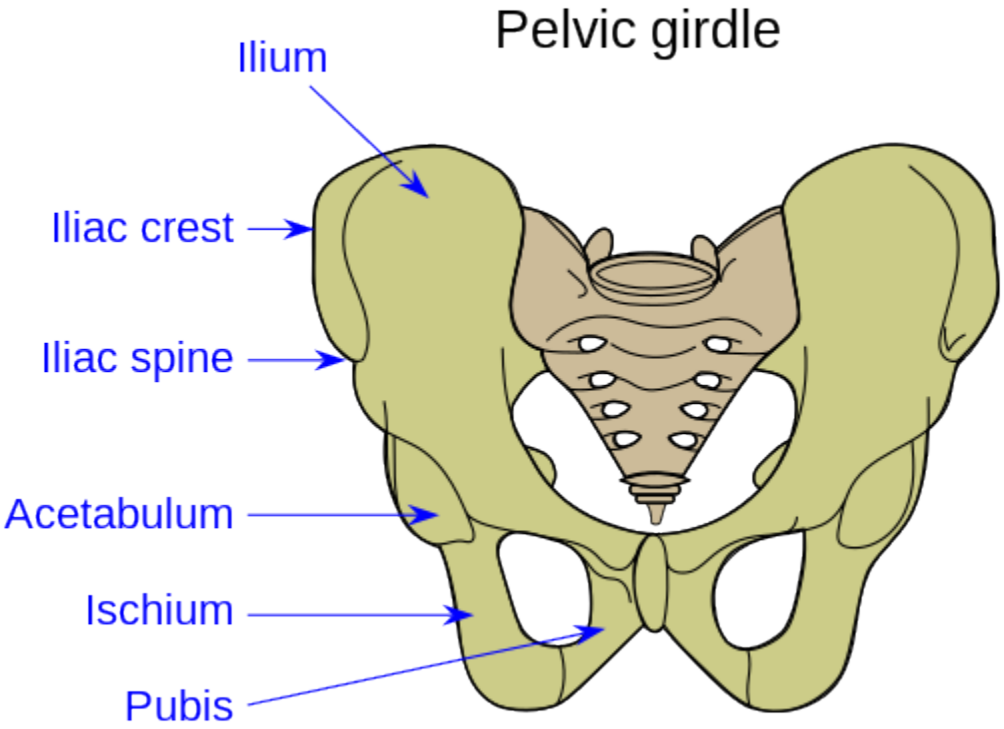


Figure 10.14 Hip and Pelvis

The shape of the pelvis is different for males and females. In general, the bones of the male pelvis are thicker and heavier because they have adapted to support a male's typically heavier physical build. Because the female pelvis has adapted for childbirth, it is wider than the male pelvis. The shape and size

18. "Pelvic_girdle_illustration.svg" by Fred the Oyster is licensed under CC BY 4.0

of the pelvis can be used during forensic assessment to identify if skeletal remains are male or female. See Figure 10.15[19] for a comparison of the female and male pelvis.

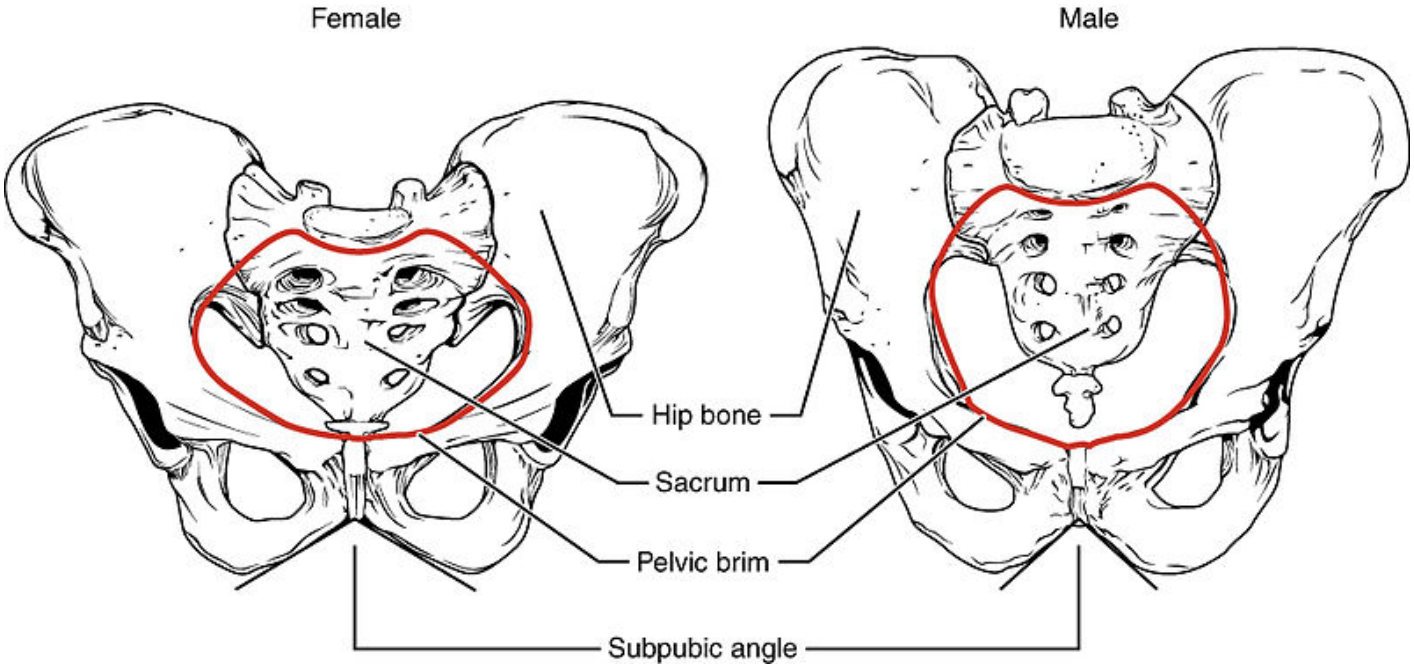


Figure 10.15 Comparison of Female and Male Pelvis

Joints

Joints, also called articulations, are places where two bones or bone and cartilage come together and form a connection. Joints allow for movement and flexibility in the body. **Dislocation** refers to displacement of a bone from its normal position in a joint. Joints are categorized based on their structures and are referred to as fibrous joints, cartilaginous joints, or synovial joints.

Fibrous Joints

Fibrous joints are nonmoveable joints where two bones are attached by fibrous connective tissue. For example, a **suture** is the narrow fibrous joint

19. "809_Male_Female_Pelvic_Girdle.jpg" by OpenStax College is licensed under CC BY 3.0

found between the skull bones. During infancy, the space between skull bones is filled with flexible material that allows the skull to grow as the baby's brain grows.

Cartilaginous Joints

Cartilaginous joints, also called amphiarthrosis or slightly movable joints, occur when two bones are connected by cartilage, a tough but flexible type of connective tissue. Examples of cartilaginous joints include the pubic symphysis and intervertebral disks.

Synovial Joints

Synovial joints, also called diarthroses or fully movable joints, have a fluid-filled space where two bones come together, called a joint cavity. Because the bones in a synovial joint are not directly connected to each other with fibrous connective tissue or cartilage, they are able to move freely against each other, allowing for increased joint mobility. Synovial joints are the most common type of joint in the body. A **synovial membrane** is the lining or covering of synovial joints, and **synovial fluid** is the lubricating fluid found between synovial joints. See Figure 10.16[20] for an illustration of a synovial joint.

20. "Figure_38_03_03.jpg" by CNX OpenStax is licensed under CC BY 4.0

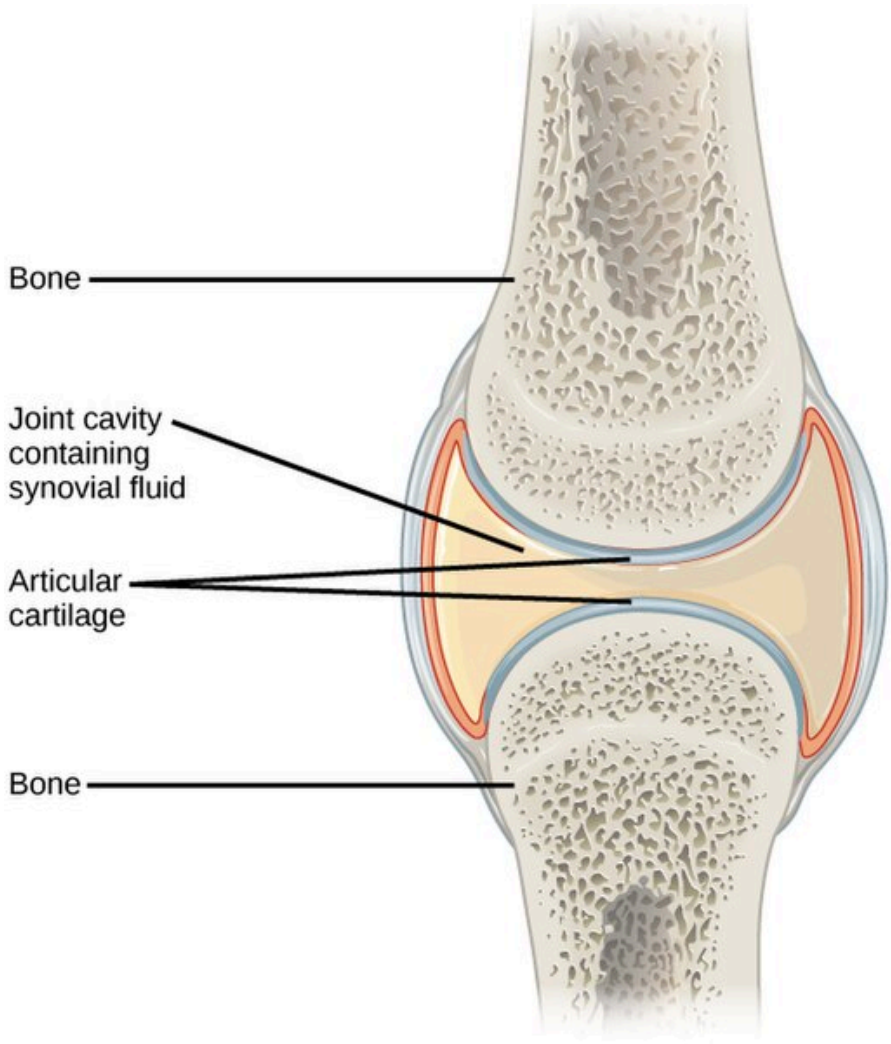


Figure 10.16 Synovial Joint

TYPES OF SYNOVIAL JOINTS

Synovial joints are categorized based on the shapes of the articulating surfaces of the bones that form each joint. The six types of synovial joints are pivot, hinge, condyloid, saddle, plane, and ball-and-socket joints. See Figure 10.17[21] for an illustration of the various types of synovial joints.

21. "909_Types_of_Synovial_Joints.jpg" by OpenStax College is licensed under CC BY 3.0

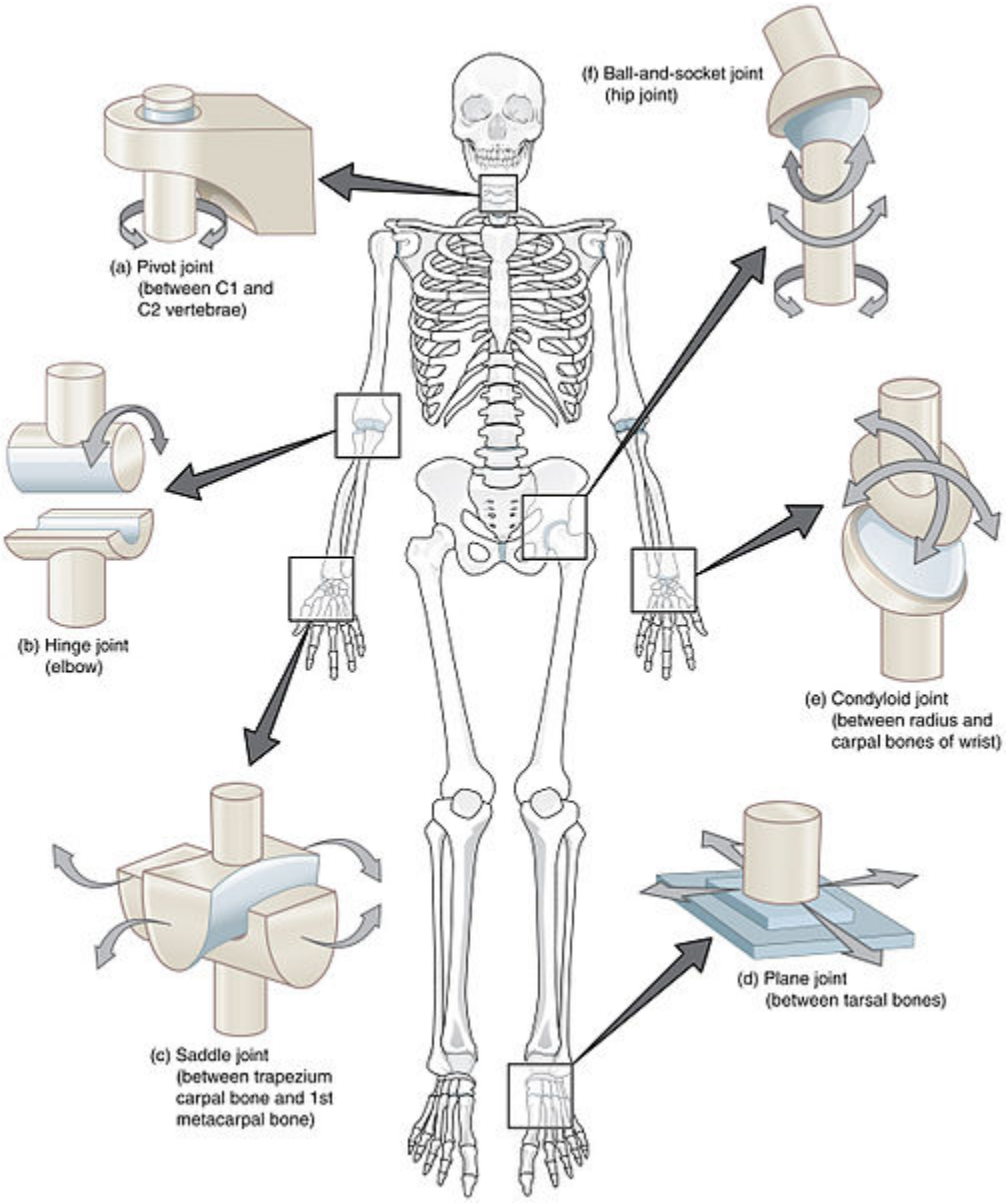


Figure 10.17 Types of Synovial Joints

A few synovial joints have a fibrocartilage structure called an arterial disk or meniscus located between the articulating bones. Arterial disks are generally small and oval-shaped, whereas a meniscus is larger and C-shaped. For example, the knee connects the femur (upper leg bone) to the tibia (one of the lower leg bones) with a meniscus.

In addition to the meniscus, the knee also contains ligaments, tendons, and additional cartilage. Ligaments in the knee include the anterior cruciate ligament (ACL), lateral collateral ligament (LCL), medial collateral ligament

(MCL), and posterior cruciate ligament (PCL). See Figure 10.18[22] for an illustration of these structures in the knee joint.

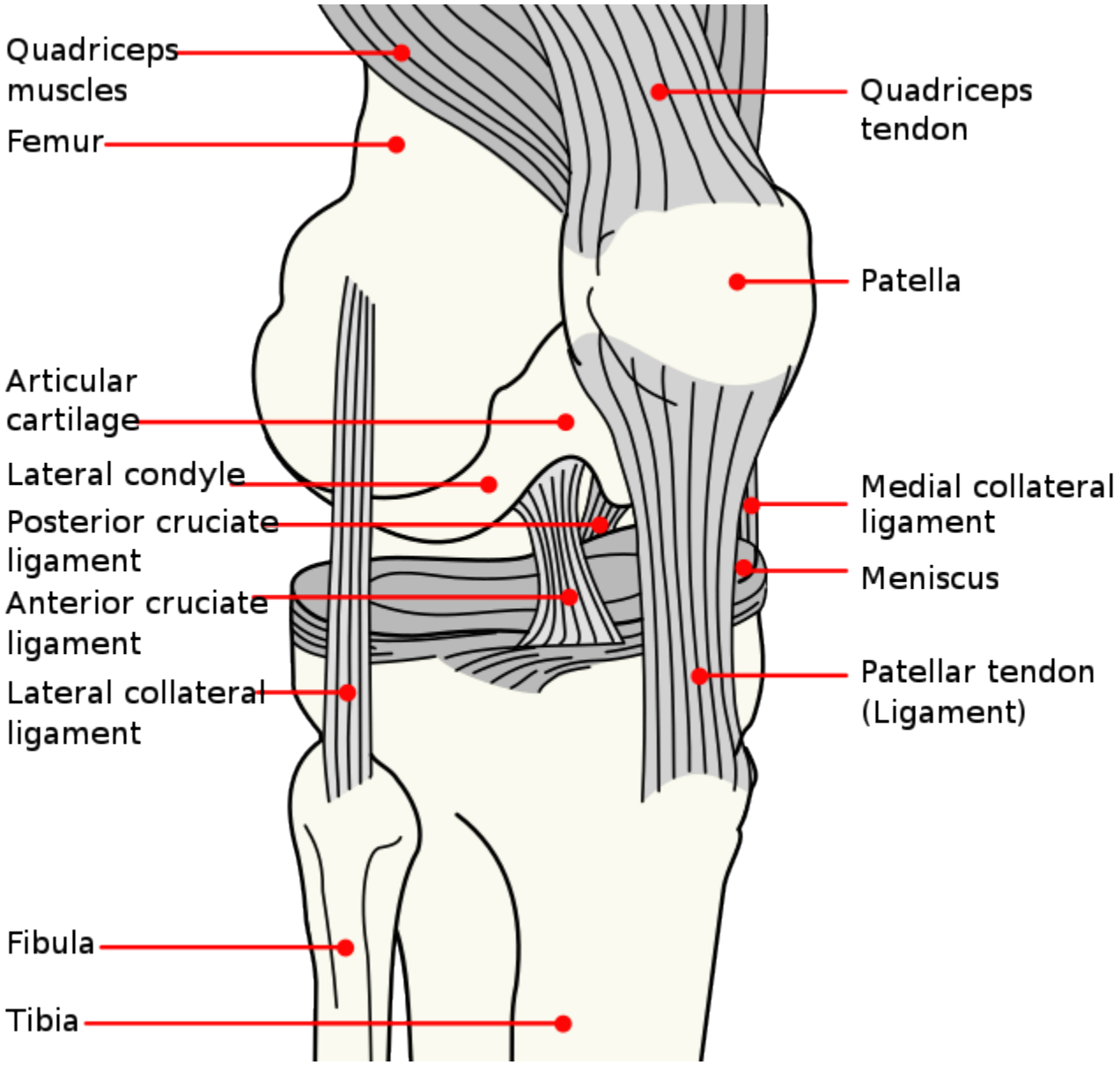


Figure 10.18 The Knee Joint Contains Ligaments, Tendons, Cartilage, and a Meniscus

22. "Knee_diagram.svg" by Mysid is licensed in the Public Domain

View a supplementary YouTube video[23] from Crash Course on joints: Joints: Crash Course Anatomy & Physiology #20.

Ligaments and Tendons

Other fibrous connective tissues in the musculoskeletal system include ligaments and tendons. **Ligaments** are narrow bands of fibrous connective tissue that connect a bone to a bone. A **tendon** is a narrow band of fibrous connective tissue that connects a muscle to a bone. Tendons are further discussed in the "Muscular System" subsection" below. See Figure 10.19[24] for an image that compares ligaments and tendons.

23. CrashCourse. (2015, May 26). *Joints: Crash Course Anatomy & Physiology #20* [Video]. All rights reserved. https://www.youtube.com/watch?v=DLxYDoN634c

24. "tendon-lig.jpg" by unknown author is licensed under CC BY-SA 4.0. Access for free at https://pressbooks.ccconline.org/bio106

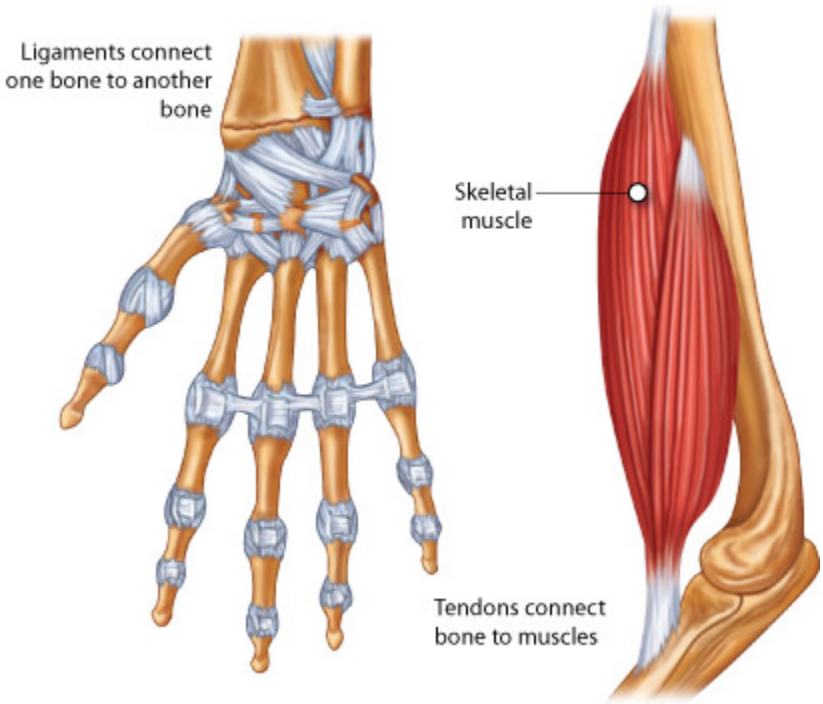


Figure 10.19 Comparison of Ligaments and Tendons

Bones

There are 206 bones in adults and 300 bones in children. As children grow, some bones fuse together to become 206 bones in adulthood.

There are three types of cells related to the growth and breakdown of bone. **Osteoblasts** are bone-forming cells, and **osteocytes** are mature bone cells. The dynamic nature of bone means that new bone tissue is constantly being formed; and old, injured, or unnecessary bone is dissolved for repair or for calcium release. The cells responsible for bone breakdown are **osteoclasts**. An equilibrium between osteoblasts and osteoclasts maintains healthy bone tissue. Two disorders caused by lack of equilibrium of these processes are osteopenia and osteoporosis. **Osteopenia** refers to abnormal reduction of bone mass, and during **osteoporosis** the bones become weak, brittle, and prone to fractures.

Bones contain more calcium (Ca+) than any other organ. When blood calcium levels decrease below normal levels, calcium is released from the bones by the osteoclasts, so there is an adequate supply for metabolic needs. In contrast, when blood calcium levels are increased, excess calcium is stored

in bone by the osteoblasts. This dynamic process of releasing and storing calcium goes on continuously.

The bones of the skeletal system are composed of inner spongy tissue referred to as bone marrow. There are two types of bone marrow called red and yellow. Red bone marrow produces the red blood cells, white blood cells, and platelets. Yellow bone marrow contains adipose tissue, which can serve as a source of energy.

> Review additional information about bone marrow and the production of red blood cells, white blood cells, and platelets in the "Hematological Alterations" chapter.

Muscular System

Types of Muscle

There are three major types of muscle tissue categorized as smooth, cardiac, and skeletal muscle. See Figure 10.20[25] for an illustration of these three types of muscle. Cardiac and skeletal muscles are **striated**, meaning they contain functional units called sarcomeres. Sarcomeres are composed of two protein filaments called actin and myosin that are responsible for muscular contraction.

25. "Types_Of_Muscle.jpg" by www.scientificanimations.com is licensed under CC BY-SA 4.0

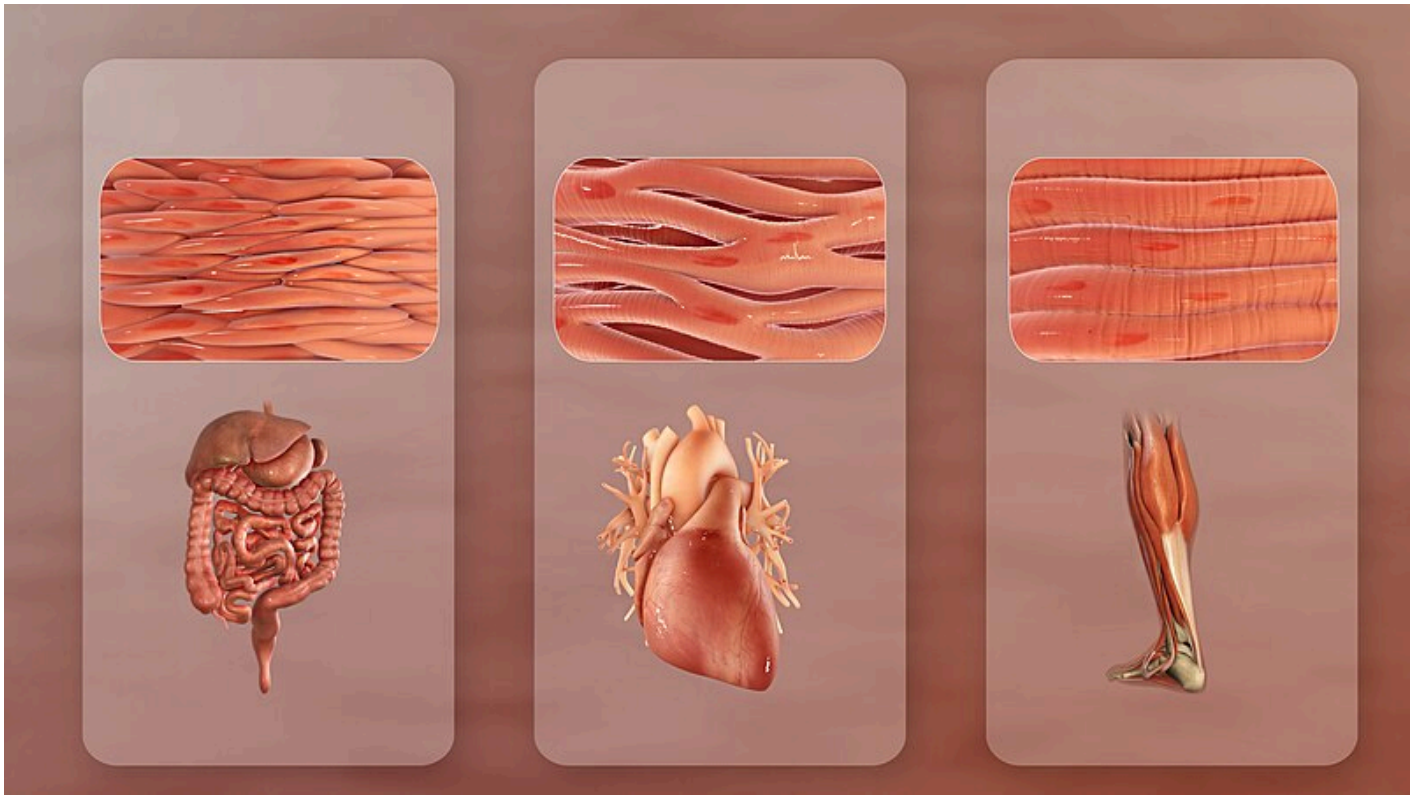


Figure 10.20 Muscle Types a) Smooth Muscle b) Cardiac Muscle c) Skeletal Muscle

SMOOTH MUSCLE

Smooth muscle is responsible for involuntary muscle movement. Smooth muscle is present in the following areas[26]:

- Walls of hollow organs, like the urinary bladder, uterus, stomach, and intestines, where muscle contractions cause the movement of fluids and other substances
- Walls of passageways, such as the arteries and veins of the circulatory system, where it causes vasodilation and vasoconstriction
- Tracts of the respiratory, urinary, and reproductive systems, where contraction and relaxation affect the movement of air, urine, and

26. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

reproductive fluids
- Eyes, where it functions to change the size of the pupil
- Skin, where it causes hair to stand erect in response to cold temperature or fear, commonly called goose bumps

CARDIAC MUSCLE

Cardiac muscle is only found in the heart. Highly coordinated contractions of cardiac muscle pump blood throughout the circulatory system. Cardiac muscle fiber cells are extensively branched and connected to one another at their ends to allow the heart to contract in a wavelike pattern and work as a pump.

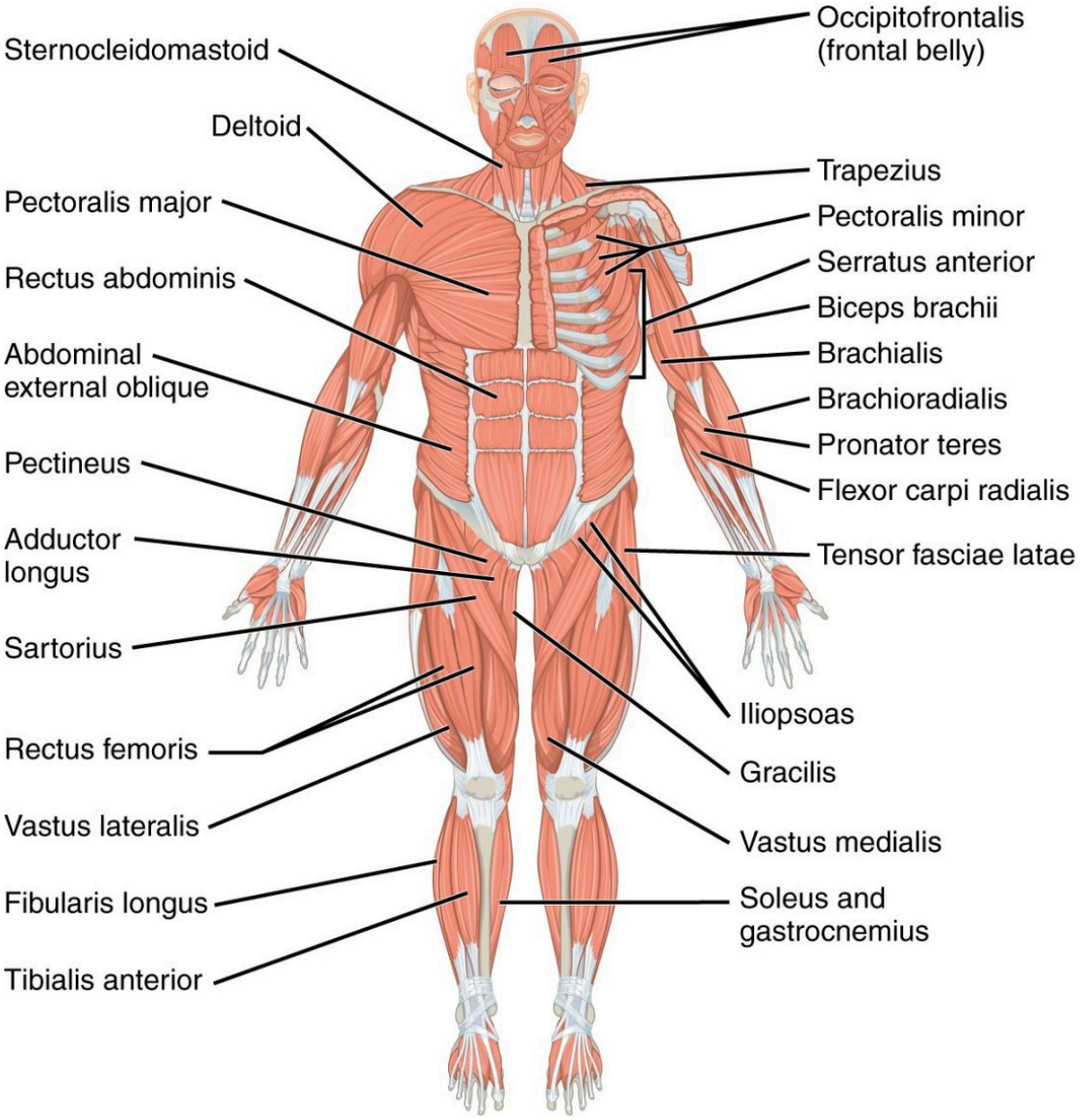
SKELETAL MUSCLE

Skeletal muscles are located throughout the body. They are under voluntary control and primarily produce movement of the arms, legs, back, and neck and maintain posture by resisting gravity. Small, constant adjustments of the skeletal muscles are needed for a person to hold their body upright or balanced in any position.

Skeletal muscles also have several additional functions. They are located throughout the body at the openings of internal tracts to control the movement of substances. These skeletal muscles allow voluntary control of functions such as swallowing, defecation, and urination in the digestive and urinary systems. Skeletal muscles also protect internal organs (particularly abdominal and pelvic organs) by acting as an external barrier against trauma and supporting the weight of the organs. They also contribute to maintaining homeostasis by generating heat. This heat generation is very noticeable during exercise, when sustained muscle movement causes a person's body temperature to rise, or conversely during cold environmental temperatures when shivering produces random skeletal muscle contractions to generate heat. Skeletal muscles also play a role in blood flow. For example, the contraction of skeletal muscles during walking helps promote blood flow and reduces the risk of blood clot formation.

See Figure 10.21[27] for an illustration of the major skeletal muscles of the body. For the anterior and posterior views in this figure, superficial muscles are shown on the right side of the image, and deep muscles are shown on the left side of the image. For the legs, superficial muscles are shown in the anterior view while the posterior view shows both superficial and deep muscles.

27. "1105_Anterior_and_Posterior_Views_of_Muscles.jpg" by OpenStax is licensed under CC BY 4.0



Major muscles of the body.
Right side: superficial; left side: deep (anterior view)

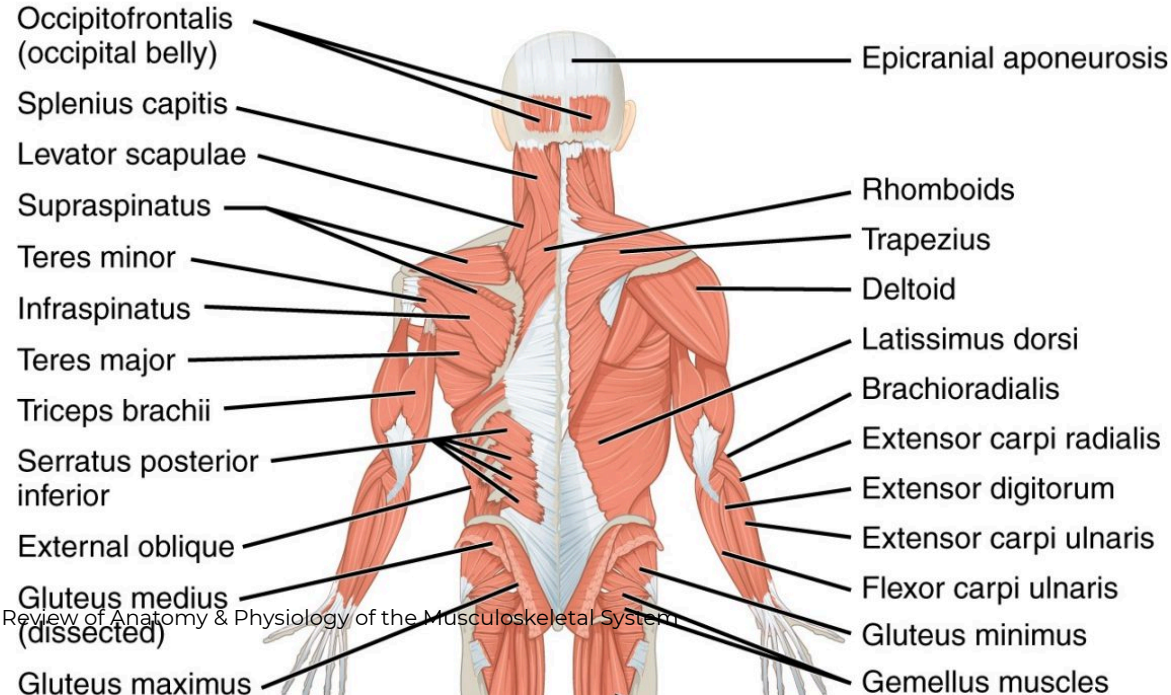


Figure 10.21 Muscular System

Muscles are named based on various characteristics, such as the following:

- **Body location:** The area of the body, for example, biceps, triceps, and quadriceps
- **Size:** The size of the muscle, such as maximus (largest) and minimus (smallest)
- **Shape:** The shape of the muscle, such as deltoid (triangular) or trapezius (trapezoid)
- **Action:** The action of the muscle, such as flexor (i.e., to flex) or adductor (i.e., towards midline of body)
- **Fiber direction:** The direction of the muscle fibers, such as external oblique

Major Skeletal Muscles

Major skeletal muscles include the following:

- **Biceps brachii:** Muscle on the anterior upper arm
- **Biceps brachialis:** Muscle located in the arm that flexes the elbow joint and rotates the forearm
- **Deltoid:** A large triangular muscle covering the shoulder joint
- **Gastrocnemius:** The chief muscle of the calf of the leg
- **Gluteus maximus:** The largest and outermost of the three gluteal muscles in the buttocks
- **Latissimus dorsi:** A large muscle in the back
- **Pectoralis major:** A thick, fan-shaped muscle situated on the chest
- **Quadriceps:** A large muscle group on the front of the thigh
- **Rectus abdominis:** A paired muscle running vertically on each side of the anterior wall of the abdomen
- **Triceps brachii:** Muscle on the posterior of the upper arm

Tendons

As previously mentioned in "The Appendicular Skeletal" subsection, **tendons** attach muscles to bones. For example, consider the Achilles tendon, hamstring, rotator cuff, and quadriceps tendons. The **Achilles tendon** attaches the calf muscles to the heel bone. The **hamstring** refers to five tendons at the back of a person's knee that connect a group of three hamstring muscles to bones in the pelvis, knee, and lower leg. The **rotator cuff** is a group of muscles and tendons that stabilize the shoulder. The quadriceps tendon attaches the quadriceps muscle to the top of the kneecap. See Figure 10.22[28] for an illustration of the quadriceps tendon.

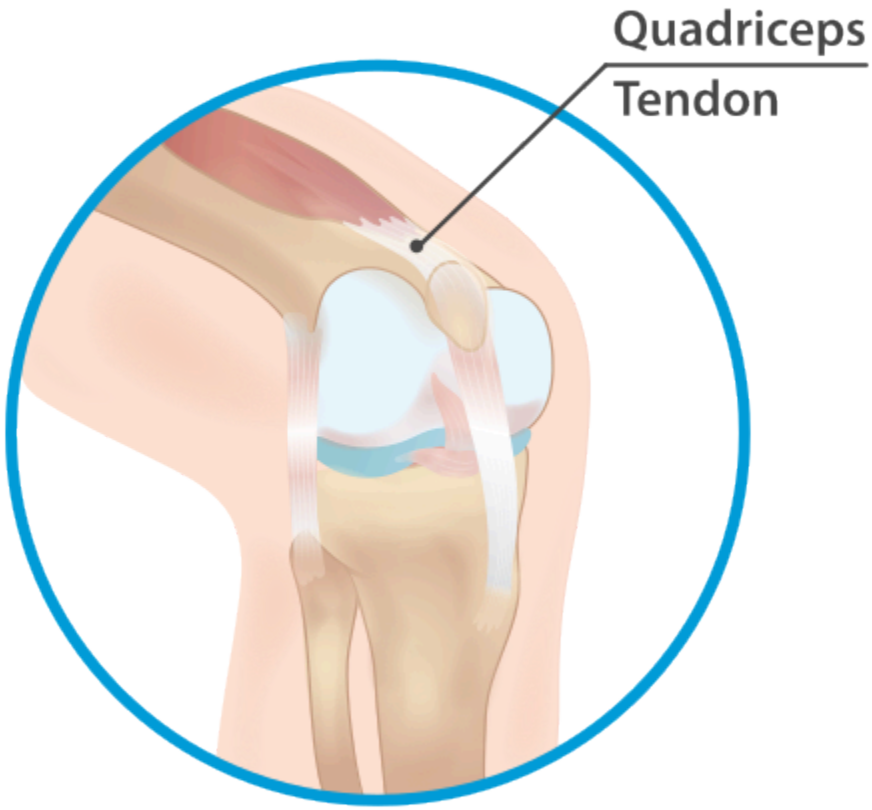


Figure 10.22 Tendon

28. "Quadriceps_tendon.svg" by InjuryMap is licensed under CC BY-SA 4.0

Function of Muscles

The main function of the muscular system is movement. Muscles work as antagonistic (opposing) pairs. As one muscle contracts, another muscle relaxes. This contraction pulls on the bones and assists with movement. Contraction is the shortening of muscle fibers whereas relaxation is the lengthening of fibers. This sequence of relaxation and contraction is stimulated by the nervous system.

There are many types of actions that are caused by the contraction and relaxation of muscles, such as flexion, extension, abduction, adduction, rotation, dorsiflexion, plantar flexion, supination, and pronation. These muscle actions are summarized in Table 10.2. See Figures 10.23[29] and 10.24[30] for illustrations of these movements.

Table 10.2. Muscle Actions

29. "Body_Movements_I.jpg" by Tonye Ogele CNX is licensed under CC BY-SA 3.0

30. "Body_Movements_II.jpg" by Tonye Ogele CNX is licensed under CC BY-SA 3.0

Action	Description
Flexion	Movement that decreases the angle between two bones, such as bending the arm at the elbow.
Extension	Movement that increases the angle between two bones, such as straightening the arm at the elbow.
Abduction	Movement of a limb away from the midline of the body.
Adduction	Movement of a limb toward the midline of the body.
Rotation	Circular movement around a central point. Internal rotation is toward the center of the body, and external rotation is away from the center of the body.
Dorsiflexion	Decreasing the angle of the foot and the leg (i.e., the foot moves upward toward the knee). This movement is the opposite of plantar flexion.
Plantar Flexion	Increasing the angle of the foot and leg (i.e., the moves foot downward toward the ground, such as when pressing down on a gas pedal in a car).
Supination	Movement of the hand or foot turning upward. When applied to the hand, it is the act of turning the palm upwards. When applied to the foot, it is the outward roll of the foot/ankle during normal movement.
Pronation	Movement of the hand or foot turning downward. When applied to the hand, it is the act of turning the palm downward. When applied to the foot, it is the inward roll of the foot/ankle during normal movement.
Eversion	Excessive movement when turning outward the sole of the foot away from the body's midline, a common cause of an ankle sprain.
Inversion	Excessive movement when turning inward the sole of the foot towards the median plane, a common cause of an ankle sprain.

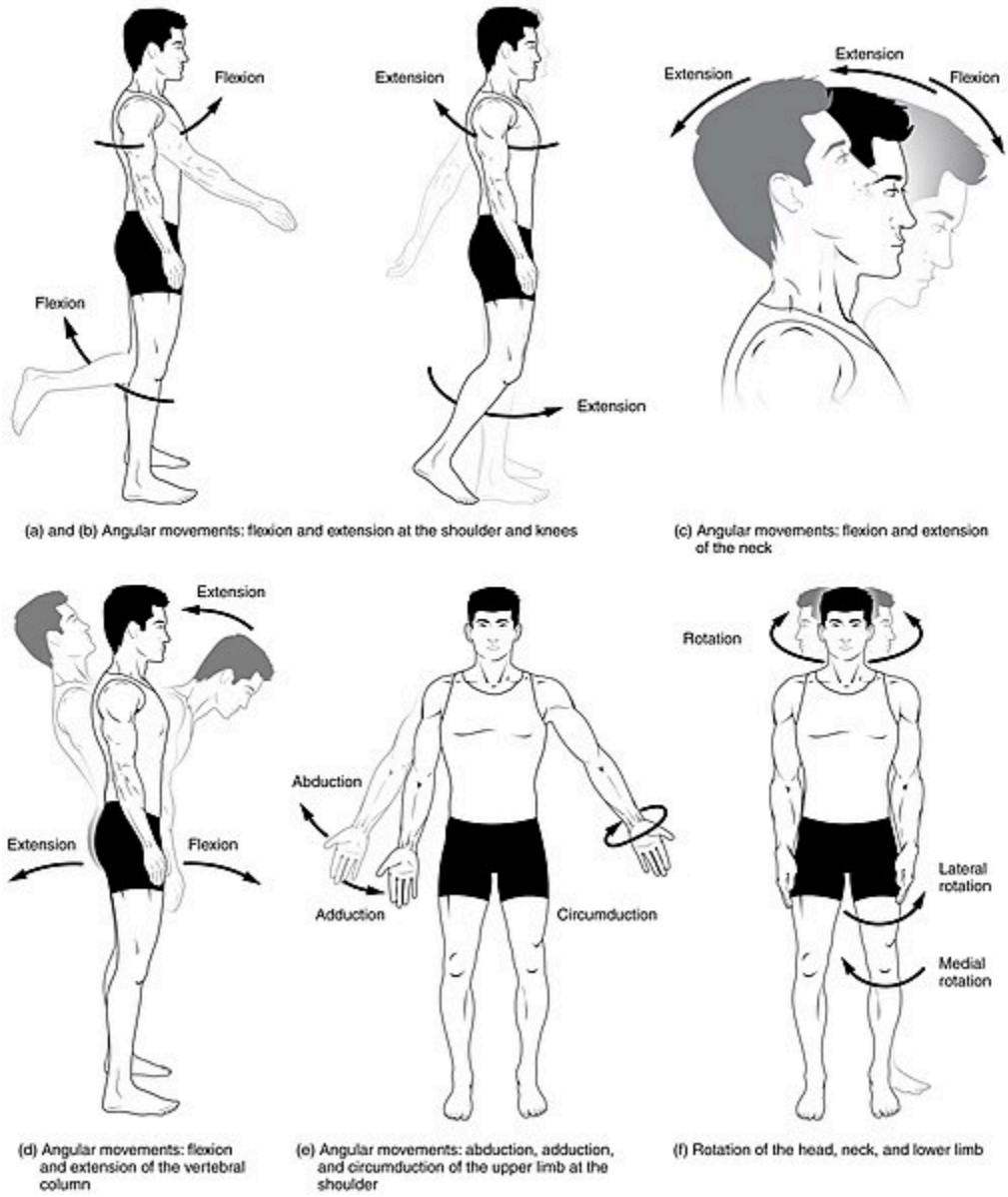


Figure 10.23 Flexion, Extension, Adduction, Abduction, Circumduction, and Rotation

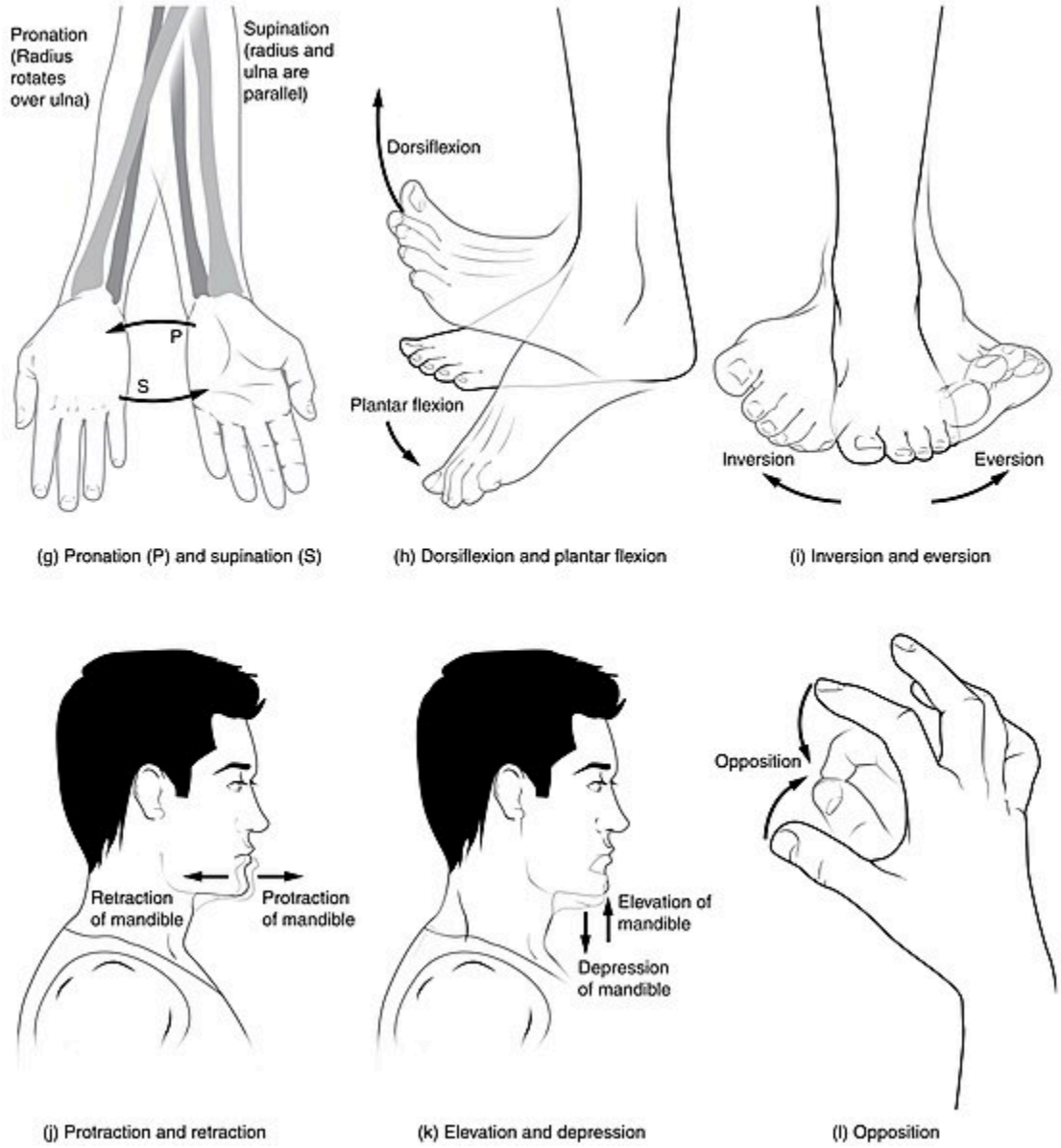


Figure 10.24 Pronation, Supination, Dorsiflexion, Plantar Flexion, Inversion, Eversion, Protraction, Retraction, Elevation, Depression, and Opposition

View supplementary YouTube videos[31,32,33,34,35] on the following topics:



31. RegisteredNurseRN. (2021, March 3). *Flexion and extension anatomy: Shoulder, hip, forearm, neck, leg, thumb, wrist, spine, finger* [Video]. YouTube. Used with permission. All rights reserved. https://www.youtube.com/watch?v=p4xbehGmkmk

32. RegisteredNurseRN. (2021, March 29). *Abduction and adduction of wrist, thigh, fingers, thumb, arm | Anatomy body movement terms* [Video]. YouTube. Used with permission. All rights reserved. https://www.youtube.com/watch?v=qcxE9uql8g4

33. RegisteredNurseRN. (2021, January 11). *Inversion and eversion of the foot, ankle | Anatomy body movement terms* [Video]. YouTube. Used with permission. All rights reserved. https://youtu.be/4HuxLWQykxk?feature=shared.

34. RegisteredNurseRN. (2020, December 29). *Dorsiflexion and plantar flexion of foot | Anatomy body movement terms* [Video]. YouTube. Used with permission. All rights reserved. https://www.youtube.com/watch?v=e6WugOzgFIM

35. Dr. Matt & Dr. Mike. (2021, February 7). *Joint movements* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=tAJjXvumL7E

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Joint movements

10.3 General Musculoskeletal System Assessment

Risk Factors and Social Determinants of Health Related to the Musculoskeletal System

Several risk factors can affect the health of the musculoskeletal system[1,2,3,4]:

- **Age:** With aging, the risk of musculoskeletal problems increases due to natural wear and tear on joints, decreased bone density, and reduced muscle mass. As individuals age, muscle fibers decrease in size and number. As a result, the muscle tissue can atrophy and deteriorate from a lack of use. As individuals age, they also experience the loss of minerals within the bones, specifically calcium and phosphorus.
- **Genetics:** Family history of conditions such as osteopenia, osteoporosis, arthritis, or scoliosis can increase risk for musculoskeletal disorders.
- **Gender:** Women are prone to musculoskeletal conditions like osteoporosis, especially after menopause, due to hormonal changes.

1. Centers for Disease Control & Prevention. (n.d.). *Work-related musculoskeletal disorders and ergonomics*. https://www.cdc.gov/niosh/ergonomics/

2. World Health Organization. (2022). *Musculoskeletal health*. https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions

3. Pouresmaeili, F., Kamalidehghan, B., Kamarehei, M., & Goh, Y. M. (2018). A comprehensive overview on osteoporosis and its risk factors. *Therapeutics Clinical Risk Management, 14*, 2029-2049. https://doi.org/10.2147/tcrm.s138000

4. Tsai, A. J. (2019). Disparities in osteoporosis by race/ethnicity, education, work status, and economic status in the United States. *European Journal of Internal Medicine, 64*, 85-89. https://doi.org/10.1016/j.ejim.2019.04.011

- **Nutrition:** Inadequate intake of essential nutrients like calcium and vitamin D can weaken bones, leading to conditions such as osteoporosis.
- **Concurrent medical conditions:** Conditions like lupus and other autoimmune diseases can affect the musculoskeletal system. Chronic conditions like cardiovascular or respiratory diseases can cause activity intolerance that affects an individual's ability to exercise and maintain muscle strength and bone density. Chronic endocrine disorders or medications affecting hormone levels can also contribute to decreased bone density.
- **Obesity:** Excess body weight puts extra strain on the joints, particularly in the knees, hips, and spine, leading to increased risk of arthritis and other joint-related issues.
- **Sedentary lifestyle:** Lack of regular physical activity contributes to muscle weakness, reduced flexibility, and decreased bone density, all of which increase the risk of musculoskeletal problems.
- **Smoking:** Smoking is linked to decreased bone density and can impair the body's ability to heal from musculoskeletal injuries.
- **Occupational factors/Repetitive movements/Previous injuries:** Jobs that involve repetitive movements, heavy lifting, or poor ergonomics can increase the risk of musculoskeletal injuries or conditions. Previous musculoskeletal injuries can also increase the risk of recurrent issues or chronic conditions.

Cultural Factors

Several cultural factors can impact musculoskeletal health. Dietary intake of calcium and vitamin D can be affected by cultural preferences for certain foods or dietary restrictions due to religious beliefs. Some cultures value intense physical training regimens, high-impact exercises, or martial arts that may increase risk for musculoskeletal disorders such as fractures, sprains, or

strains. Additionally, cultural beliefs and stigmas about health care can impact musculoskeletal health if treatment is delayed.[5,6]

Socioeconomic Factors

Several socioeconomic factors may influence musculoskeletal health. Access to health care services plays a crucial role, as individuals with limited access may experience delays in diagnosis and treatment, leading to exacerbated musculoskeletal conditions. For example, individuals with limited health care resources may not seek treatment for a fracture or injury, allowing it to heal on its own and potentially resulting in limitation in function.

Socioeconomic status can impact access to nutritious food sources. Calcium, vitamin D, and adequate protein sources play a significant role in muscle and bone health and healing, but economic limitations can impact the ability to purchase foods with these nutrients. Additionally, physically demanding occupations can cause muscle strain or injury. For example, nurses are at risk for back injuries related to repositioning clients. Addressing socioeconomic determinants of health is vital for promoting improved musculoskeletal health across diverse populations.[7,8]

5. Tsai, A. J. (2019). Disparities in osteoporosis by race/ethnicity, education, work status, and economic status in the United States. *European Journal of Internal Medicine, 64*, 85-89. https://doi.org/10.1016/j.ejim.2019.04.011

6. Noh, J., Park, H., Kim, M., Kown, Y., D., & Minji, K. (2018). Gender differences and socioeconomic factors related to osteoporosis: A cross-sectional analysis of nationally representative data. *Journal of Women's Health, 27*(2), 196-202. https://pure.rug.nl/ws/files/63546240/jwh.2016.6244.pdf

7. Tsai, A. J. (2019). Disparities in osteoporosis by race/ethnicity, education, work status, and economic status in the United States. *European Journal of Internal Medicine, 64*, 85-89. https://doi.org/10.1016/j.ejim.2019.04.011

8. Noh, J., Park, H., Kim, M., Kown, Y. D., & Minji, K. (2018). Gender differences and

General Assessment of the Musculoskeletal System

Nurses and other health professionals assess factors that impact the musculoskeletal system, as well as signs and symptoms of disorders that affect movement and function.

Health History

Completing a detailed health history can provide cues for areas of potential concern in the musculoskeletal system, including obtaining a history of chronic musculoskeletal disorders and other illnesses, fractures, dislocations, sprains, and surgeries related to bones, joints, or muscles.

Assessing a client's family history also contributes cues for potential musculoskeletal risks. For example, many musculoskeletal disorders like osteoporosis or scoliosis can have a genetic link.

Medications can also impact musculoskeletal health. For example, antibiotics such as fluoroquinolones increase the risk of tendonitis or tendon rupture. Additionally, prolonged use of corticosteroids also impacts musculoskeletal health by decreasing bone density and increasing risk for bone fracture.

Other important health history factors include exercise habits, occupation and repetitive stress, and dietary factors (specifically calcium and vitamin D intake). Additionally, congenital or developmental factors must be considered that affect musculoskeletal growth patterns.

If a musculoskeletal disorder is identified, a comprehensive pain assessment is completed, as well as a functional assessment to determine its impact on the ability to complete activities of daily living. This data is used to plan appropriate interventions and restore function.[9]

socioeconomic factors related to osteoporosis: A cross-sectional analysis of nationally representative data. *Journal of Women's Health, 27*(2), 196-202. https://pure.rug.nl/ws/files/63546240/jwh.2016.6244.pdf

9. Villa-Forte, A. (2024). *Medical history and physical examination in*

Physical Examination

Conducting a thorough examination of body systems provides the nurse with cues regarding potential musculoskeletal disorders. Early identification of abnormal findings and notification of the health care provider can lead to prompt intervention and reduce long-term impact. Table 10.3 summarizes potential manifestations of musculoskeletal disorders.

Table 10.3. Manifestations of Musculoskeletal Disorders[10,11]

Body System	Manifestations of Musculoskeletal Disorders
Musculoskeletal	Fractures, deformity, reduced bone density, muscle weakness, atrophy, muscle spasms, swelling, reduced range of motion, altered posture, gait abnormalities, tenderness, pain, muscle cramping, and fatigue
Integumentary	Inflammation in tissues around joints and changes in the color and temperature of the skin
Neurovascular	Paresthesias (changes in sensation like numbness and tingling) and decreased/absent pulse

musculoskeletal disorders. Merck Manual Consumer Version. https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/diagnosis-of-musculoskeletal-disorders/medical-history-and-physical-examination-in-musculoskeletal-disorders

10. Vilella, R.C., Reddivari, A. K. R. (2023). *Musculoskeletal Examination*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK551505/

11. Villa-Forte, A. (2024). *Medical history and physical examination in musculoskeletal disorders*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/diagnosis-of-musculoskeletal-disorders/medical-history-and-physical-examination-in-musculoskeletal-disorders

Review information regarding a comprehensive subjective and objective assessment of the musculoskeletal system in the "Musculoskeletal Assessment" chapter of Open RN *Nursing Skills, 2e*.

Life Span Considerations

Nurses consider characteristics of the pediatric and older adult populations during assessment.[12]

PEDIATRIC CONSIDERATIONS

- Infants lack muscle tone, power and coordination; they rely on the support and supervision of others to keep them stable and safe.
- Bones are soft until puberty and break and bend more easily. As a result of bones being more flexible, serious internal injuries can be present without fractures present.
- Infants and children have growth plates located between the middle and the end of the long bones. Fractures may occur that affect these growth plates and require medical care by a specialist.
- Children are physically active and typically require casts and splints to protect healing fractures.
- As infants and children grow, some bones fuse together. For example, the bones of the skull fuse during infancy and later. During the teenage years the ilium, ischium and pubis fuse together.

12. Queensland Pediatric Emergency Care. (2022). *How children are different – Anatomical and physiological differences*. https://www.childrens.health.qld.gov.au/__data/assets/pdf_file/0031/179725/how-children-are-different-anatomical-and-physiological-differences.pdf

- Additional information may be obtained from the parent or legal guardian regarding the child's history, such as history of hip dysplasia or previous fractures or difficulties with walking, jumping, or playing.

OLDER ADULT CONSIDERATIONS

- With aging, the risk of musculoskeletal problems increases due to natural wear and tear on joints, decreased bone density, and reduced muscle mass.
- As individuals age, muscle fibers decrease in size and number. As a result, the muscle tissue can atrophy and deteriorate from a lack of use.
- As individuals age, they also experience the loss of minerals within the bones, specifically calcium and phosphorus.
- During subjective assessment of older adults, additional questions include use of assistive devices, recent falls/injuries, and ability to accomplish activities of daily living with or without assistance.
- Older adults may have limited mobility and range of motion due to age-related degeneration of joints and muscle weakness.

Laboratory and Diagnostic Testing

When diagnosing and/or monitoring potential musculoskeletal disorders, blood tests and diagnostic imaging are often ordered by the health care provider. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

BLOOD TESTS

- **Serum Calcium (Ca):** Calcium is vital for preserving bone health. Abnormalities in calcium levels can indicate conditions such as osteoporosis. Decreased calcium levels can reduce bone strength and density.
- **Vitamin D:** Vitamin D works to facilitate calcium absorption. Low levels of vitamin D may impede calcium absorption.

- **Phosphorus (Phos):** Phosphorus has an inverse relationship with calcium to enhance bone mineralization. Low phosphorus levels reduce bone strength.
- **Alkaline Phosphatase (ALP):** Alkaline phosphatase is an enzyme that contributes to bone formation. Elevated levels of alkaline phosphatase can indicate the presence of bone tumors or conditions that impact bone growth and healing.
- **Creatine Kinase (CK-MM):** Creatine kinase is an enzyme found predominantly in skeletal muscle. Increased levels of creatine kinase indicate signs of muscle damage or injury.

DIAGNOSTIC TESTING

- **X-rays (Radiography):** X-rays visualize bones and detect fractures, bone deformities, joint dislocations, and disorders affecting bone density.[13,14]
- **Computed Tomography (CT Scan):** CT scans create detailed, cross-sectional, three-dimensional images of bones, joints, and soft tissues that are useful for detecting complex fractures and evaluating bone tumors, joint abnormalities, and spinal conditions.[15]
- **Magnetic Resonance Imaging (MRI):** MRI uses magnet and radio waves to generate detailed images of bones, joints, ligaments, tendons, and soft tissues. MRIs are very effective in diagnosing soft tissue injuries, cartilage

13. Derby, R., & Beutler, A. (2023). General principles of acute fracture management. *UpToDate.* www.uptodate.com

14. National Institute of Biomedical Imaging and Bioengineering. (2022). *X-rays.* National Institutes of Health. https://www.nibib.nih.gov/science-education/science-topics/x-rays

15. National Institute of Biomedical Imaging and Bioengineering. (2022). *Computed tomography.* National Institutes of Health. https://www.nibib.nih.gov/science-education/science-topics/computed-tomography-ct

damage, ligament tears, spinal cord injuries, and joint-related conditions. An MRI is particularly useful for assessing signs of inflammation/injury in tissue.[16]

- **Bone Density Scans (Dual-Energy X-ray Absorptiometry - DEXA or DXA):** DEXA scans are specialized X-ray tests that measure bone mineral density. DEXA scans are primarily used to diagnose osteoporosis and assess fracture risk by evaluating bone density in the hip, spine, or other areas prone to fractures.[17,18]
- **Ultrasound Imaging:** Ultrasound imaging uses sound waves to create images of soft tissues, tendons, and muscles. Ultrasounds are commonly used to diagnose soft tissue injuries, tendon tears, and conditions affecting muscles and ligaments. Ultrasound is also useful in guiding certain musculoskeletal procedures, such as joint injections.[19]
- **Nuclear Medicine Scans (Bone Scans):** Bone scans involve injecting a radioactive tracer into the bloodstream, which accumulates in areas of increased bone turnover or damage. These scans are useful for detecting bone infections, metastatic bone disease, stress fractures, and assessing

16. National Institute of Biomedical Imaging and Bioengineering. (n.d.). *Magnetic resonance imaging (MRI).* National Institutes of Health. https://www.nibib.nih.gov/science-education/science-topics/magnetic-resonance-imaging-mri

17. InformedHealth.org. (2017). *Understanding tests used to detect bone problems.* Institute for Quality and Efficiency in Health Care (IQWiG). https://www.ncbi.nlm.nih.gov/books/NBK279413/

18. Johns Hopkins Medicine. (n.d.). *Diagnosing bone disorders.* https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/diagnosing-bone-disorders

19. Johns Hopkins Medicine. (n.d.). *Diagnosing bone disorders.* https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/diagnosing-bone-disorders

overall bone health.[20,21]

- **Electromyogram (EMG):** An EMG is a diagnostic procedure that assesses the function of nerve cells that control muscles. Electrodes, either attached to the skin or inserted into the muscle, record electrical impulses. An EMG can identify functional problems with the peripheral nerves, muscles, or with the signals between the nerves and the muscles. During a needle EMG, a needle electrode inserted directly into a muscle records the electrical activity in that muscle. A nerve conduction study, another part of an EMG, uses surface electrodes applied to the skin to measure the speed and strength of signals traveling between two or more points. EMG results are used to diagnose muscle and nerve disorders.
- **Arthrocentesis:** A surgical puncture to aspirate fluid from a joint, such as the knee, for lab analysis and symptom relief. Lab analysis of the fluid can help determine the cause of swollen, painful joints. After aspiration of joint fluid, the health care provider may inject medications into the joint to temporarily ease pain and inflammation.
- **Arthroscopy:** A common procedure performed by orthopedic surgeons to view the inside of a joint to diagnose and/or to repair joint problems. After a local anesthetic is administered, the surgeon inserts a narrow tube attached to a fiber-optic video camera through a small incision. The view inside the joint is transmitted to a video monitor. Arthroplasty, surgical repair of a joint, may also take place during the procedure.

20. Villa-Forte, A. (2024). *Tests for musculoskeletal disorders*. https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/diagnosis-of-musculoskeletal-disorders/tests-for-musculoskeletal-disorders

21. Johns Hopkins Medicine. (n.d.). *Diagnosing bone disorders*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/diagnosing-bone-disorders.

10.4 Common Musculoskeletal Disorders

The following sections will discuss common musculoskeletal disorders, including amputation, fracture, osteoarthritis, osteoporosis, and rheumatoid arthritis. An overview of additional musculoskeletal disorders is provided in the “Other Musculoskeletal Disorders” section.

10.5 Amputation

Amputation refers to the surgical removal of a body part. The psychosocial impact of amputation often surpasses the physical impairment as individuals may experience emotional distress, body image concerns, and adjustments to their daily lives.

The two primary categories of amputation are elective and traumatic:

- **Elective Amputation:** Elective amputation is planned and performed due to medical conditions such as severe infection, tumors, or vascular diseases that compromise blood flow to the affected limb. It is often a proactive decision made by health care professionals and the client to prevent complications like sepsis and metastasis.[1] Including the client during decision-making helps in the healing and acceptance stage after the surgery.
- **Traumatic Amputation:** Traumatic amputation occurs due to accidents, injuries, or severe trauma, resulting in the sudden loss of a limb. Traumatic amputations can significantly impact an individual's ability to cope with the loss due to its unexpected and immediate impact on their life.[2]

Amputations are classified based on the location in the upper or lower extremity. Lower extremity amputations include the following[3]:

1. Lamb, K. (n.d.). *Amputation.* Society for Vascular Surgery. https://vascular.org/patients-and-referring-physicians/conditions/amputation
2. Maduri, P., Akhondi, H. (2023). *Upper Limb Amputation*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK540962/
3. Molina, C. S., Faulk, J. B. (2022). *Lower Extremity Amputation*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK546594/

- **Toe or Partial Foot Amputation:** Removal of toes or a part of the foot that preserves the foot structure, aiding in maintaining balance and mobility
- **Ankle Disarticulation:** Amputation at the ankle joint, preserving the heel pad for weight-bearing and prosthetic fitting
- **Below-Knee (Transtibial) Amputation:** Amputation below the knee joint, providing a longer residual limb for better prosthetic control and energy-efficient walking
- **Above-Knee (Transfemoral) Amputation:** Amputation above the knee joint, requiring more energy for mobility due to the absence of the knee joint and increased leverage requirements

Upper extremity amputations are as follows[4]:

- **Finger or Partial Hand Amputation:** Removal of fingers or part of the hand
- **Wrist Disarticulation:** Amputation at the wrist joint
- **Below-Elbow (Transradial) Amputation:** Amputation below the elbow joint
- **Above-Elbow (Transhumeral) Amputation:** Amputation above the elbow joint

After an amputation is performed and the incision site is healed, the client may receive an artificial body part called a **prosthesis** to promote mobility and/or function. See Figure 10.25[5] for an illustration of a prosthesis used for an above-the-knee amputation.

4. Maduri, P., Akhondi, H. (2023). *Upper Limb Amputation*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK540962/

5. "Foot_Prosthesis_Wearing_Prosthesis_Above_Knee.png" by BruceBlaus is licensed under CC BY-SA 4.0



Figure 10.25 Above-the-Knee Prosthesis

Potential Complications

Several complications can occur after an amputation, including the following[6,7]:

6. Lamb, K. (n.d.). *Amputation*. Society for Vascular Surgery. https://vascular.org/patients-and-referring-physicians/conditions/amputation

7. A.D.A.M. Medical Encyclopedia [Internet]. (2022). *Traumatic amputation*. https://medlineplus.gov/ency/article/000006.htm

- **Hemorrhage:** Hemorrhage refers to excessive bleeding during or after surgery. It can be caused by inadequate closure of blood vessels, clotting disorders, or medications that impact clotting.
- **Infection:** Infection can occur due to contamination during surgery or wound care. Symptoms include redness, swelling, tenderness, purulent discharge, and fever.
- **Phantom Limb Pain:** Phantom limb pain is the sensation of pain or discomfort in the limb that was removed. It is a common neurological phenomenon that occurs when the brain continues to perceive sensations from a limb that is no longer present.
- **Flexion Contracture:** Flexion contracture occurs when the residual limb remains in a flexed position for an extended period, leading to decreased range of motion and contracture of muscles and soft tissues.

Assessment

When caring for a client who has undergone an amputation, nursing assessment includes physical, functional, and psychosocial findings. See Table 10.5 for a summary of focused assessments following an amputation.

Table 10.5. Focused Assessments Post-Amputation[8,9,10,11]

8. A.D.A.M. Medical Encyclopedia [Internet]. (2022). *Traumatic amputation*. https://medlineplus.gov/ency/article/000006.htm

9. Lamb, K. (n.d.). *Amputation.* Society for Vascular Surgery. https://vascular.org/patients-and-referring-physicians/conditions/amputation

10. Molina, C. S., Faulk, J. B. (2022). *Lower Extremity Amputation*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK546594/

11. Maduri, P., Akhondi, H. (2023). *Upper Limb Amputation*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK540962/

Body System	Focused Assessments
Integumentary	Surgical Site: Wound healing and for signs of infection Residual limb: Skin integrity and vascular status (peripheral pulses and capillary refill)
Musculoskeletal	Prosthetic: Evaluation of prosthetic fit, comfort, use, and functional abilities Residual Limb: Muscle strength, joint stability, coordination, and control of limb
Neurological	Changes in sensation, pain, and presence of phantom pain or other neuropathic symptoms
Psychosocial & Emotional	Body image perception, self-esteem, signs of depression or anxiety, coping mechanisms, and social support network

Diagnostic Testing

Doppler ultrasound may be used to assess vascular status and blood flow to the residual extremity. Hemoglobin and hematocrit are also monitored postoperatively due to blood loss. Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing diagnoses following an amputation encompass physical, psychosocial, and functional challenges. Common nursing diagnoses for clients experiencing amputation include the following:

- Acute Pain
- Impaired Skin Integrity
- Disturbed Body Image
- Risk for Impaired Mobility
- Ineffective Coping

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Sample expected outcomes for a client experiencing an amputation are as follows:

- *The client will demonstrate signs of healing of the surgical site within one week without redness, swelling, or purulent drainage.*
- *The client will express feelings related to the changes in their body image within one week.*
- *The client will demonstrate accurate use of assistive devices by the end of the teaching session.*

Interventions

Medical Interventions

Medical interventions related to amputation include surgery, rehabilitation, wound care, and pain control.

- Surgical removal of the affected limb is performed at a specific level, as determined by the extent of damage or disease.[12]
- Physical therapy and occupational therapy are prescribed for prosthetic evaluation and rehabilitation to regain strength, mobility, and independence. Clients receive custom fitting and training in the use of prosthetic devices.[13]
- Wound care may include use of a wound vacuum-assisted closure or specialized dressings to facilitate healing. Wound care orders include cleansing and dressing changes.[14,15]
- Medication therapy typically includes pain medications and antibiotics:

12. Lamb, K. (n.d.). *Amputation.* Society for Vascular Surgery. https://vascular.org/patients-and-referring-physicians/conditions/amputation

13. Lamb, K. (n.d.). *Amputation.* Society for Vascular Surgery. https://vascular.org/patients-and-referring-physicians/conditions/amputation

14. Lamb, K. (n.d.). *Amputation.* Society for Vascular Surgery. https://vascular.org/patients-and-referring-physicians/conditions/amputation

- Opioid and nonopioid medications are prescribed to help manage postoperative pain.
- Prophylactic antibiotics are often prescribed to prevent postoperative infections.

Nursing Interventions

Nursing interventions include monitoring for complications, performing health teaching, and providing psychosocial support.

MONITORING FOR COMPLICATIONS

Nurses perform routine assessments on the residual limb to monitor vascular status and assess for signs of infection or skin breakdown. The client's mobility, functioning, and home environment are assessed to plan interventions to reduce the risk of falls or other injuries at home.

HEALTH TEACHING

Nurses teach clients and their caregivers about post-amputation care, including wound care, signs of complications to immediately report to the health care provider, positioning, and care to prevent skin breakdown. Clients are taught to implement prone positioning as prescribed and to not use pillows under the limb to prevent contractures. For example, a client with a lower-extremity amputation is typically prescribed prone positioning for 20 to 30 minutes every three to four hours to prevent hip contracture until they are regularly out of bed and moving. Clients and caregivers may also be taught how to wrap the remaining limb to prevent friction and blistering. Specialized wraps may be used in collaboration with the physical therapist to decrease phantom limb pain.

15. Molina, C. S., Faulk, J. B. (2022). *Lower Extremity Amputation*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK546594/

Information is provided on rehabilitation programs, prescribed exercises, safe transfers, use of assistive devices, and home modifications for safety.

PSYCHOSOCIAL SUPPORT

Nurses actively listen and use therapeutic communication to encourage clients to verbalize feelings related to the loss of their limb and discuss coping strategies. Resources or referrals are provided for counseling, support groups, or other community resources.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Amputation

View a brief YouTube video overview of amputation[16]:

16. Open RN Project. (2024, June 23). *Health Alterations – Chapter 10 – Amputation* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/lOHyjLsY-i0?si=Snm5afqDWHP0jHso

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10.6 Fracture

A **fracture** occurs when there is a break or disruption in the integrity of a bone. Fractures can vary in severity, location, and the way in which the bone breaks.

Types of Fractures

Different types of fractures include the following[1,2,3]:

- **Closed or Simple:** Bone is broken but does not protrude the skin
- **Open or Compound:** Bone is broken and pierces through the skin
- **Transverse:** Bone is broken straight across
- **Spiral:** Bone has twisted apart
- **Comminuted:** A bone is crushed into pieces
- **Impacted:** One fragment of the bone is driven into the other, usually as a result of compression
- **Greenstick:** Bone is partially broken; a common fracture in children that occurs rarely in adults
- **Oblique:** Bone is broken at an angle
- **Stress:** Small crack in a bone
- **Complete Fracture:** The bone breaks entirely into two or more separate pieces

1. MedlinePlus [Internet]. (2016). *Fractures*. https://medlineplus.gov/fractures.html#summary

2. Campagne, D. (2022). *Overview of fractures*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/injuries-and-poisoning/fractures/overview-of-fractures

3. American Academy of Orthopaedic Surgeons. (2021). *Fractures (Broken bones)*. https://orthoinfo.aaos.org/en/diseases–conditions/fractures-broken-bones/

- **Incomplete Fracture:** The bone cracks but doesn't break into separate pieces (e.g., stress fracture or greenstick fracture)
- **Compression Fracture:** Typically occurs in vertebrae and involves the bone being crushed or collapsing; often seen in conditions like osteoporosis
- **Pathologic Fracture:** A fracture that occurs due to disease process

See Figure 10.26[4] for an illustration of different types of fractures.

4. "612_Types_of_Fractures.jpg" by OpenStax College is licensed under CC BY 4.0

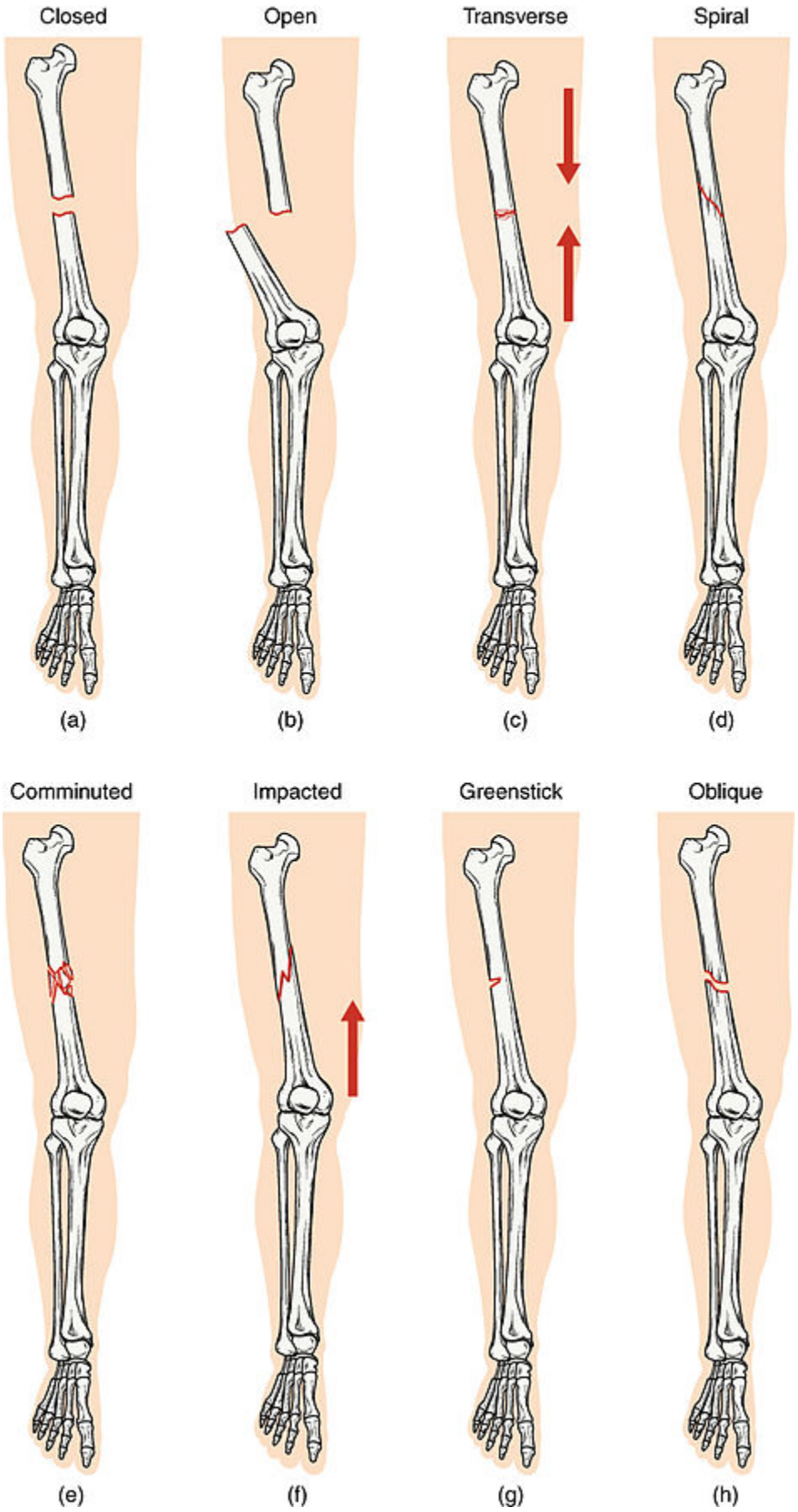


Figure 10.26 Types of Fractures (a) Closed; (b) Open; (c) Transverse; (d) Spiral; (e) Comminuted; (f) Impacted; (g) Greenstick; and (h) Oblique

Hip Fractures

A **hip fracture**, commonly referred to as a "broken hip," can be intracapsular or extracapsular. An intracapsular fracture occurs in the femoral neck, as illustrated in Figure 10.27.[5] Extracapsular fractures occur outside of the joint capsule and include the proximal one third of the femur.

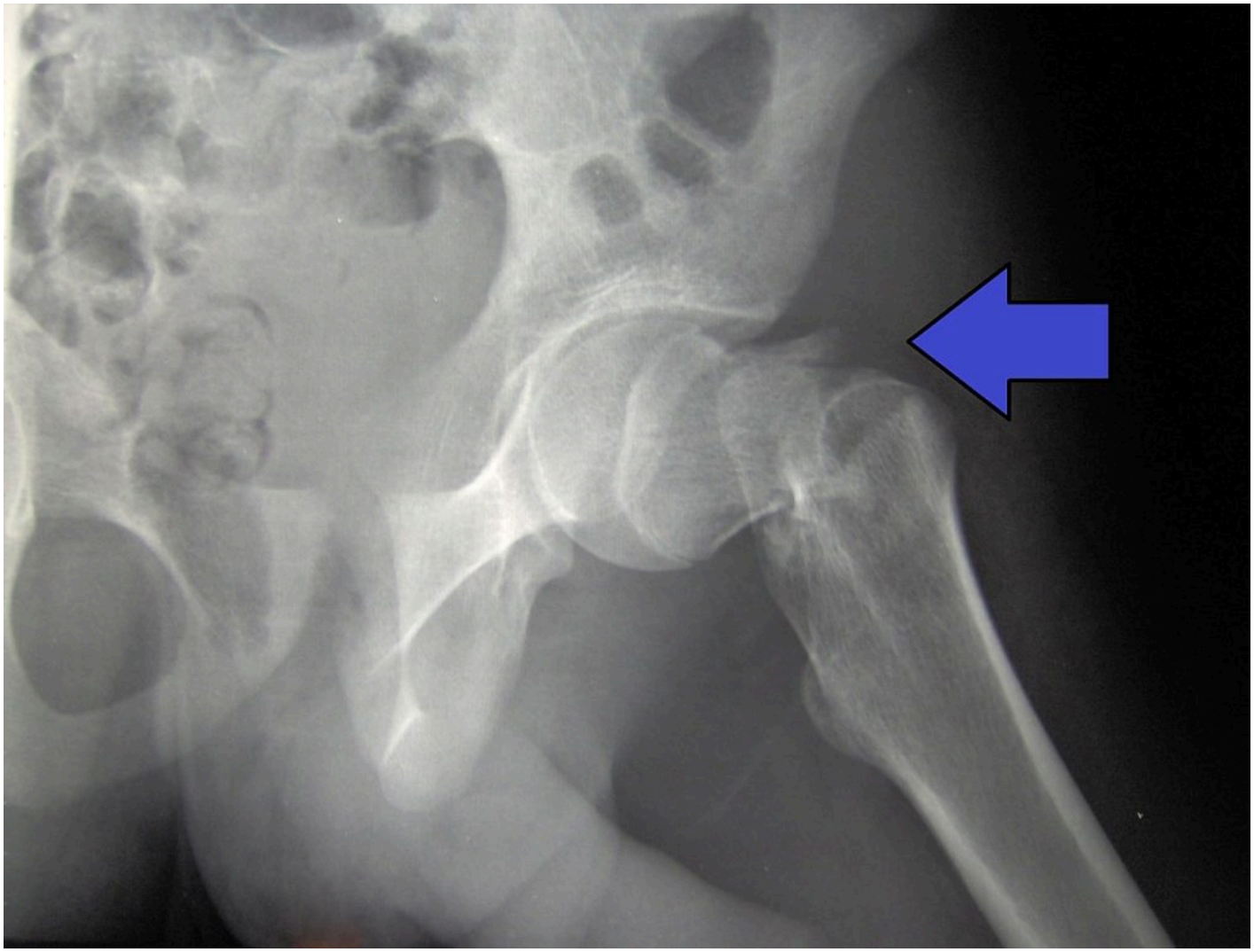


Figure 10.27 Hip Fracture

5. "Cdm hip fracture 343.jpg" by Booyabazooka is licensed under CC BY-SA 3.0

Hip fractures are typically caused by a fall, especially in older adults with preexisting osteoporosis. Symptoms of a hip fracture include the following[6]:

- Pain
- An inability to lift, move, or rotate the affected leg
- An inability to stand or put weight on the affected leg
- Bruising and swelling around the hip
- The injured leg appears shorter than the other leg
- The injured leg is rotated outwards

Hip fractures typically require surgical repair within 48 hours of the injury. In approximately half of the cases, hip arthroplasty (i.e., hip replacement) is needed. In the remaining cases, the fracture is repaired during a surgery called open reduction internal fixation (ORIF). Read more information about ORIF in the "Medical Interventions" subsection.

Risk Factors for Fractures

There are numerous risk factors for fractures, including advancing age, trauma, and the presence of other medical conditions such as osteoporosis, metastatic cancer, or Cushing's disease. Other risk factors include long-term use of corticosteroids, lack of physical activity or weight-bearing exercises, poor nutrition, and genetics. Women, especially after menopause, are at higher risk for fractures due to reduced bone density as a result of hormonal changes.

Stages of Bone Healing

When a fracture occurs, the healing process immediately begins with the following stages of bone healing[7]:

6. NHS (UK). (2023). *Hip fracture*. https://www.nhs.uk/conditions/hip-fracture/

7. Sheen, J. R., Mabrouk, A., Garla, V. V. (2023). *Fracture Healing Overview*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK551678/

- **Hematoma Formation (within 48 to 72 hours after injury):** Immediately after a bone fracture, blood vessels at the injury site rupture, leading to the formation of a blood clot or hematoma. The hematoma serves as a framework for subsequent healing processes.
- **Hematoma to Granulation Tissue:** Over the next few days, the hematoma transforms into granulation tissue, where new blood vessels and specialized cells invade the site to remove damaged tissue.
- **Callus Formation:** Within the first few weeks, the granulation tissue develops into a soft callus made of collagen and cartilage, stabilizing the fractured bone ends. This callus provides a temporary framework for bone healing.
- **Osteoblastic Proliferation:** Osteoblasts become active and start producing new bone tissue. These cells gradually replace the soft callus with a harder woven bone.
- **Bone Remodeling:** Over several weeks to months, the new woven bone is remodeled into stronger lamellar bone, resembling the original bone structure. Excess bone tissue is reabsorbed, and the bone undergoes restructuring to regain its strength and shape.
- **Bone Healing Completion:** Generally, bone healing is completed within about six weeks; however, in older individuals or cases with complications, it may take up to six months. The time required for complete healing varies based on factors such as age, overall health, the severity of the fracture, and the bone's location.

See Figure 10.28[8] for an illustration of bone healing.

8. "613_Stages_of_Fracture_Repair.jpg" by OpenStax College is licensed under CC BY 3.0

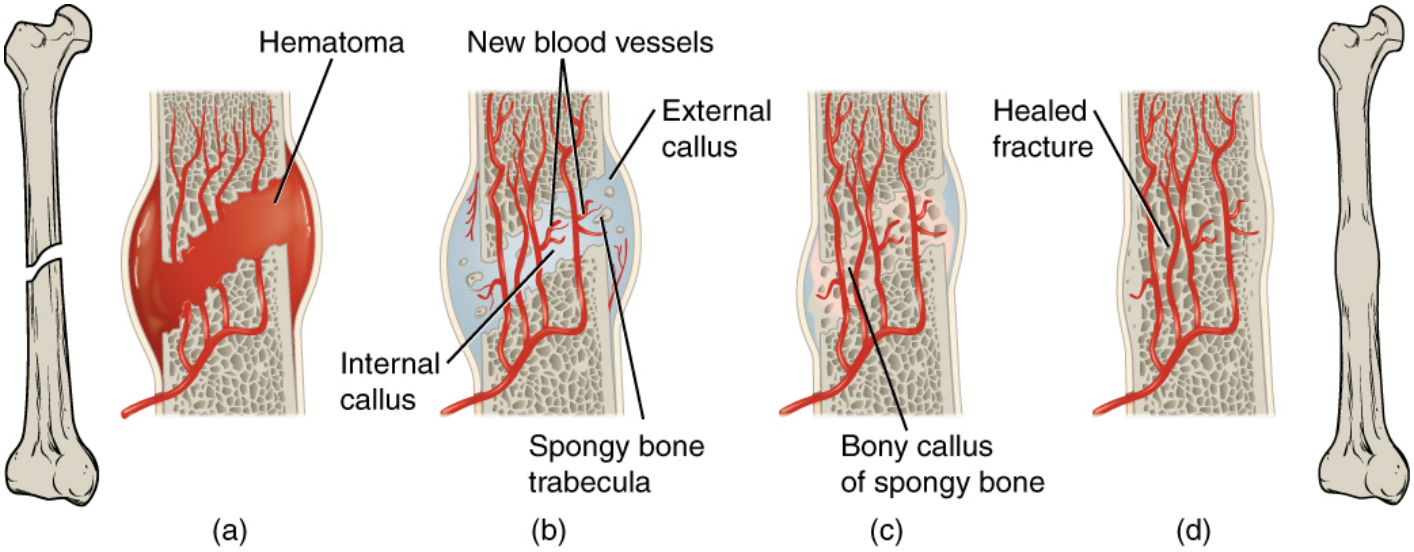


Figure 10.28 Bone Healing

Assessment

The location and type of bone fracture can cause various assessment findings. Common manifestations of fractures by body system are summarized in Table 10.6.

Table 10.6. Manifestations of Fracture by Body System[9,10,11,12]

9. MedlinePlus [Internet]. (2016). *Fractures*. https://medlineplus.gov/fractures.html#summary

10. Singaram, S., & Naidoo, M. (2019). The physical, psychological and social impact of long bone fractures on adults: A review. *African Journal of Primary Health Care & Family Medicine, 11*(1), e1-e9. https://doi.org/10.4102/phcfm.v11i1.1908

11. Campagne, D. (2022). *Overview of fractures.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/injuries-and-poisoning/fractures/overview-of-fractures

12. Cleveland Clinic. (n.d.). *Bone fractures.* https://my.clevelandclinic.org/health/diseases/15241-bone-fractures

Body System	Assessment Findings
Musculoskeletal	Pain at the site of injury, swelling of soft tissue, deformity or misalignment, limited range of motion, tenderness upon palpation, and crepitus (grating sensation or sound)
Integumentary	Bruising or discoloration, open wounds or skin breaks, bleeding or hematoma, and warmth or redness over the affected area
Nervous	Numbness or tingling distal to the injury, loss of sensation, weakness in the affected limb, and loss of function (e.g., inability to move the affected area)
Cardiovascular	Pallor (pale skin) due to decreased blood flow, coldness in the affected area, decreased or absent pulses distal to the fracture, and delayed capillary refill
Respiratory	Rib fractures can cause shallow breathing, resulting in shortness of breath
Gastrointestinal	Nausea or vomiting due to pain or shock or abdominal tenderness with pelvic fractures
Psychosocial	Anxiety or distress, fear or worry about the injury, and impact on the ability to perform activities of daily living

Potential Complications of Fractures

A fracture can result in severe complications if rapid swelling occurs in the surrounding tissues.

A significant complication associated with fracture is **acute compartment syndrome (ACS)**, which is characterized by increased pressure within a muscle compartment, resulting in reduced blood flow to the tissues within that compartment. This heightened pressure impairs circulation, leading to tissue ischemia (lack of oxygen and nutrients) and subsequent tissue damage. Nurses monitor this complication and promptly notify the health care provider of concerns. Read additional information about ACS in the following box.

Acute Compartment Syndrome (ACS)

The pathophysiological changes in ACS are often described as an ischemia-edema cycle. Initially, an injury or trauma causes tissue damage, leading to inflammation and swelling (edema) within the affected compartment. Swelling and inflammation lead to increased pressure within the confined space of the muscle compartment. As pressure rises, it compresses blood vessels, reducing blood flow to the muscles and nerves. Decreased blood flow results in tissue ischemia, depriving the

muscles and nerves of oxygen and nutrients. Without adequate blood supply, cells begin to die, and metabolic waste products accumulate in the tissue. Persistent elevation of compartment pressure further compromises circulation, exacerbating tissue damage and potentially leading to irreversible nerve and muscle injury.[13]

Warning signs of ACS are often referred to as the **six P's**[14]:

- Pain: Pain is typically the first sign of ACS. It is described as severe, unrelenting pain that is disproportionate to the injury and is unresponsive to opioid administration.
- Paresthesia: Abnormal or progressive loss of sensation.
- Poikilothermia: Cool skin.
- Pallor: Pale skin.
- Pulselessness: Decreased or absent pulses distal to the injury.
- Paralysis: Inability to move the extremity.

Early recognition and prompt intervention are crucial. Close monitoring of clients at risk, such as those with fractures, crush injuries, or extensive soft tissue trauma, can help prevent the progression of ACS.

ACS can be caused by a cast being too tight on an extremity

13. Torlincasi, A. M., Lopez, R. A., Waseem, M. (2023). *Acute Compartment Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448124/

14. Pechar, J., & Lyons, M. M. (2016). Acute compartment syndrome of the lower leg: A review. T*he Journal for Nurse Practitioners: JNP 12*(4), 265-270. https://doi.org/10.1016/j.nurpra.2015.10.013

and restricting blood flow, in which case the cast is removed. Otherwise, treatment of ACS often requires emergency **fasciotomy**, a surgical procedure that relieves pressure within the compartment by making incisions through the fascia (connective tissue surrounding the compartment) to release the built-up pressure. See Figure 10.29[15] for an image of a fasciotomy.[16]

15. "Compartment_Syndrome_Picture_Wikipedia.jpg" by CarrieRocks is licensed under CC BY-SA 3.0

16. Torlincasi, A. M., Lopez, R. A., Waseem, M. (2023). *Acute Compartment Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448124/



Figure 10.29 Fasciotomy for ACS

Other potential complications of fractures include hypovolemic shock, fat embolism, deep vein thrombosis, and infection[17,18,19]:

- **Hypovolemic Shock:** Severe fractures, especially those involving significant bleeding, can cause hypovolemic shock, characterized by a rapid heart rate, low blood pressure, and altered consciousness. Immediate stabilization through intravenous fluids and blood transfusions restores blood volume and prevents further deterioration.
- **Fat Embolism Syndrome:** Fat embolism syndrome can arise from certain fractures, particularly long-bone fractures or bone with large amounts of marrow, such as the ribs, pelvis, and femur. In this condition, fat globules from the yellow bone marrow are released into the bloodstream, leading to potentially life-threatening emboli in the lungs, brain, and other organs. Symptoms include respiratory distress, altered mental status, petechial rash, and fever. Nurses assess for this complication and promptly request emergency assistance as indicated, which includes rapid administration of oxygen therapy, high Fowler's positioning, and potential intubation and mechanical ventilation to maintain adequate oxygenation.
- **Deep Vein Thrombosis (DVT):** DVT is a significant risk following fractures, particularly during prolonged immobility. DVT refers to the formation of blood clots in deep veins, commonly in the legs, that can move in the bloodstream and become pulmonary emboli. Symptoms of DVT include

17. Campagne, D. (2022). *Overview of fractures.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/injuries-and-poisoning/fractures/overview-of-fractures

18. American Academy of Orthopaedic Surgeons. (2021). *Fractures (Broken bones).* https://orthoinfo.aaos.org/en/diseases–conditions/fractures-broken-bones/

19. Cleveland Clinic. (n.d.). *Bone fractures.* https://my.clevelandclinic.org/health/diseases/15241-bone-fractures

unilateral swelling, pain, warmth, and redness in the affected limb. Preventive measures for DVT after fracture repair include early mobilization, anticoagulant therapy, and compression stockings. Read additional information about DVTs in the "Deep Vein Thrombosis" section of the "Cardiovascular Alterations" chapter.

- **Infection:** Local or systemic infections can occur from open fractures or surgical interventions when bacteria contaminate the wounds. Symptoms of infection include increased pain, redness, swelling, fever, and purulent drainage from wounds or incisions. Treatment includes prompt administration of antibiotics and, in some cases, surgical intervention to remove infected tissue.
- **Nonunion/Malunion:** Some clients experience delayed bone healing that can impact recovery. When the normal healing process of a fracture is disrupted, it can result in impaired or nonunion of the bone. Ongoing pain, decreased mobility, and poor progression of healing in imaging studies are signs of nonunion or malunion of bone.

Diagnostic Testing

Diagnostic testing to identify a fracture typically includes radiography to identify the location and severity of the bone injury, as well as other tests based on the circumstances[20,21]:

- X-rays provide a 2-D image of the bone, identifying the location and extent of the fracture. This is the most common test used to diagnose a fracture.

20. Villa-Forte, A. (2022). *Tests for musculoskeletal disorders*. https://www.merckmanuals.com/home/bone,-joint,-and-muscle-disorders/diagnosis-of-musculoskeletal-disorders/tests-for-musculoskeletal-disorders

21. Derby, R., & Beutler, A. (2023). General principles of acute fracture management. *UpToDate*. www.uptodate.com

- If a complex fracture is suspected, a CT scan may also be ordered. A CT scan can provide better visualization of the bone and surrounding tissues by displaying cross-sectional images.
- MRI scans are helpful for providing detailed images of soft tissue, ligaments, tendons, and bones. MRI scans can provide more detailed images of fractures that may be more subtle, such as a stress fracture.
- Ultrasounds can also be useful for identifying fractures in children with better visualization of growth plates.
- If metastatic bone cancer is a suspected cause of a fracture, a bone scan may be ordered. The bone scan involves the injection of radioactive material into the bloodstream that collects in areas of high osteoblastic activity.

Nursing Diagnoses

Nursing diagnoses for clients with fractures focus on minimizing complications and restoring function. Common nursing diagnoses include the following:

- Acute Pain
- Impaired Physical Mobility
- Impaired Skin Integrity
- Anxiety
- Risk for Falls

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Sample expected outcomes for a client diagnosed with a fracture are as follows:

- *The client will report a decrease in pain intensity using a pain severity*

scale within one hour of receiving analgesics.

- *The client will perform prescribed exercises demonstrating improved physical mobility within one week.*
- *The client will show signs of fracture healing within six weeks, including decreased swelling and increased mobility.*
- *The client will verbalize a reduction in anxiety levels related to the fracture, scoring below "5" on a standardized anxiety assessment tool within 24 hours.*
- *The client will demonstrate accurate use of assistive devices, showing no signs of instability or falls before discharge.*

Interventions

Medical Interventions

Medical interventions for fractures aim to align the bones, promote healing, manage pain, prevent complications, and restore function. Interventions include fracture reduction, immobilization, medication therapy, physical therapy, and nutritional support.

FRACTURE REDUCTION

There are several types of procedures used to realign fractured bones:

- **Closed Reduction:** A nonsurgical procedure where the provider manipulates the fractured bones back into their proper position without making an incision. This procedure is often followed by immobilization with a cast, splint, or brace to help ensure the bones remain in the optimal position for healing.[22,23]

22. Campagne, D. (2022. *Overview of fractures.* Merck Manual Consumer Version. https://www.merckmanuals.com/home/injuries-and-poisoning/fractures/overview-of-fractures

- **Open Reduction and Internal Fixation (ORIF):** Involves an incision for the surgical realignment of the fractured bones and then they are internally fixated (i.e., held together) with hardware like metal pins, plates, rods, or screws. After the bone heals, this hardware is not typically removed unless additional symptoms occur.[24,25] See Figure 10.30[26] for an image of an ORIF.
- **External Fixation:** A surgical procedure where metal pins or screws are inserted into the bone above and below the fracture site and connected to an external frame to stabilize the fracture. This method is often used for severe open fractures, when swelling or other injuries make immediate internal fixation risky, or for fractures with delayed healing.[27,28] See Figure 10.31[29] for an image of external fixation.

23. American Academy of Orthopaedic Surgeons. (2021). *Fractures (Broken bones)*. https://orthoinfo.aaos.org/en/diseases–conditions/fractures-broken-bones/

24. Campagne, D. (2022). *Overview of fractures*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/injuries-and-poisoning/fractures/overview-of-fractures

25. American Academy of Orthopaedic Surgeons. (2021). *Fractures (Broken bones)*. https://orthoinfo.aaos.org/en/diseases–conditions/fractures-broken-bones/

26. "TibPlatRepair.png" by James Heilman, MD is licensed under CC BY-SA 4.0

27. Campagne, D. (2022). *Overview of fractures*. Merck Manual Consumer Version. https://www.merckmanuals.com/home/injuries-and-poisoning/fractures/overview-of-fractures

28. American Academy of Orthopaedic Surgeons. (2021). *Fractures (Broken bones)*. https://orthoinfo.aaos.org/en/diseases–conditions/fractures-broken-bones/

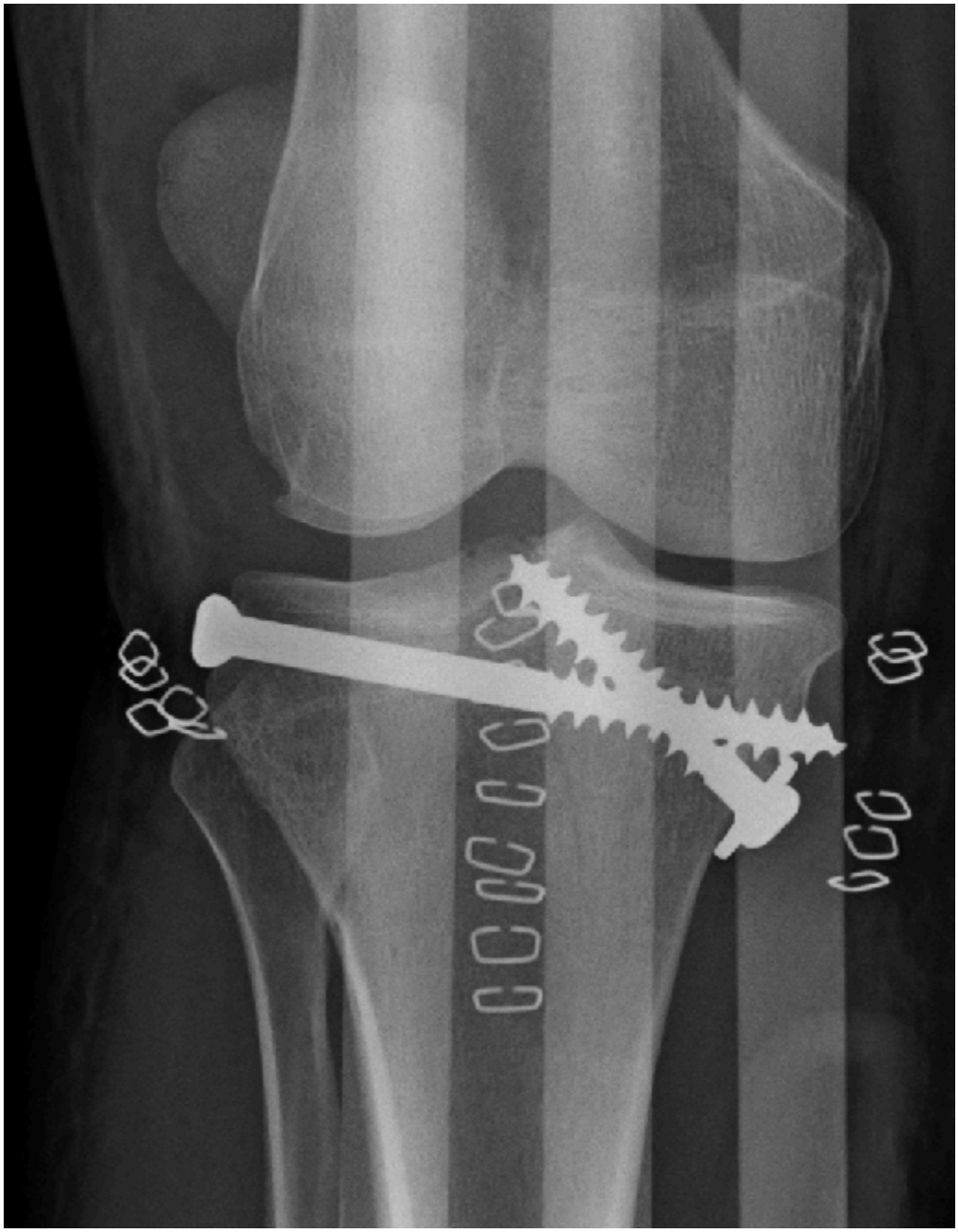


Figure 10.30 ORIF

29. "Ilizarov_Apparatus_External_Fixator.JPG" by Pagemaker787 is licensed under CC BY-SA 4.0



Figure 10.31 External Fixation

IMMOBILIZATION

Immobilization involves application of a cast, splint, or brace to restrict

movement of the affected limb or body part, allowing the bones to heal properly. See Figure 10.32[30] for an image of a cast.



Figure 10.32 Cast

30. "Plaster_of_Paris_Short_leg_cast.jpg" by Jonuscumgi is licensed under CC BY-SA 4.0

Occasionally, **traction** may also be used by applying a pulling force to the affected limb or body part using weights and pulleys to align and immobilize the fracture and reduce muscle spasms.[31,32] See Figure 10.33[33] for an image of a client with traction.

There are two different types of traction called skin and skeletal traction. Skin traction also known as **Buck's traction** is utilized to decrease muscle spasms and align the bone until surgery or reduction can be performed. Skin traction involves the application of weights over the end of the bed as a pulling force. They are typically attached to a boot that is applied to the client. The size of the weight is prescribed by the provider. Skeletal traction is used for bone realignment and uses external pins that go through the skin to the bone to reduce the fracture.

31. American Academy of Orthopaedic Surgeons. (2020). *Care of casts and splints.* https://orthoinfo.aaos.org/en/recovery/care-of-casts-and-splints/

32. Choudhry, B., Leung, B., Filips, E., & Dhaliwal, K. (2020). Keeping the traction on in orthopaedics. *Cureus, 12*(8), e10034. https://doi.org/10.7759/cureus.10034

33. "DA-SC-86-02998.jpeg" by SFC William Clay is in the Public Domain. Access for free at https://catalog.archives.gov/id/6398091



Figure 10.33 Traction

View a supplementary YouTube video[34] on Buck's traction: How To Apply Buck's Traction and Education.

34. Katie Copeland. (2020, March 12). *How to apply buck's traction and education* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=dZNNOJEdecg

TRACTION CARE

If a client has traction prescribed for a fracture, nurses perform focused assessments and interventions as summarized in the following box.

Traction Care[35]

- Regularly assess the traction setup to ensure the proper balance between the force applied by the traction and the countertraction force, which stabilizes the body part.
- Check the equipment regularly to verify that it remains intact, properly aligned, and functioning correctly.
- Collaborate with the health care team to ensure the prescribed traction force aligns with the treatment plan and the client's condition.
- Ensure that weights are properly suspended and freely hanging, avoiding contact with the floor or the bed. Improperly placed or resting weights may disrupt the traction and compromise its effectiveness.
- Regularly check the weights for any signs of fraying in the ropes or malfunction in the pulley system.

Skin Inspection

- Perform frequent skin assessments around the traction site and bony prominences to identify any signs of skin breakdown, irritation, or pressure injuries.

35. Choudhry, B., Leung, B., Filips, E., & Dhaliwal, K. (2020). Keeping the traction on in orthopaedics. *Cureus, 12*(8), e10034. https://doi.org/10.7759/cureus.10034

- Maintain proper skin hygiene and implement measures to prevent pressure injuries, such as using specialized padding or positioning devices as directed.

Pin Care

- If the traction involves pins inserted into bone (as in skeletal traction), follow strict aseptic technique during pin care to prevent infections.
- Cleanse the pin sites as per the health care provider's instructions and change dressings using sterile techniques.

Assessment of Neurovascular Status

- Assess neurovascular status frequently, including assessing pulses, sensation, and movement distal to the traction site.
- Record neurovascular assessments in the client's chart, noting any changes or abnormalities to report to the health care provider promptly.

Education and Communication

- Educate the client and family members about the purpose of traction, skin care, potential complications, and the importance of adhering to prescribed positioning and movement restrictions.
- Report any concerns regarding traction setup, skin integrity, or changes in the client's neurovascular status to the health care team promptly for timely intervention.

MEDICATION THERAPY

Pain medications, such as opioids or local anesthetics, may be prescribed to alleviate discomfort during the acute phase of a fracture. Nonsteroidal anti-inflammatory drugs (NSAIDs) are avoided due to the risk of malunion of the fracture. Antibiotics may be prescribed for open fractures or for those repaired with surgery. Postoperatively, hospitalized clients are often prescribed anticoagulants to prevent deep vein thrombosis.

PHYSICAL THERAPY AND OCCUPATIONAL THERAPY

Physical therapy helps restore range of motion and strength after a fracture. It includes exercises, stretching, and other modalities to promote healing, maintain strength, and regain mobility. Occupational therapy helps restore functioning and the ability to complete activities of daily living. Teaching about safe use of assistive devices, such as crutches and walkers, is also provided.

NUTRITIONAL SUPPORT

The client is encouraged to have an adequate intake of nutrients, especially calcium, vitamin D, and protein to support bone healing and strength.

Nursing Interventions

Nursing interventions focus on monitoring for potential complications and providing health teaching.

MONITORING FOR COMPLICATIONS

Nurses routinely assess neurovascular status (color, circulation, movement, and sensation) of the affected limb to detect signs of compromised circulation or nerve function. The client and their family members are educated about the signs of potential complications and when to seek immediate medical attention.

If a cast is placed, nurses perform the following focused assessments:

- Assess for any foul smell or discharge around the cast, indicating possible infection.
- Assess for sensory changes such as increased pain or sensations of tingling or burning, as these might indicate nerve compression, acute compartment syndrome, or other complications.
- Assess for decreased temperature, pulses, or capillary refill distal to the fracture, which might signify compromised circulation.
- Monitor for swelling above or below the cast, as well as movement limitations, which can signify circulation problems or complications with bone healing.

HEALTH TEACHING

Nurses teach clients about comfort measures and actions to prevent complications.

- Ice is typically prescribed by the health care provider for fractures to help with discomfort and reduce swelling. Generally, ice or a cold pack is on the affected area for 10 to 20 minutes at a time and repeated every one to two hours while awake for several days. A thin cloth should be placed between the ice and the skin.
- Elevation of a fractured extremity can reduce swelling and alleviate discomfort. If not contraindicated, the injured area should be placed on a pillow and elevated about the level of the heart when sitting or lying for several days.
- Safe use of assistive devices (i.e., crutches and walkers) or immobilization devices (i.e., casts and splints) is reinforced. If the client has a cast, teaching about cast care is provided. Read more about cast care in the following box.
- Early ambulation and/or range-of-motion exercises can prevent muscle atrophy, joint stiffness, and the development of deep vein thrombosis (DVT). Nurses collaborate with physical therapy to initiate a progressive exercise regimen to prevent muscle atrophy and aid in rehabilitation.

Health Teaching: Cast Care[36]

- Instruct the client to elevate the casted limb above heart level to minimize swelling and improve circulation.
- Monitor for signs of infection, compromised circulation, or nerve damage, and report any changes promptly.
- Emphasize infection prevention measures and circulation checks to the client, including signs of complications such as numbness, tingling, or color changes.
- Educate the client about the potential risks associated with immobilization, including muscle atrophy and joint stiffness.
- Regularly inspect the skin around the edges of the cast for redness, irritation, or breakdown that might indicate skin problems.
- Educate the client about the importance of keeping the cast dry to prevent skin irritation and the breakdown of the cast material.
- Advise against placing objects down into the cast, which could cause irritation or skin damage.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected

36. American Academy of Orthopaedic Surgeons. (2020). *Care of casts and splints*. https://orthoinfo.aaos.org/en/recovery/care-of-casts-and-splints/

outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Fracture

View a brief YouTube video overview of fracture[37]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2862#oembed-1

37. Open RN Project. (2024, June 23). *Health Alterations – Chapter 10 – Fracture* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/bqoGJP8DSLs?si=mkhrigTxO0jzS4xr

10.7 Osteoarthritis

Osteoarthritis (OA) is the most common form of arthritis and typically affects weight-bearing joints such as the knees, hips, spine, and hands.

Risk factors for osteoarthritis include age, genetics, obesity, joint injuries, and occupations involving repetitive joint stress.[1] See Figure 10.34[2] for an image of a person with osteoarthritis in their finger.

1. Arthritis Foundation. (n.d.). *Osteoarthritis*. https://www.arthritis.org/diseases/osteoarthritis

2. "Osteoarthritis_in_the_left_hand_index_finger.jpg" by Whoisjohngalt is licensed under CC BY-SA 4.0



Figure 10.34 Osteoarthritis in the Hand

Pathophysiology

Osteoarthritis is a degenerative joint disease characterized by the breakdown of joint cartilage and changes in the underlying bone. It occurs when cartilage wears away due to repetitive overuse of a joint and the inability of the cartilage to repair itself. As the cartilage breaks down, inflammatory processes within the joint occur as enzymes are released, causing the joints to swell and become stiff and painful. As the cartilage breaks down, osteophytes or bone spurs may occur, further restricting movement and causing

additional pain. The joint spaces continue to narrow, resulting in reduced mobility and increased friction between the bones. **Crepitus** is a common symptom associated with osteoarthritis and is a popping, clicking, or crackling sound when moving a joint. It typically reflects air movement in the joint and is harmless.[3]

Assessment

While osteoarthritis primarily affects the musculoskeletal system, it can indirectly impact other body systems due to chronic pain, limited mobility, and the psychological toll it can take on an individual's overall well-being. Assessment findings vary based on the severity and location of osteoarthritis. Common manifestations of osteoarthritis are summarized in Table 10.7a.

Table 10.7a. Manifestations of Osteoarthritis[4,5,6]

Body System	Potential Assessment Findings
Musculoskeletal	Asymmetrical joint involvements with pain, especially after activity or prolonged rest; stiffness and reduced range of motion in affected joints; crepitus (grating or crackling sensation) with joint movement; and visible joint deformities or swelling
Integumentary	Warmth and redness over affected joints during periods of inflammation
Neurological	Numbness or tingling sensations due to nerve compression in affected joints
Psychological	Psychological impact such as anxiety, depression, or frustration due to chronic pain and limited mobility

3. Drum, E. E., Kovats, A., Jones, M. D., Dennis, S., Naylor, J., Mills, K., & Thom, J. M. (2023). Creaky knees: Is there a reason for concern? A qualitative study of the perspectives of people with knee crepitus. *Musculoskeletal Care, 21*(4), 1114–1124. https://doi.org/10.1002/msc.1793

4. Arthritis Foundation. (n.d.). *Osteoarthritis*. https://www.arthritis.org/diseases/osteoarthritis

5. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2023). *Osteoarthritis*. https://www.niams.nih.gov/health-topics/osteoarthritis

6. MedlinePlus [Internet]. (2024). *Osteoarthritis*. https://medlineplus.gov/osteoarthritis.html

Diagnostic Testing

Diagnosis of osteoarthritis (OA) may include imaging studies and laboratory tests. X-rays may be ordered by the health care provider to visualize joint damage, joint narrowing, osteophyte formation, and potential changes in bone density. MRIs may also be ordered to examine soft tissue, cartilage breakdown, and the extent of joint damage. Laboratory tests, such as C-reactive protein and erythrocyte sedimentation rate, may also be ordered to rule out inflammatory arthritis.[7,8] Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnoses

Nursing diagnoses associated with osteoarthritis focus on an individual's functional ability, pain management, and adaptation to changes in lifestyle.

Common nursing diagnoses for osteoarthritis include the following:

- Pain
- Impaired Mobility
- Self-care Deficit
- Risk for Falls
- Ineffective Coping

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client

7. Johns Hopkins Medicine. (n.d.). *Diagnosing bone disorders.* https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/diagnosing-bone-disorders

8. MedlinePlus [Internet]. (2024). *Osteoarthritis*. https://medlineplus.gov/osteoarthritis.html

within a specific time frame that are responsive to nursing interventions. Sample expected outcomes for a client with osteoarthritis are as follows:

- *The client will report a chronic pain level acceptable to them within two weeks of implementing pain management strategies.*
- *The client will independently perform activities of daily living (e.g., walking, dressing, bathing) with minimal discomfort within two weeks.*
- *The client will demonstrate accurate use of assistive devices within one week.*
- *The client will verbalize three coping strategies related to self-management of osteoarthritis within one month.*

Interventions

Medical Interventions

Medical interventions for osteoarthritis are diverse and aim to alleviate pain, improve joint function, and enhance the individual's quality of life. Interventions may include medication therapy, physical therapy, weight management, and surgical interventions.[9,10,11]

MEDICATION THERAPY

Medication therapy for osteoarthritis may include several classes of medications:

9. Arthritis Foundation. (n.d.). *Osteoarthritis*. https://www.arthritis.org/diseases/osteoarthritis
10. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2023). *Osteoarthritis*. https://www.niams.nih.gov/health-topics/osteoarthritis
11. MedlinePlus [Internet]. (2024). *Osteoarthritis*. https://medlineplus.gov/osteoarthritis.html

- **Pain Relievers:** Acetaminophen is an analgesic that reduces pain. NSAIDs (i.e., ibuprofen or naproxen sodium) reduce pain, as well as inflammation. Celecoxib is a selective NSAID that helps reduce pain and inflammation but does not have the typical gastrointestinal side effects of other NSAIDs. It is typically avoided in individuals with hypertension, renal disease, or cardiovascular issues due to potential side effects. In cases of severe pain not adequately managed by other medications, opioids may be prescribed cautiously for short-term use to relieve pain. However, due to their potential for significant side effects and substance use disorder, they are usually considered only when other options have failed.
- **Topical Medications:** Creams, gels, or patches containing lidocaine, capsaicin, or diclofenac gel offer localized pain relief for joints with osteoarthritis.
- **Disease-Modifying Drugs:** In some cases, disease-modifying osteoarthritis drugs (DMOADs) like hyaluronic acid injections or glucosamine/chondroitin supplements are used to slow the progression of cartilage breakdown.
- **Corticosteroid Injections:** Injections of corticosteroids directly into the affected joint can provide short-term pain relief and reduce inflammation.

PHYSICAL THERAPY/ASSISTIVE DEVICES

Tailored exercises and physical therapy programs help improve joint flexibility, strength, and range of motion. Therapists may also use modalities like heat, ice, or ultrasound for pain relief. In some cases, assistive devices like canes, braces, or splints can help reduce stress on affected joints and improve mobility.

WEIGHT MANAGEMENT

Maintaining a healthy weight or losing excess weight reduces stress on weight-bearing joints, such as hips and knees, and can reduce the symptoms of osteoarthritis.

SURGICAL INTERVENTIONS

In severe cases where conservative treatments fail, surgical options like arthroscopy (joint repair), arthroplasty (joint replacement) or joint fusion may be considered to relieve pain and improve joint function. **Arthroscopy** is a minimally invasive surgical procedure in which an endoscope is inserted by an orthopedic surgeon into the joint through a small incision. Small surgical instruments are inserted via additional incisions to remove or repair ligaments and other joint structures.

Arthroplasty refers to joint replacement surgery, an invasive procedure requiring extended recovery time. Hip and knee joints are commonly replaced, but other joints that can be replaced are shoulders, elbows, ankles, and wrists. This type of surgery involves replacing the articular surfaces of the bones with artificial components. For example, in hip arthroplasty, the worn or damaged parts of the hip joint, including the head and neck of the femur and the acetabulum of the pelvis, are removed and replaced with artificial joint components. The replacement head for the femur consists of a rounded ball attached to the end of a shaft that is inserted inside the femur. The acetabulum of the pelvis is reshaped, and a replacement socket is fitted into its place.[12] See Figure 10.35[13] for an illustration of joint replacement surgery.

12. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

13. "Replacement surgery – Shoulder total hip and total knee replacement — Smart-Servier.jpg" by Laboratoires Servier is licensed under CC BY-SA 3.0

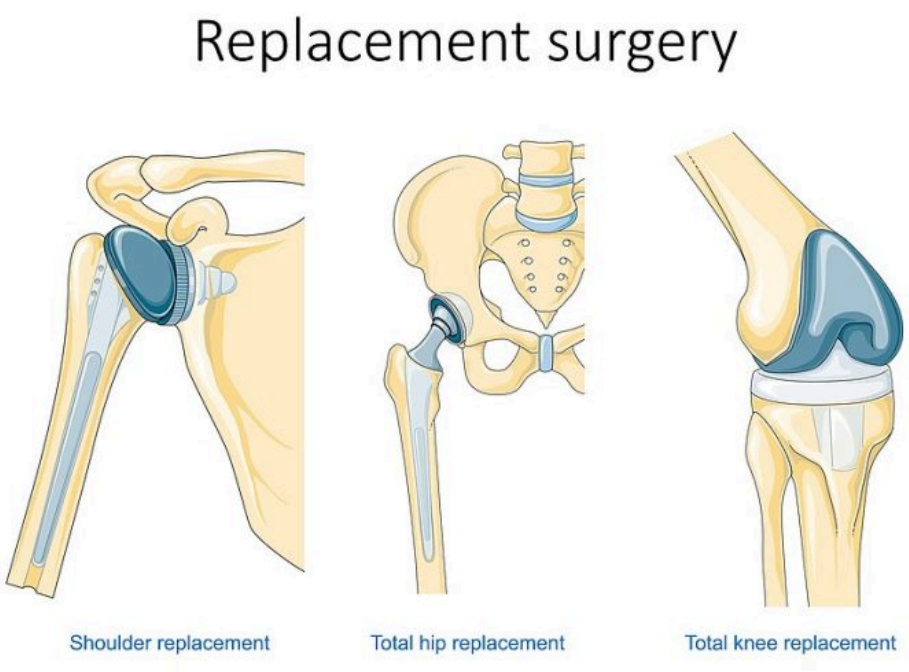


Figure 10.35 Joint Replacement Surgery

Clients having arthroplasty may have outpatient surgery and go home the same day or stay in the hospital for one or two nights, depending upon their condition and recovery. See the following box for additional information on nursing considerations related to hip replacement surgery.

Hip Replacement Surgery (Arthroplasty)

Preoperative Care

Nurses provide preoperative education about the procedure and postoperative care for successful recovery and use of the new joint. Topics include assistive/adaptive equipment, restricted movements to prevent dislocation of the joint, setting up of the home environment for after surgery, and medication planning such as pain management and anticoagulant therapy to prevent blood clots. Clients also complete preoperative testing, including

blood tests (to rule out infection and determine baseline bleeding times) and an electrocardiogram (EKG) to evaluate their heart.

Hip Precautions

Hip precautions are implemented after surgery and taught to the client to avoid dislocation of the new hip joint.[14]

- Avoid crossing the legs or feet.
- Sleep with a pillow between your legs.
- Do not flex the hip more than 90 degrees (i.e., do not lean too far forward from the waist or position the knee above the hip level when seated).
- Do not rotate the hip/leg inward toward your body.

Potential Complications

Nurses assess for potential complications and provide nursing care to prevent postoperative complications. See Table 10.7b for a summary of common complications, related focused assessments, and preventative measures.

Table 10.7b. Common Complications of Hip Replacement Surgery[15]

14. A.D.A.M. Medical Encyclopedia [Internet]. (2020). *Taking care of your new hip joint*. https://medlineplus.gov/ency/patientinstructions/000171.htm

15. Perkins, A. (2021). Total hip replacement explained. *Nursing Made Incredibly Easy!, 19*(1), 28-35. https://www.nursingcenter.com/cearticle?an=00152258-202101000-00007&Journal_ID=417221&Issue_ID=5727808

Potential Complication	Focused Assessment	Preventative Measures
Deep Vein Thrombosis (DVT) and/or Pulmonary Embolism (PE)	The surgical limb is frequently assessed for signs of DVT, including unilateral calf pain, swelling, redness, and warmth. Sudden symptoms of chest pain and/or shortness of breath should be immediately reported.	• Antiembolism stockings and/or sequential compression devices are applied as prescribed by the surgeon. • Anticoagulant therapy is administered for up to several weeks. Health teaching is provided about bleeding precautions and routine lab follow-up. • Early ambulation and range-of-motion exercises are encouraged as prescribed.
Excessive Bleeding	Monitor the surgical site dressing for excessive bleeding. Monitor lab values (hemoglobin and hematocrit) for signs of anemia.	• Follow the surgeon's instructions regarding dressing changes. • If excessive bleeding is suspected, mark the dressing. • Reinforce the dressing and notify the surgeon. • Administer blood transfusions as ordered for severe anemia.
Surgical Site Infection	Monitor the client's temperature, surgical limb, and white blood cell count for signs of infection.	• Notify the surgeon of suspected infection. • Administer antibiotics as prescribed.

Poor Pain Management	Frequently assess pain levels. Monitor participation levels in physical therapy.	• Teach clients the importance of good pain management for optimal participation in physical therapy exercises to avoid delays in regaining full mobility. • Administer pain medications as prescribed, with planned doses about one hour before physical therapy. • Use nonpharmacological therapies like ice and positioning.
Constipation and Ileus	Perform abdominal assessment, including auscultation of bowel sounds. Monitor the date of the last bowel movement.	• Encourage clients to drink fluids and increase fiber intake to promote bowel motility. • Administer stool softeners to prevent constipation. Use laxatives as prescribed to treat constipation as part of a bowel management plan.

Hypotension and Fall Risk	Monitor balance and orthostatic blood pressure.	• While hospitalized, instruct clients to call for assistance when getting out of bed because their decreased mobility after surgery increases their fall risk. • Allow time between position changes and before standing to prevent postural hypotension. • Encourage the client to prepare the home environment for use of assistive devices, such as removing throw rugs, using a raised toilet seat, and raising commonly used items such as utensils to higher cupboards.
Dislocation	Assess for leg shortening with external or internal rotation if the client reports sudden onset of pain, a "snapping" feeling, or the sudden inability to walk or bear weight on the affected leg.	• Follow mobility precautions per the surgeon's orders and physical therapy recommendations. • Teach and implement hip precautions. • Immediately report suspected dislocation to the surgeon.
Skin Breakdown	Monitor pressure points for skin breakdown, including the heels.	• Reposition clients frequently. • Elevate heels off the bed.

For more information about health teaching topics for clients after a hip replacement surgery, read the following article from Medline Plus: How to Take Care of Your New Hip Joint.

Nursing Interventions

Nursing interventions for clients with osteoarthritis focus on managing pain, promoting mobility and fulfillment of activities of daily living, and providing health teaching.

PAIN MANAGEMENT

Nurses assess the client's pain level and evaluate their response to prescribed medications. Clients are educated about the proper use of prescribed pain medications and their potential side effects. Clients are also taught about nonpharmacological pain management techniques like heat/cold therapy or guided imagery.

> Read additional information about specific analgesics in the "Analgesic and Musculoskeletal Medications" section of Open RN *Nursing Pharmacology, 2e*.

MOBILITY THERAPY

Nurses collaborate with physical therapists and reinforce personalized exercise programs focusing on joint mobility, flexibility, and strengthening. Clients are also taught proper body mechanics to reduce joint strain during daily activities. If assistive devices (i.e., canes, braces, or walkers) are prescribed, nurses reinforce their safe and effective use to improve mobility and reduce stress on affected joints.

HEALTH TEACHING

Nurses provide education about osteoarthritis, including its progression, treatment options, and self-care strategies. Guidance on lifestyle changes like weight management, healthy eating habits, and regular exercise is provided.

Potential fall hazards in the home are discussed, and recommendations for preventing falls, like removing throw rugs, are provided.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Osteoarthritis

View a brief YouTube video overview of osteoarthritis[16]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2894#oembed-1

16. Open RN Project. (2024, June 23). *Health Alterations – Chapter 10 – Osteoarthritis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/ADmaiFWeJu4?si=E1BAe9HkcOFGqIM4

10.8 Osteoporosis

Osteopenia is an abnormal reduction of bone mass that can lead to osteoporosis. **Osteoporosis** is a progressive bone disease characterized by a decrease in bone density and deterioration of bone tissue, leading to bone fragility and increased risk of fractures in the hips, spine, and wrist.

Pathophysiology

The pathophysiology of osteoporosis involves an imbalance between bone resorption and bone formation. Bone resorption outpaces bone formation, leading to a reduction in bone mass and structural deterioration. See Figure 10.36 for an illustration of osteoporosis.

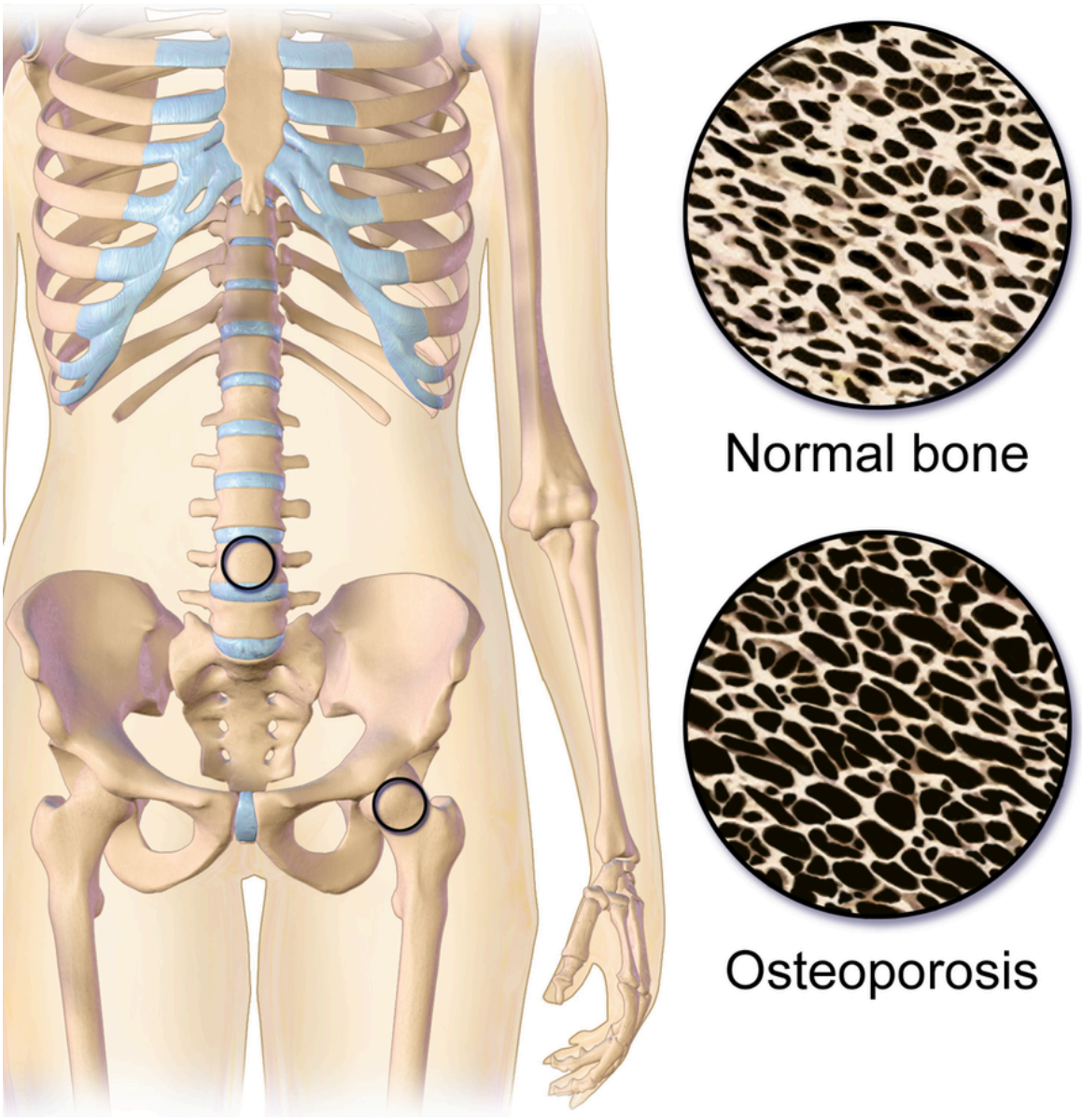


Figure 10.36 Osteoporosis in the Hip and Spine

Risk factors for osteoporosis include age, gender (women are at a higher risk, especially after menopause), genetics, hormonal changes, inadequate calcium and vitamin D intake, certain medications like corticosteroids, and lifestyle factors like smoking, excessive alcohol consumption, and lack of exercise.

Fractures related to osteoporosis can have severe consequences, affecting

mobility, causing chronic pain, and leading to complications that impact overall quality of life.[1,2]

Assessment

Osteoporosis is often considered a “silent disease” because it typically progresses without noticeable symptoms in its early stages. Individuals may remain unaware of their condition until a fracture occurs, often resulting from a simple fall or even during routine daily activities. Common manifestations of osteoporosis are summarized in Table 10.8.

Table 10.8. Manifestations of Osteoporosis[3,4,5]

Body System	Potential Assessment Findings
Skeletal	Decreased bone mineral density (seen in DEXA scans); decreased height; vertebral compression fractures; hip, wrist, or other fractures from minor trauma or falls; and kyphosis
Respiratory	Reduced lung capacity or respiratory complications due to spinal deformities caused by vertebral compression fractures or abnormal curvature of the spine

1. National Institute on Aging. (2022). *Osteoporosis*. National Institutes of Health. https://www.nia.nih.gov/health/osteoporosis/osteoporosis
2. MedlinePlus [Internet]. (2017). *Osteoporosis*. https://medlineplus.gov/osteoporosis.html
3. National Institute on Aging. (2022). *Osteoporosis*. National Institutes of Health. https://www.nia.nih.gov/health/osteoporosis/osteoporosis
4. MedlinePlus [Internet]. (2017). *Osteoporosis*. https://medlineplus.gov/osteoporosis.html
5. American Academy of Orthopaedic Surgeons. (2021). *Osteoporosis*. https://orthoinfo.aaos.org/en/diseases–conditions/osteoporosis/

Diagnostic Testing

Diagnostic testing for osteoporosis primarily involves assessing bone density and evaluating fracture risk[6,7,8]:

- **DEXA scans** are the gold standard for diagnosing osteoporosis. The scan provides a T-score, comparing an individual's bone density to that of a young, healthy adult and indicating the risk of fracture. A T-score between -1 and -2.5 indicates osteopenia, and a T-score of lower than -2.5 is diagnostic for osteoporosis.
- **Quantitative ultrasound (QUS)** measures bone density with sound waves at peripheral sites such as the heel. It can provide an estimate of fracture risk.
- A **FRAX screening tool** may be used to assess an individual's overall fracture risk. The FRAX tool is a fracture risk calculator that estimates a client's ten-year probability of a hip fracture or other major fracture. Completion of the FRAX tool allows providers to help make appropriate recommendations about lifestyle modification and risk mitigation.

Nursing Diagnoses

Nursing diagnoses for clients with osteoporosis can help guide nursing care

6. InformedHealth.org. (2017). *Understanding tests used to detect bone problems*. Institute for Quality and Efficiency in Health Care (IQWiG). https://www.ncbi.nlm.nih.gov/books/NBK279413/

7. Johns Hopkins Medicine. (n.d.). *Diagnosing bone disorders*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/diagnosing-bone-disorders

8. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2023). *Osteoarthritis*. https://www.niams.nih.gov/health-topics/osteoarthritis

and address the specific needs of these individuals. Common nursing diagnoses for osteoporosis include the following:

- Risk for Injury
- Impaired Nutrition: Less Than Body Requirements

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Sample expected outcomes for a client diagnosed with osteoporosis include the following:

- *The client will verbalize three preferred sources of calcium-rich foods by the end of the teaching session.*
- *The client will verbalize three modifications to their home environment to prevent falls by the end of the teaching session.*

Interventions

Medical Interventions

Medical interventions for osteoporosis aim to strengthen bones, reduce fracture risk, and improve overall bone health.

MEDICATION THERAPY

Common medications used to treat osteoporosis include the following:

- **Bisphosphonates:** Bisphosphonates (e.g., alendronate and risedronate) slow bone loss and reduce fracture risk by inhibiting bone breakdown.
- **Denosumab:** Denosumab is a monoclonal antibody injection given twice yearly, which helps to prevent osteoclast cells from developing.

- **Hormone Therapy:** In some cases, selective estrogen receptor modulators (SERMs) may be prescribed for postmenopausal women to help maintain bone density. An example of a SERM is raloxifene.
- **Synthetic Forms of Parathyroid Hormone:** Teriparatide and abaloparatide stimulate bone formation.
- **Calcitonin:** Calcitonin prevents bone loss and increases bone density.
- **Calcium & Vitamin D Supplements:** Calcium and vitamin D supplements may be prescribed to supplement dietary intake.

LIFESTYLE MODIFICATIONS

Weight-bearing exercises and resistance training help maintain bone density and strength. Clients are encouraged to eat a balanced diet rich in calcium and vitamin D. Clients who smoke are advised to stop smoking, and excessive alcohol consumption should be avoided because it can weaken bones.

SURGICAL INTERVENTION

In some cases of fractures caused by osteoporosis, surgical intervention may be required. Common fractures requiring surgical intervention include hip fractures and vertebral fractures. **Vertebroplasty** involves the injection of bone cement into fractured vertebrae to stabilize the fracture areas.[9,10,11,12]

9. National Institute on Aging. (2022). *Osteoporosis*. National Institutes of Health. https://www.nia.nih.gov/health/osteoporosis/osteoporosis

10. MedlinePlus [Internet]. (2017). *Osteoporosis*. https://medlineplus.gov/osteoporosis.html

11. American Academy of Orthopaedic Surgeons. (2021). *Osteoporosis*. https://orthoinfo.aaos.org/en/diseases–conditions/osteoporosis/

12. Arthritis Foundation. (n.d.). *Osteoarthritis*. https://www.arthritis.org/diseases/osteoarthritis

Nursing Interventions

Nursing interventions for osteoporosis focus on health teaching, preventing complications, and promoting overall client well-being.

HEALTH TEACHING

Nurses educate clients about modifiable risk factors for osteoporosis. Guidance is provided on preventive measures like adequate calcium and vitamin D intake, weight-bearing exercises, and fall prevention strategies. Calcium and vitamin D dietary sources include dairy products, leafy greens, and calcium-fortified foods like orange juice. Weight-bearing exercises like walking, jogging, dancing, as well as strength resistance training, can improve bone strength and density. Nurses consider the client's abilities and preferences when discussing exercise programs and consider referrals to a physical therapist for additional recommendations for exercise programs and balance exercises. Routine bone density screenings are encouraged, especially for postmenopausal women, for the early detection of osteoporosis.

For clients who have been diagnosed with osteoporosis, nurses identify potential fall hazards in the home and provide recommendations for modifications to prevent falls that can cause fractures (e.g., removing rugs, improving lighting, and installing handrails). Techniques for using assistive devices like canes and walkers are reinforced to prevent falls.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Osteoporosis

View a brief YouTube video overview of osteoporosis[13]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2913#oembed-1

13. Open RN Project. (2024, June 23). *Health Alterations – Chapter 10 – Osteoporosis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/WFuPGu_58xY?si=St-9SiFSAra6tUa9

10.9 Rheumatoid Arthritis

Rheumatoid arthritis (RA) causes symptoms such as bilateral joint pain, stiffness, and swelling. It is known for its pattern of remission and exacerbations, where symptoms might improve and worsen intermittently. Deformities may occur like a **swan-like deformity** of the hands (see Figure 10.37[1]) or **boutonniere deformities**, which are firm, observable lumps underneath the skin on or near the base of the joint (see Figure 10.38[2]).[3]

1. "Rheumatoid_arthritis_–_Smart-Servier_(cropped).jpg" by Laboratoires Servier is licensed under CC BY-SA 3.0
2. "RA_hand_deformity.JPG" by Prashanthns is licensed CC BY-SA 3.0.
3. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Rheumatoid arthritis.* National Institutes of Health. https://www.niams.nih.gov/health-topics/rheumatoid-arthritis

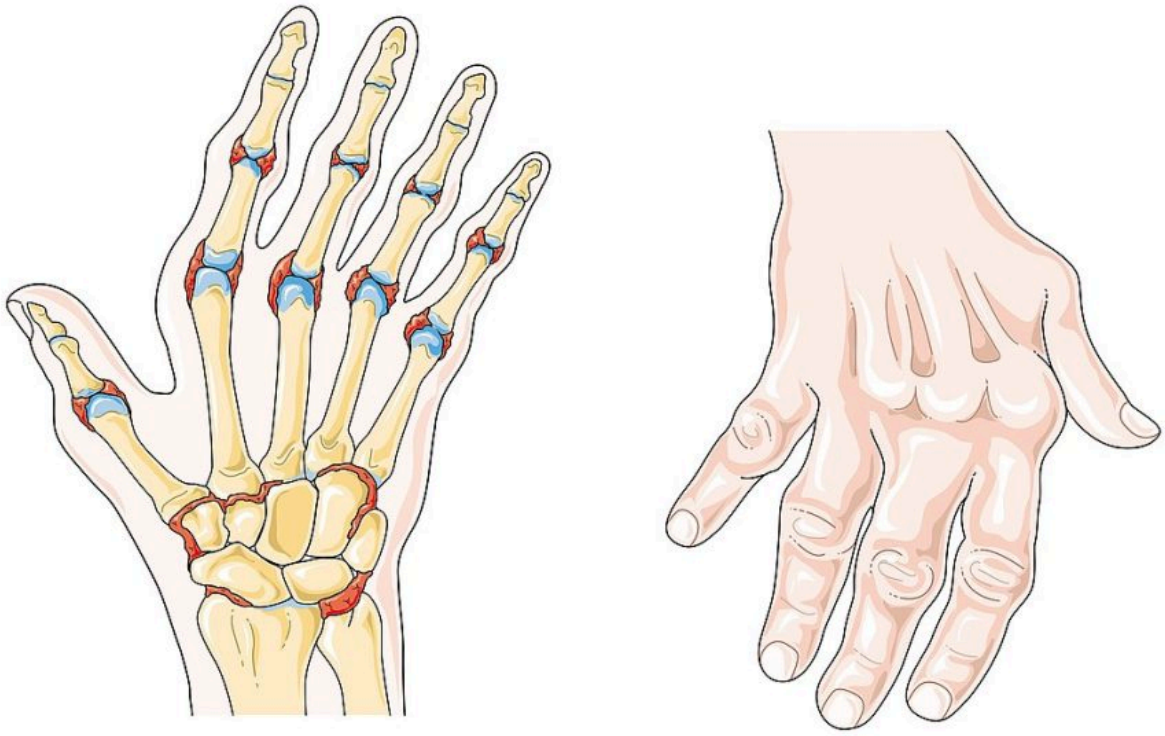


Figure 10.37 Swan-like Deformity of the Hands in RA



Figure 10.38 Boutonniere Deformities

Several risk factors contribute to the development of RA. Women are more likely than men to develop RA, and it commonly begins between the ages of 20 and 50. Genetic predisposition also plays a significant role, so family history of RA can increase the likelihood of occurrence. Chronic stress has also been associated with RA because of its effect on the immune system.

Early diagnosis and appropriate management, including medications, physical therapy, and lifestyle modifications, aim to reduce inflammation, manage symptoms, and slow down joint damage progression in individuals with RA.[4]

4. Arthritis Foundation. (2021). *Rheumatoid arthritis: Causes, symptoms, treatments and more*. https://www.arthritis.org/diseases/rheumatoid-arthritis

Pathophysiology

RA is a chronic, systemic autoimmune disorder primarily affecting the synovial tissue (i.e., the lining of joints). The inflammatory process that occurs in RA is bilateral, meaning it affects both sides of the body, and often involves multiple joints simultaneously. The immune system's attack on the synovial tissue causes chronic inflammation, which, if left untreated, can cause damage to the joint cartilage, bones, and other nearby structures.

Assessment

Physical assessment findings for rheumatoid arthritis vary based on early versus late stages of the disease. A summary of signs and symptoms of early and late stages of rheumatoid arthritis by body system is provided in Table 10.9.

Table 10.9. Manifestations of Early and Late Stages of Rheumatoid Arthritis[5,6,7]

Body System	Early RA Physical Assessment Findings	Late RA Physical Assessment Findings
Musculoskeletal	Joint pain and tenderness; swelling, warmth, and erythema at affected joints; morning stiffness lasting greater than 30 minutes; symmetrical involvement of multiple joints (hands, wrists, etc.); muscle weakness; and fatigue	Severe joint deformities (e.g., swan-neck or boutonniere deformities), limited range of motion, joint contractures due to chronic inflammation, joint instability, and muscle wasting due to disuse
Cardiovascular	Pericardial friction rub may be heard in auscultation	Increased risk of cardiovascular diseases due to accelerated atherosclerosis
Respiratory	Mild pleuritic chest pain or dry cough	Pleurisy (inflammation of lung lining) or interstitial lung disease
Neurological	Numbness or tingling due to nerve compression or inflammation. Mild eye dryness or irritation	Peripheral neuropathy, scleritis (inflammation of the eye's outer layers)

5. Arthritis Foundation. (2021). *Rheumatoid arthritis: Causes, symptoms, treatments and more*. https://www.arthritis.org/diseases/rheumatoid-arthritis

6. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Rheumatoid arthritis*. National Institutes of Health. https://www.niams.nih.gov/health-topics/rheumatoid-arthritis

7. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Rheumatoid arthritis*. https://medlineplus.gov/ency/article/000431.htm

Diagnostic Testing

Blood tests commonly ordered by health care providers to diagnosis RA include the following[8]:

- **Rheumatoid Factor (RF) Antibody Assay:** Detects atypical IgG and IgM antibodies commonly found in connective tissue disorders
- **Antinuclear Antibody (ANA):** Measures antibodies that target cell nuclei, contributing to tissue damage in autoimmune conditions
- **Erythrocyte Sedimentation Rate (ESR):** Confirms the presence of inflammation or infection throughout the body
- **C-reactive Protein (CRP):** Assists in gauging the level of inflammation present

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges." Diagnostic testing may include X-rays, MRIs, and ultrasounds.

Nursing Diagnoses

For clients diagnosed with RA, nursing diagnoses often revolve around managing symptoms, promoting mobility, and providing support. Common nursing diagnoses for clients with RA include the following:

- Chronic Pain
- Impaired Mobility
- Fatigue
- Risk for Altered Skin Integrity

8. Johns Hopkins Medicine. (n.d.). *Diagnosing bone disorders*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/diagnosing-bone-disorders.

Outcome Identification

Outcome identification includes setting short- and long-term goals and creating expected outcome statements customized for the client's specific needs. Expected outcomes are statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. Sample expected outcomes for a client diagnosed with RA include the following:

- *The client will report a reduction in pain levels to 3/10 or less on the pain scale within two weeks.*
- *The client will accurately demonstrate prescribed exercises and mobility-enhancing techniques within two weeks.*
- *The client will verbalize a reduction in fatigue levels, reporting increased energy to perform daily activities within three weeks.*
- *The client will maintain intact skin over nodules utilizing moisturizing techniques.*

Interventions

Medical Interventions

Medical interventions include medication therapy and physical/occupational therapy.

MEDICATION THERAPY

Medication therapy focuses on managing symptoms, reducing inflammation,

and slowing disease progression and may include the following medications[9,10]:

- **Analgesics, Nonsteroidal Anti-Inflammatory Drugs (NSAIDs), and Opioids:** Acetaminophen, ibuprofen, naproxen, or opioids may be prescribed to manage chronic pain.
- **Antimalarial Medications:** Antimalarial medications like hydroxychloroquine and chloroquine may be prescribed for their anti-inflammatory properties to manage joint pain and fatigue and to prevent flare-ups.
- **Steroids:** Prednisone is a corticosteroid that can swiftly reduce inflammation and provide rapid relief. It is often prescribed for acute flare-ups of RA or as a short-term bridge therapy. Intra-articular injections of corticosteroids directly into affected joints can provide targeted relief from pain and inflammation, particularly when specific joints are severely affected.
- **Immunosuppressants:** Immunosuppressants help to slow down the immune system's response that causes joint inflammation and damage. Cyclophosphamide is a potent immunosuppressant that may be considered in severe cases of RA.
- **Disease-Modifying Anti-Rheumatic Drugs (DMARDs):** Medications like methotrexate and sulfasalazine aim to slow or alter the disease progression by modifying the immune response. Methotrexate is one of the most commonly used DMARDs due to its effectiveness in reducing inflammation and slowing joint damage. DMARDs have potentially distressing and life-threatening side effects such as drug reaction with eosinophilia and systemic symptoms (DRESS), erythema multiforme,

9. Arthritis Foundation. (2021). *Rheumatoid arthritis: Causes, symptoms, treatments and more*. https://www.arthritis.org/diseases/rheumatoid-arthritis

10. A.D.A.M. Medical Encyclopedia [Internet]. (2023). *Rheumatoid arthritis*. https://medlineplus.gov/ency/article/000431.htm

Stevens-Johnson syndrome, toxic epidermal necrolysis, torsades de pointes, hepatotoxicity, or aplastic anemia.

- **Biological Response Modifiers:** Also known as biologics, these medications target specific components of the immune system to reduce inflammation.
- **Tumor Necrosis Factor (TNF) Inhibitors:** Medications like infliximab and adalimumab are biologics that target TNF, a protein involved in the inflammatory response. They can effectively reduce symptoms and slow joint damage. However, caution is necessary as these medications can suppress the immune system, increasing susceptibility to infections. Therefore, they might not be suitable for clients with serious infections.

PHYSICAL/OCCUPATIONAL THERAPY

Structured exercise programs and physical therapy are integral for maintaining joint flexibility, strength, and function. Customized exercises help manage pain, prevent muscle atrophy, and improve mobility. Occupational therapists assist clients in adapting their daily routines and environments to reduce strain on joints. They provide guidance on adaptive equipment and techniques for tasks like dressing, cooking, and using tools.[11]

Assistive devices such as splints, braces, or orthotics may be recommended to support and protect affected joints, reducing strain and improving function.[12]

11. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Rheumatoid arthritis.* National Institutes of Health. https://www.niams.nih.gov/health-topics/rheumatoid-arthritis

12. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2022). *Rheumatoid arthritis.* National Institutes of Health. https://www.niams.nih.gov/health-topics/rheumatoid-arthritis

Nursing Interventions

PAIN MANAGEMENT

Nurses assess client's pain levels using pain scales to effectively manage pain and evaluate the effectiveness of pain medications and nonpharmacological interventions such as heat or cold therapy, massage, or relaxation techniques.

SKIN AND JOINT CARE

Nurses assist in joint protection by reinforcing the effective use of splints or braces. If these devices are used, nurses perform skin assessments on areas at risk for skin breakdown and educate clients on proper skin care to prevent pressure injuries.

HEALTH TEACHING

Clients taking immune-suppression drugs must follow stringent infection control techniques to minimize the risk of infections. Nurses provide teaching on the following topics:

- **Perform Good Hand and Personal Hygiene:** Regular and thorough handwashing with soap and water or using alcohol-based hand sanitizers helps prevent the spread of infections. Maintaining good personal hygiene, including regular bathing and oral care, helps prevent the spread of bacteria and viruses.
- **Avoid Individuals Who Are Ill:** Clients should avoid close contact with individuals who are sick or showing possible signs of infection to reduce the risk of exposure.
- **Stay Current on Vaccinations:** Staying up-to-date on vaccinations, including flu shots and other recommended vaccines, can provide additional protection against preventable infections.
- **Follow Safe Food Handling Practices:** Ensuring that food is properly cooked and handling it with care help prevent foodborne illnesses.
- **Avoid Crowded Places:** Limiting exposure to crowded places, especially

during flu seasons or outbreaks, can reduce the risk of coming into contact with infectious agents.

- **Use Protective Equipment:** Wear face masks, gloves, and other protective equipment in health care and crowded settings to provide an extra layer of protection.
- **Maintain Environmental Hygiene:** Keep living spaces clean. Regularly disinfect surfaces to help eliminate potential sources of infection.
- **Monitor Symptoms:** Monitor for signs of infection and seek prompt medical attention if symptoms arise.
- **Communicate with Health Care Providers:** Open communication with health care providers about symptoms, concerns, and any changes in health status is essential for proper management of RA.

ADVOCACY AND PSYCHOSOCIAL SUPPORT

Nurses advocate for clients' needs within the health care team, ensuring comprehensive care and addressing barriers to treatment. Nurses may collaborate with other health care professionals like physical therapists, occupational therapists, and rheumatologists to ensure a multidisciplinary approach to client care. Nurses promote optimal functioning and independence by providing health teaching on self-care and self-management of chronic illness, including joint protection, energy conservation, and the use of assistive devices to enhance independence.

Nurses also provide active listening and therapeutic communication while addressing the emotional impact of living with a chronic illness. Clients are encouraged to participate in support groups or other community resources to cope with chronic illness and maximize emotional well-being.

Evaluation

During the evaluation stage, nurses determine the effectiveness of nursing interventions for a specific client. The previously identified expected outcomes are reviewed to determine if they were met, partially met, or not met by the time frames indicated. If outcomes are not met or only partially met by the time frame indicated, the nursing care plan is revised. Evaluation

should occur every time the nurse implements interventions with a client, reviews updated laboratory or diagnostic test results, or discusses the care plan with other members of the interprofessional team.



RN Recap: Rheumatoid Arthritis

View a brief YouTube video overview of rheumatoid arthritis[13]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=2921#oembed-1

13. Open RN Project. (2024, June 23). *Health Alterations – Chapter 10 – Rheumatoid arthritis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/Jd4KWLSMy9M?si=VJX_ZKbuX7Lm9vd3

10.10 Other Musculoskeletal Disorders

Additional musculoskeletal disorders are briefly discussed in this section.

Bone Cancer

There are three types of primary bone cancers: osteosarcoma, Ewing sarcoma, and chondrosarcoma. These are considered primary cancers because they originate in the bones. Osteosarcoma and Ewing sarcomas are cancers found in children, teenagers, and young adults. Ewing sarcoma is considered to be the more aggressive of the two cancers because it tends to metastasize quickly. Osteosarcoma is the most common type of bone cancer, and it begins in the tissues of growing bones. Chondrosarcoma develops in cells that produce cartilage and affects adults.

Bone cancer can also be caused by cancer that has metastasized from other areas of the body. For example, breast, lung, and prostate cancer commonly cause bone metastasis.

Symptoms of bone cancer may include fatigue, unintended weight loss, bone pain, swelling, tenderness, and weakened bone leading to fractures. Diagnostic testing may include a bone scan, X-ray, CT scan, MRI, PET scan, and bone biopsy. Treatment is based on the type of cancer, the stage of the cancer, and the client's overall health and preferences. For example, some bone cancers are treated with surgery; some are treated with surgery and chemotherapy; and others are treated with surgery, chemotherapy, and radiation therapy.[1]

Cerebral Palsy

Cerebral palsy (CP) is a group of disorders that affects the ability to move and maintain balance and posture. "Cerebral" means having to do with the brain, and "palsy" means weakness or problems with using the muscles. CP is

1. Mayo Clinic. (2023). *Bone cancer.* https://www.mayoclinic.org/diseases-conditions/bone-cancer/symptoms-causes/syc-20350217

caused by abnormal brain development or damage to the developing brain that affects the ability to control muscles.[2]

The symptoms of CP vary from person to person. A person with severe CP might require the use of special equipment to walk or might not be able to walk at all and need lifelong care. A person with mild CP, on the other hand, might walk a little awkwardly, but otherwise not require specialized care. Doctors classify CP according to the main type of movement disorder involved. Depending on which areas of the brain are affected, one or more of the following movement disorders can occur[3]:

- **Spasticity:** Stiff muscles
- **Dyskinesia:** Uncontrollable movements
- **Ataxia:** Poor balance and coordination

There is no cure for CP, but treatment can improve the quality of life for people who have the condition. After CP is diagnosed, a team of health professionals works with the child and family to develop a plan to help the child reach their optimal potential. Common treatments include medications; surgery; braces; and physical, occupational, and speech therapy.[4]

See Figure 10.39[5] for an image of David Smith who has cerebral palsy and is a Paralympian. Paralympians are athletes with a range of impairments who compete in the Paralympics, a competition similar to the Olympics.

2. Centers for Disease Control and Prevention. (n.d.). *What is cerebral palsy?* https://www.cdc.gov/cerebral-palsy/about/

3. Centers for Disease Control and Prevention. (n.d.). *What is cerebral palsy?* https://www.cdc.gov/cerebral-palsy/about/

4. Centers for Disease Control and Prevention. (n.d.). *What is cerebral palsy?* https://www.cdc.gov/cerebral-palsy/about/

5. "David_Smith_and_his_Boccia_medals_(cropped).jpg" by Richard Gillin from St Albans, UK is licensed under CC BY-SA 2.0

Paralympic athletes inspire people around the world with their performances and focus on moving forward and never giving up.[6]



Figure 10.39 David Smith, a Paralympian With Cerebral Palsy

6. International Paralympic Committee. (n.d.). *FAQ*. https://www.paralympic.org/classification/faq

Clubfoot

Clubfoot is a congenital condition that causes the foot and lower leg to turn inward and downward. See Figure 10.40[7] for an image of an infant with a clubfoot. Clubfoot can range from mild and flexible to severe and rigid. Treatment by an orthopedic specialist involves using repeated applications of casts beginning soon after birth to gradually moving the foot into the correct position. Severe cases of clubfoot require surgery. After the foot is in the correct position, the child typically wears a special brace for up to three years.[8]

7. "813 Clubfoot.jpg" by OpenStax is licensed under CC BY 3.0

8. A.D.A.M. Medical Encyclopedia [Internet]. (2020). *Club foot*. https://medlineplus.gov/ency/article/001228.htm



Figure 10.40 Clubfoot

Contracture

A **contracture** is a condition of shortening and hardening of muscles, tendons, or other tissue, often leading to deformity and rigidity of joints.

Contractures are caused by immobility and can happen in as little as two days if the joint remains immobile. It can be the result of several disorders such as a stroke, cerebral palsy, or muscular dystrophy. Contractures may be prevented and/or treated with braces, physical therapy, and range-of-motion exercises.[9] See Figure 10.41[10] for an image of a hand contracture.



Figure 10.41 Hand Contracture

9. Friedlander, T., Masterson, R., & Mahesh, K. (2023). *Contractures.* PM&R KnowledgeNow. https://now.aapmr.org/contractures/#:~:text=Soft%20tissue%20changes%20that%20contribute,fibers%20occurs%20within%2024%20hours

10. "Freeman-Sheldon_syndrome.JPG" by MI Poling at English Wikipedia is licensed under CC BY-SA 2.5

Dislocation and Subluxation

A **dislocation** is an injury, often caused by a fall or a blow to the joint, that forces the ends of bones out of position. **Subluxation** refers to partial dislocation of a joint, resulting in structural displacement. Dislocated joints are typically very painful, swollen, and visibly out of place. The client may not be able to move the affected extremity. See Figure 10.42[11] for an X-ray image of an anterior dislocation of the right shoulder where the ball (i.e., head of the humerus) has popped out of the socket (i.e., the glenoid cavity of the scapula). A dislocated joint requires immediate medical attention. Treatment depends on the joint and the severity of the injury and may include manipulation to reposition the bones, medication, a splint or sling, or rehabilitation. When properly repositioned, a joint will usually function and move normally again in a few weeks; however, once a joint is dislocated, it is more likely to become dislocated again. Instructing clients to wear protective gear during sports may help to prevent future dislocations.[12]

11. "AnterDisAPMark.png" by James Heilman, MD is licensed under CC BY-SA 4.0

12. MedlinePlus [Internet]. (2019). *Dislocations*. https://medlineplus.gov/dislocations.html

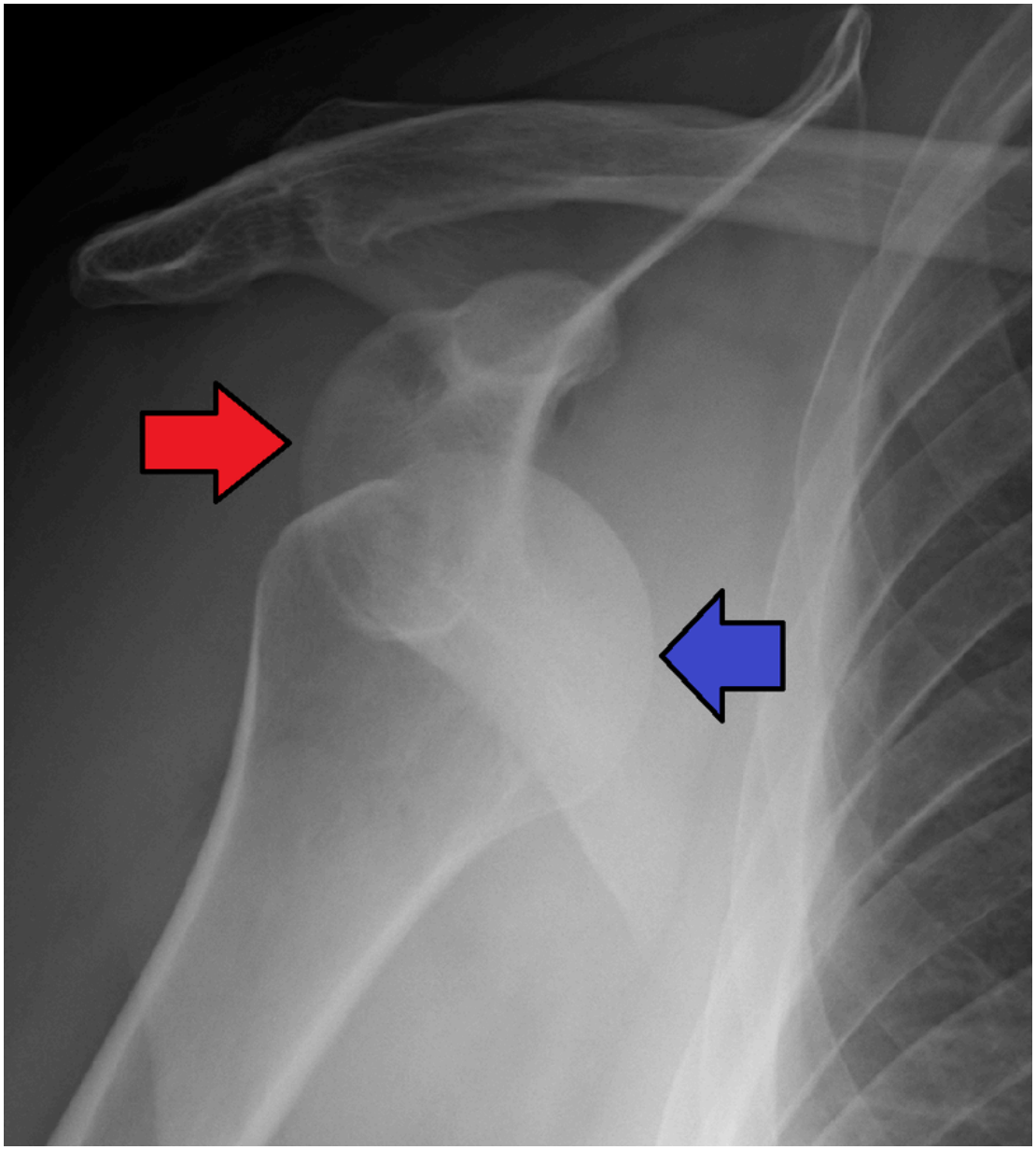


Figure 10.42 X-ray of Dislocated Shoulder

Fibromyalgia

Fibromyalgia is a condition that causes widespread pain, sleep problems, fatigue, and often emotional and mental distress. People with fibromyalgia may be more sensitive to pain than people without fibromyalgia, referred to

as abnormal pain perception processing. The cause of fibromyalgia is not known, but it can be effectively treated and managed.[13]

Common symptoms of fibromyalgia include the following:

- Pain and stiffness all over the body
- Fatigue and tiredness
- Depression and anxiety
- Sleep problems
- Problems with thinking, memory, and concentration
- Headaches, including migraines
- Tingling or numbness in hands and feet
- Pain in the face or jaw, including disorders of the jaw known as temporomandibular joint syndrome (TMJ)
- Digestive problems, such as abdominal pain, bloating, constipation, and irritable bowel syndrome (IBS)

Fibromyalgia is treated by a doctor or team of health care professionals who specialize in the treatment of fibromyalgia. A combination of treatments is typically prescribed, which may include the following[14]:

- Medications, including prescription drugs and over-the-counter pain relievers
- Aerobic exercise and muscle strengthening exercise
- Client education classes
- Stress management techniques such as meditation, yoga, and massage
- Good sleep habits to improve the quality of sleep
- Cognitive behavioral therapy, a type of talk therapy that helps people change the way they think about their life circumstances

13. Centers for Disease Control and Prevention. (n.d.). *Fibromyalgia*. https://www.cdc.gov/arthritis/fibromyalgia/

14. Centers for Disease Control and Prevention. (n.d.). *Fibromyalgia*. https://www.cdc.gov/arthritis/fibromyalgia/

Foot Drop

Foot drop is the inability to raise the front part of the foot due to weakness or paralysis of the muscles that lift the foot. As a result, individuals with foot drop often scuff their toes along the ground when walking or bend their knees to lift their foot higher than usual to avoid the scuffing. Foot drop is a symptom of an underlying problem and can be temporary or permanent, depending on the cause. The prognosis for foot drop depends on the cause. Foot drop caused by trauma or nerve damage usually shows partial or complete recovery, but in progressive neurological disorders, foot drop will be a symptom that is likely to continue as a lifelong disability. Treatment depends on the specific cause of foot drop. The most common treatment is to support the foot with lightweight leg braces. See Figure 10.43[15] for an image of a client with foot drop treated with a leg brace. Exercise therapy to strengthen the muscles and maintain joint motion also helps to improve a client's gait.[16]

15. "AFO brace for foot drop.JPG" by Pagemaker787 is licensed under CC BY-SA 4.0

16. National Institute of Neurological Disorders and Stroke. (n.d.). *Foot drop information page*. https://www.ninds.nih.gov/Disorders/All-Disorders/Foot-Drop-Information-Page



Figure 10.43 Foot Drop Treated with Leg Brace

Gout

Gout is a type of inflammatory arthritis that causes pain and swelling in the joints, usually as flares that last for one or two weeks and then resolve. Gout flares often begin in the big toe or a lower limb. Gout occurs when high levels of serum uric acid form needle-shaped crystals in and around the joint and cause inflammation. Uric acid is a waste product produced by the breakdown of purine, a type of molecule found in many foods we eat. Gout is diagnosed with blood tests for uric acid. It is commonly treated with medications like nonsteroidal anti-inflammatories (NSAIDs) and colchicine.[17] It is common for

17. National Institute of Arthritis and Musculoskeletal and Skin Diseases. (2020). *Gout*. National Institutes of Health. https://www.niams.nih.gov/health-topics/gout

gout to reoccur. Clients with recurring gout are treated with allopurinol to decrease chronic uric acid levels. See Figure 10.44[18] for an illustration of gout.



Figure 10.44 Gout

> Read additional information about medications used to treat gout in "Antigout Medications" in the "Analgesics and Musculoskeletal System" chapter in Open RN *Nursing Pharmacology, 2e*.

Osteomyelitis

Osteomyelitis is an infection in a bone. Infections can reach a bone by

18. "Gout_Signs_and_Symptoms.jpg" by www.scientificanimations.com is licensed under CC BY-SA 4.0

traveling through the bloodstream or spreading from nearby tissue. Infections can also begin in the bone itself if an injury exposes the bone to bacteria. Smokers and people with chronic health conditions, such as diabetes or kidney failure, are at higher risk of developing osteomyelitis. People who have diabetes may develop osteomyelitis in their feet if they develop foot ulcers. Although once considered incurable, osteomyelitis can now be successfully treated with surgery and intravenous antibiotics typically administered over a long period of time, such as four to six weeks.[19]

Muscular Dystrophy

Muscular dystrophy (MD) refers to a group of diseases caused by abnormal muscle development due to gene mutations. Muscular dystrophy can run in families, or a person can be the first in their family to have muscular dystrophy. Over time, muscle weakness decreases mobility and makes it difficult to perform everyday tasks. There are many types of muscular dystrophy, each affecting specific muscle groups. Each type has signs and symptoms that appear at different ages and vary in severity.[20]

An example of one type of MD is Duchenne muscular dystrophy (DMD), a genetic disorder characterized by progressive muscle degeneration and weakness due to the alterations of a muscle protein called dystrophin. DMD symptom onset is in early childhood, usually between the ages two and three. The disease primarily affects boys. Muscle weakness is the principal symptom of DMD and begins by first affecting the proximal muscles (those closest to the core of the body) and later affecting the distal limb muscles. The child with DMD might have difficulty jumping, running, and walking. Other symptoms include enlargement of the calves, a waddling gait, and lumbar lordosis (an inward curve of the spine). The heart and respiratory muscles are

19. Mayo Clinic. (2024). *Osteomyelitis*. https://www.mayoclinic.org/diseases-conditions/osteomyelitis/symptoms-causes/syc-20375913

20. Centers for Disease Control and Prevention. (n.d.). *What is muscular dystrophy?* https://www.cdc.gov/muscular-dystrophy/about/

affected as well. Progressive weakness and scoliosis result in impaired pulmonary function, which can eventually cause acute respiratory failure. Treatment of DMD requires multidisciplinary care to coordinate specialized assessments and interventions needed to maximize function and quality of life. Due to recent advances in cardiology and pulmonology, people with DMD are living longer than ever and often well into adulthood.[21]

The impact of DMD can be significantly minimized by keeping the body as flexible, upright, and mobile as possible. As muscle deteriorates, a person with muscular dystrophy often develops contractures. If not treated, contractures can become severe, causing discomfort and restricting mobility and flexibility. Contractures can affect the knees, hips, feet, elbows, wrists, and fingers. However, there are many ways to minimize and postpone contractures. Range-of-motion exercises performed on a regular schedule help delay contractures by keeping tendons from shortening prematurely. Braces on the lower legs also can help keep the limbs stretched and flexible, delaying the onset of contractures. Eventually, a wheelchair is needed, typically by about age 12. Although a child and their parents may dread using a wheelchair, many people find that when they start to use one, they are more mobile, energetic, and independent than when trying to walk without assistance[22] See Figure 10.45[23] for an image of a child with MD using a specialized wheelchair called an "Easy Stand" that supports him while sitting and also allows him to stand for periods of time.

21. Muscular Dystrophy Association. (n.d.). *Duchenne muscular dystrophy*. https://www.mda.org/disease/duchenne-muscular-dystrophy

22. Muscular Dystrophy Association. (n.d.). *Duchenne muscular dystrophy*. https://www.mda.org/disease/duchenne-muscular-dystrophy

23. "3576255511_4c36222845_b.jpg" by EasyStand is licensed under CC BY-NC-ND 2.0



Figure 10.45 Child with Muscular Dystrophy in an EasyStand Wheelchair

Myasthenia Gravis

Myasthenia gravis (MG) is a chronic, autoimmune, neuromuscular disease that causes weakness in voluntary muscles, including those required for breathing and swallowing. Onset of symptoms can be rapid.[24]

24. National Institute of Neurological Disorders and Stroke. (2023). *Myasthenia gravis*. National Institutes of Health. https://www.ninds.nih.gov/health-information/disorders/myasthenia-gravis

MG is discussed in "Myashenia Gravis" section of the "Nervous System Alterations" chapter.

Paralysis

Paralysis occurs when an injury or medical condition disrupts the nerve signals to the muscles, resulting in being unable to make voluntary movements. Common causes of paralysis include spinal cord injuries and strokes. Paralysis can be localized, where it affects specific areas of the body, such as the face. For example, Bell's palsy temporarily paralyzes facial muscles. Paralysis can also be generalized where it affects a larger area of the body. There are categories of generalized paralysis based on its extent. Common categories include hemiplegia, paraplegia, and quadriplegia/tetraplegia[25]:

- **Hemiplegia:** Paralysis affects one side of the body, for example, an arm and a leg on the same side.
- **Paraplegia:** Paralysis affects both legs and sometimes the torso.
- **Quadriplegia or Tetraplegia:** Cervical nerves are damaged, causing paralysis in all limbs, with little or no movement from the neck down.

See Figure 10.46[26] for an illustration of paraplegia, hemiplegia, and tetraplegia (quadriplegia), where pink indicates the area of muscle paralysis. Because muscle paralysis is caused by disruption of nerve signals, the cervical (C), thoracic (T), and lumbar (L) nerves are labeled in the image.

25. Cleveland Clinic. (2024). *Paralysis*. https://my.clevelandclinic.org/health/diseases/15345-paralysis

26. "Neurological_Levels_%26_Types_of_Paralysis.png" by Servier Medical Art is licensed under CC BY 2.0

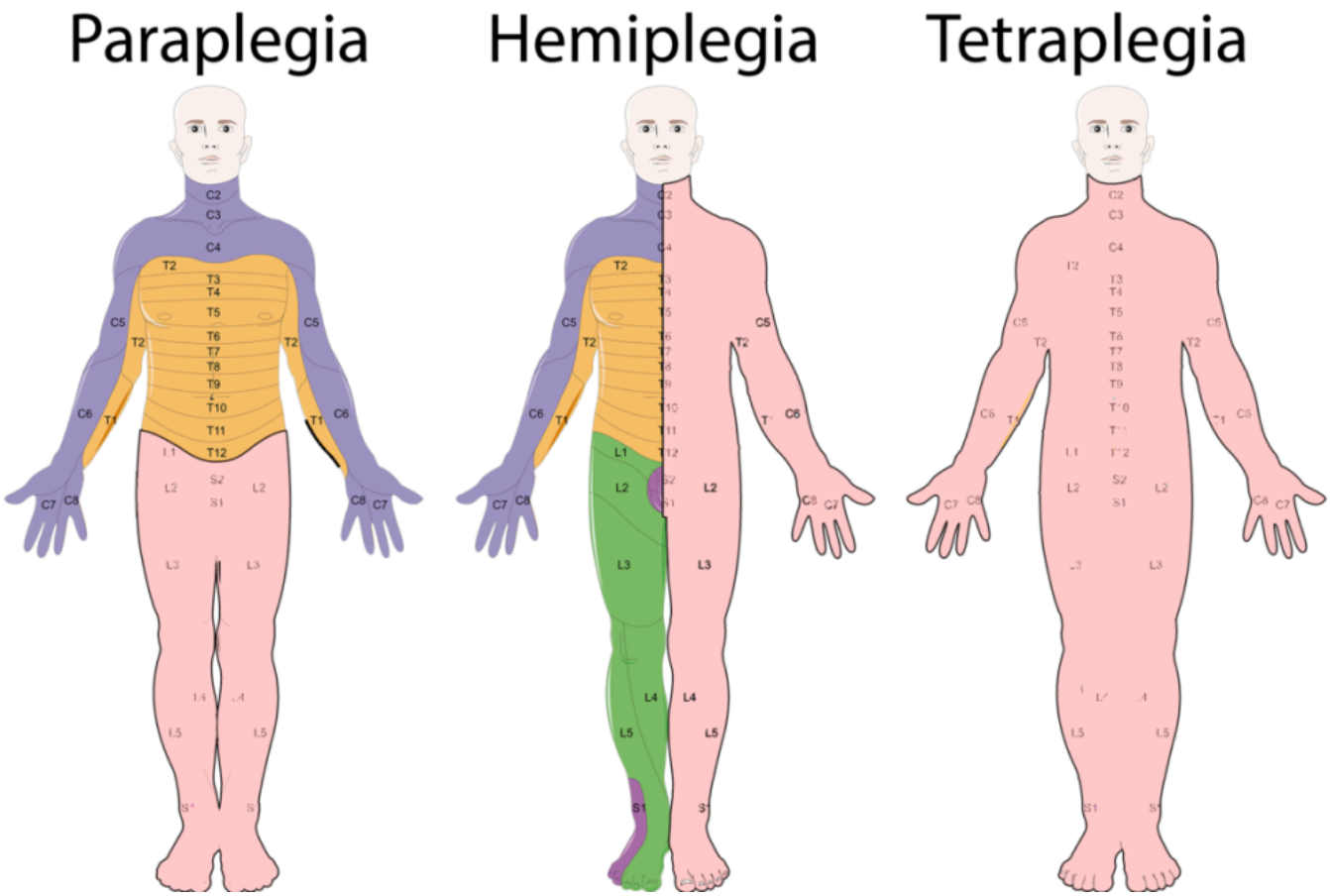


Figure 10.46 Paraplegia, Hemiplegia, and Tetraplegia (Quadriplegia)

Paralysis is also classified by its effect on muscles in terms of being flaccid or spastic[27]:

- **Flaccid:** The muscles atrophy (i.e., shrink) due to loss of function.
- **Spastic:** The muscles tighten, causing uncontrollable jerks and spasms.

There is no cure for permanent paralysis caused by spinal nerve damage because the spinal cord can't heal itself. However, rehabilitative services like physical and occupational therapy can help people with paralysis live

27. Cleveland Clinic. (2024). *Paralysis*. https://my.clevelandclinic.org/health/diseases/15345-paralysis

independently and enjoy a quality life. Equipment used for rehabilitative/restorative care may include the following[28]:

- **Adaptive equipment:** Equipment that allows people to feed themselves or drive.
- **Assistive equipment:** Equipment that enhances mobility, such as wheelchairs, scooters, crutches, and canes.
- **Orthotic/prosthetic devices:** Devices that support the limbs and prevent contractures, such as braces.
- **Voice-activated technology:** Technology that doesn't require the need for touch or movement, such as computers, lighting systems, and phones.

See Figure 10.47[29] for an image of Mark Manion, founder of "Mark Speaks Out." Mark was permanently disabled during a cross-country biking trip when he was struck by a drunk driver. He travels the country educating and inspiring audiences on how he has effectively coped with his life circumstances.

28. Cleveland Clinic. (2024). *Paralysis*. https://my.clevelandclinic.org/health/diseases/15345-paralysis

29. "USMC-100519-M-3215R-002.jpg" by unknown author for United States Marine Corps is licensed in the Public Domain



Figure 10.47 Mark Manion

Rhabdomyolysis

Rhabdomyolysis refers to the breakdown of muscles that causes damage to

the kidney. When muscle is damaged, a protein called myoglobin is released into the bloodstream and is filtered out of the body by the kidneys. Myoglobin breaks down into substances that damage kidney cells.[30] See Figure 10.48[31] for an illustration of rhabdomyolysis.

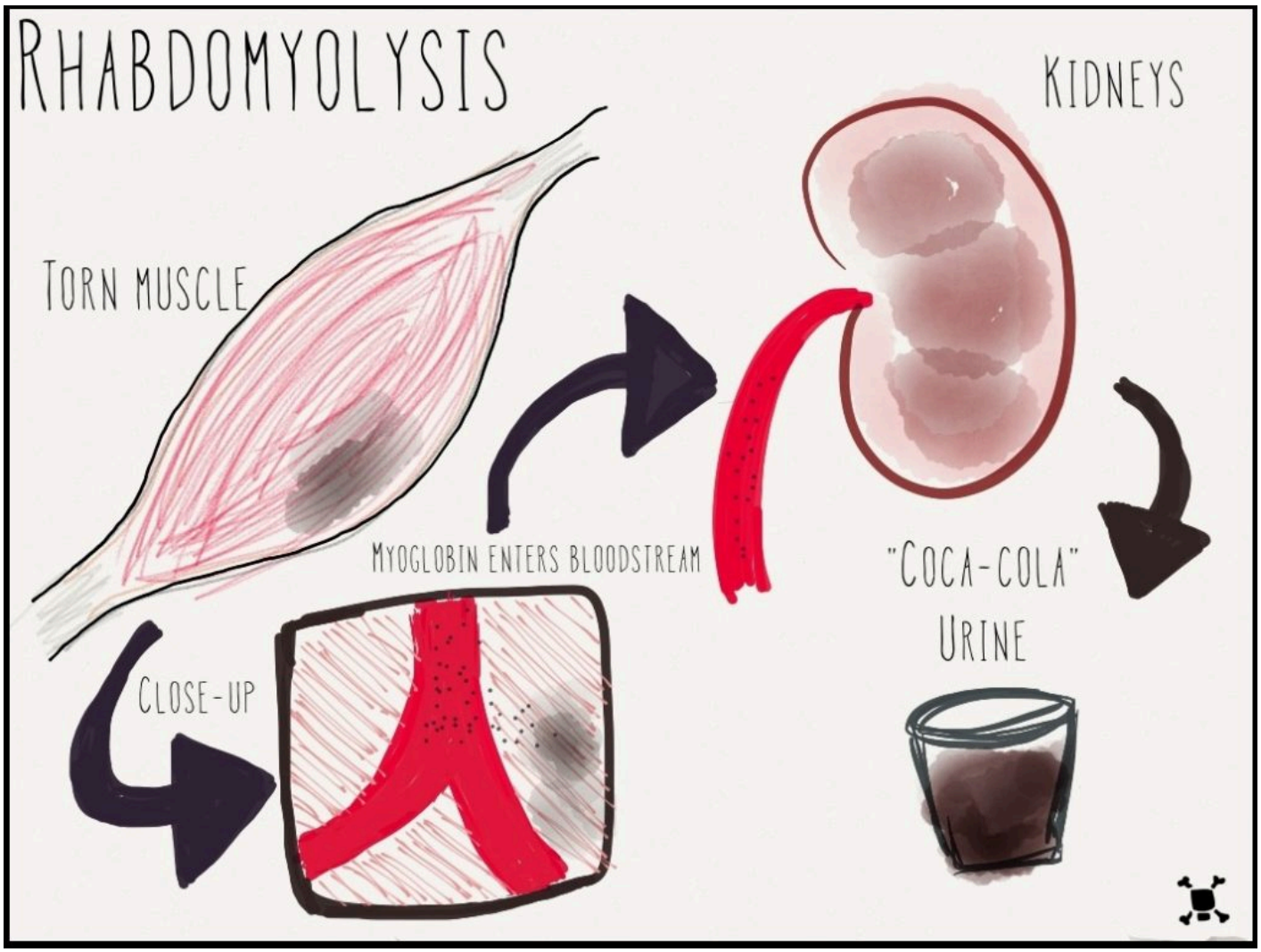


Figure 10.48 Rhabdomyolysis

Rhabdomyolysis may be caused by injury or any other condition that

30. A.D.A.M. Medical Encyclopedia [Internet]. (2021). *Rhabdomyolysis*. https://medlineplus.gov/ency/article/000473.htm

31. "Rhabdo.jpg" by AquapatMedia is licensed under CC BY-SA 3.0

damages skeletal muscle. Potential causes of rhabdomyolysis include the following conditions[32]:

- Trauma or crush injuries
- Use of drugs such as cocaine, amphetamines, statins, heroin, or phencyclidine (PCP)
- Genetic muscle diseases
- Extremes of body temperature
- Ischemia or death of muscle tissue
- Low phosphate levels
- Seizures or muscle tremors
- Severe exertion, such as marathon running or calisthenics
- Lengthy surgical procedures
- Severe dehydration

Symptoms of rhabdomyolysis include dark, red, or cola-colored urine; decreased urine output; weakness; and **myalgia** (i.e., muscle pain). Rhabdomyolysis is diagnosed with blood tests, including creatine kinase (CK), myoglobin, and creatinine, as well as urine tests such as urinalysis and urine myoglobin. Rhabdomyolysis is treated with intravenous fluids that contain bicarbonate. In cases causing severe kidney damage, dialysis may be required.[33]

Strains and Sprains

A **strain** is an injury to a muscle or tendon from being overstretched or torn, causing pain. Strains can be caused by an injury, overusing a muscle, or using a muscle in the wrong way (such as twisting the back while lifting a heavy

32. A.D.A.M. Medical Encyclopedia [Internet]. (2021). *Rhabdomyolysis*. https://medlineplus.gov/ency/article/000473.htm

33. A.D.A.M. Medical Encyclopedia [Internet]. (2021). *Rhabdomyolysis*. https://medlineplus.gov/ency/article/000473.htm

object). A **sprain** is an injury to a joint when a ligament is stretched or torn. See Figure 10.49[34] for an illustration of an ankle sprain.



Figure 10.49 Sprained Ankle

Initial treatments for strains and sprains are similar and can be easily recalled by the mnemonic called RICE, which stands for the following[35]:

- **Rest:** Rest the strain or sprain for at least 24 hours. The health care provider may recommend not putting any weight on the injured area for 48 to 72 hours, so crutches may be needed for lower extremity injuries.
- **Ice:** Apply ice as soon as possible after the injury to reduce swelling. The ice should not be applied directly to the skin but should be wrapped in a

34. "Ankle_sprain_–_Smart-Servier.jpg" by SMART-Servier Medical Art, part of Laboratoires Servier is licensed under CC BY-SA 3.0

35. Mayo Clinic. (2024). *Sprain: First aid.* https://www.mayoclinic.org/first-aid/first-aid-sprain/basics/art-20056622

cloth to avoid tissue injury. Ice should be applied for 5 to 20 minutes, four to eight times a day, for the first 48 hours or until swelling improves.

- **Compression:** Compress the area with an elastic wrap or bandage to reduce swelling.
- **Elevate:** Elevate the injured limb above the heart whenever possible to help prevent or limit swelling.

Tendonitis

Tendonitis refers to inflammation of a tendon, causing pain around a joint. Tendonitis usually happens after repeated injury to an area such as the wrist or ankle. Common forms of tendonitis are named after the sports that increase their risk, such as tennis elbow, golfer's elbow, pitcher's shoulder, swimmer's shoulder, and jumper's knee. Health care providers diagnose tendonitis based on medical history, a physical exam, and possible imaging tests. Initial treatment is focused on reducing pain and swelling with RICE (rest, ice, compression, and elevation). Other treatments may include ultrasound, physical therapy, steroid injections, and surgery in severe cases.[36]

Vertebral Disorders

The spine is composed of many vertebrae stacked on top of one another, forming the vertebral column. There are several disorders that can occur in the vertebral column causing abnormal curvature of the spine such as kyphosis, lordosis, and scoliosis. See Figure 10.50[37] for an illustration of kyphosis, lordosis, and scoliosis.

36. MedlinePlus [Internet]. (2022). *Tendinitis*. https://medlineplus.gov/tendinitis.html

37. "Vertebral column disorders – Normal Scoliosis Lordosis Kyphosis — Smart-Servier.jpg" by Laboratoires Servier is licensed under CC BY-SA 3.0

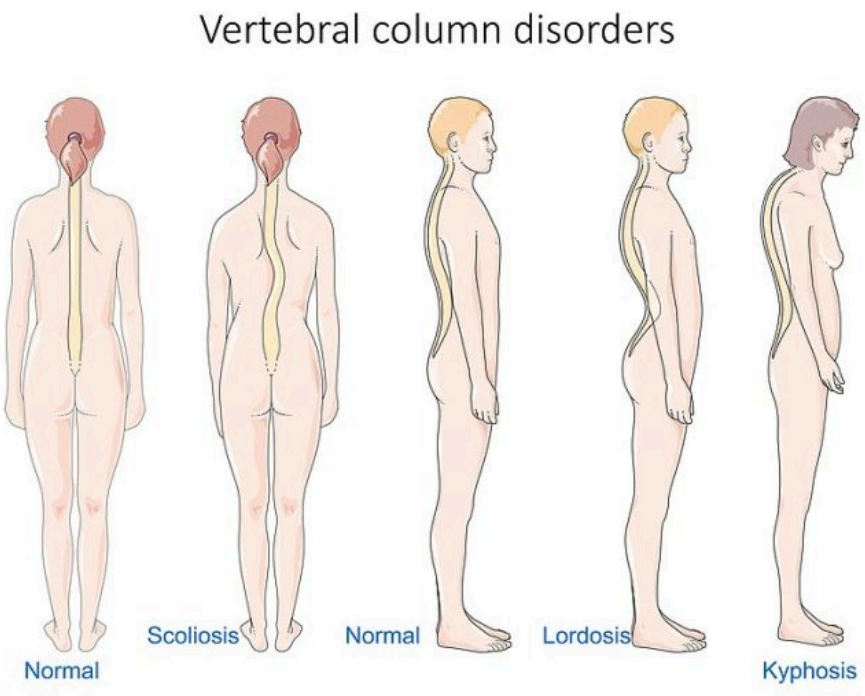


Figure 10.50 Vertebral Disorders

Kyphosis is a curving of the spine that causes a bowing or rounding of the back, often referred to as a "buffalo hump," that can lead to a hunchback or slouching posture. Kyphosis can be caused by osteoarthritis, osteoporosis, or other conditions. Pain in the middle or lower back is the most common symptom. Treatment depends upon the cause, the severity of pain, and the presence of any neurological symptoms.[38]

Lordosis is the inward curve of the lumbar spine just above the buttocks. A small degree of lordosis is normal, especially during the third trimester of pregnancy. Too much curving of the lower back is often called swayback.

38. A.D.A.M. Medical Encyclopedia [Internet]. (2020). *Kyphosis*. https://medlineplus.gov/ency/article/001240.htm

Most of the time, lordosis is not treated if the back is flexible because it is not likely to progress or cause problems.[39]

Scoliosis causes a sideways curve of the spine. It commonly develops in late childhood and the early teens when children grow quickly. Symptoms of scoliosis include leaning to one side and having uneven shoulders and hips. Treatment depends on the client's age, the amount of expected additional growth, the degree of curving, and whether the curve is temporary or permanent. Clients with mild scoliosis might only need checkups to monitor if the curve is getting worse, whereas others may require a brace or have surgery.[40]

39. A.D.A.M. Medical Encyclopedia [Internet]. (2020). *Lordosis – lumbar*. https://medlineplus.gov/ency/article/003278.htm

40. MedlinePlus [Internet]. (2020). *Scoliosis*. https://medlineplus.gov/scoliosis.html

10.11 Learning Activities

Learning Activities

Osteoarthritis Case Study (Case Study answers are located in the Answer Key at the end of the book.)[1]

Mary is a 65-year-old woman who presents to the clinic with complaints of joint pain and stiffness, particularly in her knees and hands. She reports that the pain worsens with activity and is relieved with rest. Mary also mentions difficulty with gripping objects and climbing stairs. She has a history of obesity and reports that her symptoms have been gradually worsening over the past few years.

1. Based on Mary's symptoms, what are the potential differential diagnoses to consider besides osteoarthritis?
2. How would you assess Mary's pain level, and what pain assessment tools could be utilized?
3. What risk factors for osteoarthritis does Mary possess, and how do they contribute to her condition?
4. What additional assessments would you conduct to further evaluate the extent of Mary's osteoarthritis?
5. How would you prioritize Mary's nursing diagnoses, and why?

1. "Osteoarthritis Case Study" by Open RN is licensed under CC BY-NC 4.0

6. What education would you provide to Mary regarding her osteoarthritis diagnosis and management?

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=2971#h5p-34

"Musculoskeletal Glossary Cards" by Open RN is licensed under CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=2971#h5p-55

"Case Study: Osteoarthritis" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

NEXT GEN RN

Test your knowledge on musculoskeletal system disorders using this NCLEX Next Generation-style multiple response

grouping question. You may reset and resubmit your answers to this question an unlimited number of times.[2]



- Test your knowledge on musculoskeletal conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[3]



- Test your knowledge on osteoarthritis and hip arthroplasty using this NCLEX Next Generation style case study.[4]



2. "Musculoskeletal Multiple Response Grouping Question" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

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- Test your knowledge on musculoskeletal conditions using this NCLEX Next Generation style case study.[5]



- Test your knowledge on musculoskeletal conditions using this NCLEX Next Generation style case study.[6]



- Test your knowledge on musculoskeletal conditions using this NCLEX Next Generation style case study.[7]

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X Glossary

Above-elbow (Transhumeral) amputation: Amputation above the elbow joint. (Chapter 10.5)

Above-knee (Transfemoral) amputation: Amputation above the knee joint, requiring more energy for mobility due to the absence of the knee joint and increased leverage requirements. (Chapter 10.5)

Acetabulum: The large socket that holds the head of the femur. (Chapter 10.2)

Achilles tendon: Attaches the calf muscles to the heel bone. (Chapter 10.2)

Acromion: An extension from the scapula that forms the bony tip of the shoulder. (Chapter 10.2)

Acute compartment syndrome (ACS): Increased pressure within a muscle compartment, resulting in reduced blood flow to the tissues within that compartment. (Chapter 10.6)

Amputation: Refers to the surgical removal of a body part. (Chapter 10.5)

Ankle disarticulation: Amputation at the ankle joint, preserving the heel pad for weight-bearing and prosthetic fitting. (Chapter 10.5)

Arthrocentesis: A surgical puncture to aspirate fluid from a joint, such as the knee, for lab analysis and symptom relief. (Chapter 10.3)

Arthroplasty: Refers to joint replacement surgery; an invasive procedure requiring extended recovery time. (Chapter 10.7)

Arthroscopy: A common procedure performed by orthopedic surgeons to view the inside of a joint to diagnose and/or to repair joint problems. (Chapter 10.3, Chapter 10.7)

Ataxia: Poor balance and coordination. (Chapter 10.10)

Below-elbow (Transradial) amputation: Amputation below the elbow joint. (Chapter 10.5)

Below-knee (Transtibial) amputation: Amputation below the knee joint, providing a longer residual limb for better prosthetic control and energy-efficient walking. (Chapter 10.5)

Biceps brachialis: Muscle located in the arm that flexes the elbow joint and rotates the forearm. (Chapter 10.2)

Biceps brachii: Muscle on the anterior upper arm. (Chapter 10.2)

Body: References the middle portion of the sternum. (Chapter 10.2)

Bone density scans (Dual-energy X-ray absorptiometry – DEXA or DXA): Specialized X-ray tests that measure bone mineral density. (Chapter 10.3)

Boutonniere deformities: Firm, observable lumps underneath the skin on or near the base of the joint. (Chapter 10.9)

Buck's traction: Skin traction that involves the application of weights over the end of the bed as a pulling force. (Chapter 10.6)

Calcaneus: Heel bone. (Chapter 10.2)

Cardiac muscle: Specialized muscle located in the heart. (Chapter 10.2)

Carpals: Wrist bones. (Chapter 10.2)

Cartilaginous joints: When two bones are connected by cartilage; a tough but flexible type of connective tissue. (Chapter 10.2)

Cerebral palsy (CP): A group of disorders that affects the ability to move and maintain balance and posture. (Chapter 10.10)

Cervical: The first seven vertebrae in the neck region, C1 to C7. (Chapter 10.2)

Clavicle: Connects the sternum to the scapula; also known as the collarbone. (Chapter 10.2)

Closed or simple fracture: The broken bone doesn't penetrate the skin, remaining within the body. (Chapter 10.6)

Closed reduction: Involves a nonsurgical procedure where the provider manipulates the fractured bones back into their proper position without making an incision. (Chapter 10.6)

Clubfoot: A congenital condition that causes the foot and lower leg to turn inward and downward. (Chapter 10.10)

Coccyx: The tailbone; formed by the fusion of four very small coccygeal vertebrae. (Chapter 10.2)

Comminuted fracture: A bone is crushed into pieces. (Chapter 10.6)

Complete fracture: The bone breaks entirely into two or more separate pieces. (Chapter 10.6)

Compression fracture: Typically occurs in vertebrae and involves the bone being crushed or collapsing; often seen in conditions like osteoporosis. (Chapter 10.6)

Computed tomography (CT): Detailed, cross-sectional, three-dimensional images of bones, joints, and soft tissues. (Chapter 10.3)

Contracture: A condition of shortening and hardening of muscles, tendons, or other tissue, often leading to deformity and rigidity of joints. (Chapter 10.10)

Cranium: The bones that form the head, including the skull and facial bones. (Chapter 10.2)

Crepitus: Popping, clicking, or crackling sound when moving a joint. (Chapter 10.7)

Deltoid: A large triangular muscle covering the shoulder joint. (Chapter 10.2)

DEXA scans: The gold standard test for diagnosing osteoporosis comparing an individual's bone density to that of a young healthy adult reflecting the risk of fracture. (Chapter 10.8)

Dislocation: Displacement of a bone from its normal position in a joint. (Chapter 10.2, Chapter 10.10)

Dyskinesia: Uncontrollable movements. (Chapter 10.10)

Elective amputation: Amputation is planned and performed due to medical conditions such as severe infection, tumors, or vascular diseases that compromise blood flow to the affected limb. (Chapter 10.5)

Electromyogram (EMG): A diagnostic procedure that assesses the function of nerve cells that control muscles. (Chapter 10.3)

Ethmoid: Part of the nose and base of the skull. (Chapter 10.2)

External fixation: A surgical procedure where metal pins or screws are inserted into the bone above and below the fracture site and connected to an external frame to stabilize the fracture. (Chapter 10.6)

False ribs: Ribs 8, 9, and 10 that are attached to the cartilage that joins the sternum. (Chapter 10.2)

Fasciotomy: A surgical procedure to relieve pressure within the compartment by making incisions through the fascia (connective tissue surrounding the compartment) to release the built-up pressure. (Chapter 10.6)

Fat embolism syndrome: Can arise from certain fractures, particularly long-bone fractures or bone with large amounts of marrow, such as the ribs, pelvis, and femur. (Chapter 10.7)

Femur: Thigh bone. (Chapter 10.2)

Fibromyalgia: A condition that causes widespread pain, sleep problems, fatigue, and often emotional and mental distress. (Chapter 10.10)

Fibrous joints: Nonmoveable joints where two bones are attached by fibrous connective tissue. (Chapter 10.2)

Fibula: The smaller, lateral bone of the lower leg. (Chapter 10.2)

Finger or partial hand amputation: Removal of fingers or part of the hand. (Chapter 10.5)

Flaccid: The muscles atrophy (i.e., shrink) due to loss of function. (Chapter 10.10)

Flexion contracture: Occurs when the residual limb remains in a flexed position for an extended period, leading to decreased range of motion and contracture of muscles and soft tissues. (Chapter 10.5)

Floating ribs: Ribs 11 and 12 that are not attached to the front of the sternum. (Chapter 10.2)

Foot drop: The inability to raise the front part of the foot due to weakness or paralysis of the muscles that lift the foot. (Chapter 10.10)

Fracture: A break or disruption in the integrity of a bone. (Chapter 10.6)

FRAX tool: A fracture risk calculator that estimates a client's ten-year probability of a hip fracture or other major fracture. (Chapter 10.8)

Frontal: Bone covering the forehead area of the skull. (Chapter 10.2)

Gastrocnemius: The chief muscle of the calf of the leg. (Chapter 10.2)

Gluteus maximus: The largest and outermost of the three gluteal muscles in the buttocks. (Chapter 10.2)

Gout: A type of inflammatory arthritis that causes pain and swelling in the joints, usually as flares that last for one or two weeks and then resolves. (Chapter 10.10)

Greenstick fracture: Bone is partially broken; a common fracture in children that occurs rarely in adults. (Chapter 10.6)

Hallux: The great toe. (Chapter 10.2)

Hamstring: Five tendons at the back of a person's knee that connect a group of three hamstring muscles to bones in the pelvis, knee, and lower leg. (Chapter 10.2)

Hemorrhage: Excessive bleeding internally or at the surgical site due to blood vessel damage or clotting abnormalities. (Chapter 10.5)

Herniated disk: A condition in which a disk protrudes beyond the normal confines of the vertebrae. (Chapter 10.2)

Hip fracture: Commonly referred to as a “broken hip.” (Chapter 10.6)

Humerus: Upper arm. (Chapter 10.2)

Hyoid: An independent bone that does not contact any other bone and, thus, is not part of the skull. (Chapter 10.2)

Hypovolemic shock: Type of shock caused by extensive blood loss and characterized by a rapid heart rate, low blood pressure, and altered consciousness. (Chapter 10.6)

Ilium: The superior region that forms the largest part of the hip bone. (Chapter 10.2)

Immobilization: Involves using casts, splints, or braces to restrict movement of the affected limb or body part, allowing the bones to heal properly. (Chapter 10.6)

Impacted fracture: One fragment of the bone is driven into the other, usually as a result of compression. (Chapter 10.6)

Incomplete fracture: Bone cracks but doesn’t break completely into separate pieces. (Chapter 10.6)

Inferior conchae: Lower lateral walls of the nasal cavity. (Chapter 10.2)

Intercostal: Area between the ribs. (Chapter 10.2)

Intervertebral disks: Cartilage that acts as shock absorbers and allows for flexibility in the spine. (Chapter 10.2)

Ischium: Forms the posteroinferior region of each hip bone and supports the body when sitting. (Chapter 10.2)

Joints: Places where two bones or bone and cartilage come together and form a connection. (Chapter 10.2)

Kyphosis: A curving of the spine that causes a bowing or rounding of the back, often referred to as a “buffalo hump” that can lead to a hunchback or slouching posture. (Chapter 10.10)

Lacrimal: Walls of the inner orbit (i.e., eye socket). (Chapter 10.2)

Lateral malleolus: The bony protrusion on the lateral side of the ankle. (Chapter 10.2)

Latissimus dorsi: A large muscle in the back. (Chapter 10.2)

Ligaments: Narrow bands of fibrous connective tissue that connect a bone to a bone. (Chapter 10.2)

Lordosis: The inward curve of the lumbar spine just above the buttocks. (Chapter 10.10)

Lumbar: The five vertebrae that form the inner curvature of spine, L1 to L5. (Chapter 10.2)

Magnetic resonance imaging (MRI): Uses magnet and radio waves to generate detailed images of bones, joints, ligaments, tendons, and soft tissues. (Chapter 10.3)

Mandible: Lower jawbone and only movable bone of the skull. (Chapter 10.2)

Manubrium: The upper portion of the sternum. (Chapter 10.2)

Maxillary: Upper jaw and hard palate. (Chapter 10.2)

Medial malleolus: The bony protrusion on the medial side of the ankle. (Chapter 10.2)

Metacarpals: Wrist bones. (Chapter 10.2)

Metatarsals: Bones of the anterior half of the foot. (Chapter 10.2)

Muscular dystrophy (MD): Refers to a group of diseases caused by abnormal muscle development due to gene mutations. (Chapter 10.10)

Myalgia: Muscle pain. (Chapter 10.10)

Myasthenia gravis (MG): A chronic, autoimmune, neuromuscular disease that causes weakness in voluntary muscles, including those required for breathing and swallowing. (Chapter 10.10)

Nasal: Pair of bones that form the bridge of the nose. (Chapter 10.2)

Nuclear medicine scans (Bone Scans): Bone scans involve injecting a radioactive tracer into the bloodstream, which accumulates in areas of increased bone turnover or damage. (Chapter 10.3)

Oblique fracture: Bone is broken at an angle. (Chapter 10.6)

Occipital: Posterior skull and base of the skull. (Chapter 10.2)

Open or compound fracture: Broken bone penetrates the skin, or there's an open wound leading to the fracture site. (Chapter 10.6)

Open reduction and internal fixation (ORIF): Involves the surgical realignment of the fractured bones using screws, plates, or rods to stabilize and hold them in place while they heal. (Chapter 10.6)

Osteoarthritis (OA): A degenerative joint disease characterized by the breakdown of joint cartilage and underlying bone changes. (Chapter 10.7)

Osteoblasts: Bone-forming cells. (Chapter 10.2)

Osteoclasts: Cells responsible for bone breakdown. (Chapter 10.2)

Osteocytes: Mature bone cells. (Chapter 10.2)

Osteomyelitis: An infection in a bone. Infections can reach a bone by traveling through the bloodstream or spreading from nearby tissue. (Chapter 10.10)

Osteopenia: Abnormal reduction of bone mass. (Chapter 10.2, Chapter 10.8)

Osteoporosis: A progressive bone disease characterized by a decrease in bone density and deterioration of bone tissue, leading to increased bone fragility and a higher risk of fractures. (Chapter 10.2, Chapter 10.8)

Palatine: Pair of L-shaped bones between the maxilla and the sphenoid that form the hard palate, walls of the nasal cavity, and orbital floor of the eye. (Chapter 10.2)

Paralysis: Occurs when an injury or medical condition disrupts the nerve signals to the muscles, resulting in being unable to make voluntary movements. (Chapter 10.10)

Parietal: Upper lateral sides of the skull. (Chapter 10.2)

Patella: Kneecap. (Chapter 10.2)

Pathologic fracture: A fracture that occurs due to disease process. (Chapter 10.6)

Pectoralis major: A thick, fan-shaped muscle situated on the chest. (Chapter 10.2)

Pelvic girdle: Structure formed by the two hip bones, the sacrum, the coccyx. (Chapter 10.2)

Phalanges: Fingers (and toes). (Chapter 10.2)

Phalanx: Single finger. (Chapter 10.2)

Phantom limb pain: Refers to the sensation of pain or discomfort felt in an amputated limb. (Chapter 10.5)

Prosthesis: An artificial body part. (Chapter 10.5)

Pubis: Forms the anterior portion of the hip bone. (Chapter 10.2)

Quadriceps: A large muscle group on the front of the thigh. (Chapter 10.2)

Quantitative ultrasound (QUS): Measures bone density at peripheral sites such as the heel with sound waves. (Chapter 10.8)

Radius: The thumb side of the forearm. (Chapter 10.2)

Rectus abdominis: A paired muscle running vertically on each side of the anterior wall of the abdomen. (Chapter 10.2)

Rhabdomyolysis: Refers to the breakdown of muscles that causes damage to the kidney. (Chapter 10.10)

Rheumatoid arthritis (RA): A chronic and systemic autoimmune disorder primarily affecting the synovial tissue. (Chapter 10.9)

Rotator cuff: A group of muscles and tendons that stabilize the shoulder. (Chapter 10.2)

Sacrum: The triangular-shaped bone at the base of the spine, formed by the fusion of five sacral vertebrae, a process that does not begin until after the age of 20. (Chapter 10.2)

Scapula: Shoulder blade. (Chapter 10.2)

Scoliosis: A sideways curve of the spine. (Chapter 10.10)

Six P's: Acronym to describe warning signs of acute compartment syndrome. (Chapter 10.6)

Skeletal muscle: Voluntary muscle that produces movement of the arms, legs, back, neck, and maintains posture by resisting gravity. (Chapter 10.2)

Smooth muscle: Muscle which is responsible for involuntary muscle movement. (Chapter 10.2)

Spastic: The muscles tighten, causing uncontrollable jerks and spasms. (Chapter 10.10)

Spasticity: Stiff muscles. (Chapter 10.10)

Sphenoid: Posterior eye sockets and part of the base of the skull. (Chapter 10.2)

Spiral fracture: Bone has twisted apart. (Chapter 10.6)

Sprain: An injury to a joint when a ligament is stretched or torn. (Chapter 10.10)

Sternum: The breastbone. (Chapter 10.2)

Strain: An injury to a muscle or tendon from being overstretched or torn, causing pain. (Chapter 10.10)

Stress fracture: Small crack in a bone. (Chapter 10.6)

Striated muscle: Muscle which contains functional units called sarcomeres. (Chapter 10.2)

Subluxation: Refers to partial dislocation of a joint resulting in structural displacement. (Chapter 10.10)

Suture: The narrow fibrous joint found between the skull bones. (Chapter 10.2)

Swan-like deformity: A bending in (flexion) of the base of the finger, a straightening out (extension) of the middle joint, and a bending in (flexion) of the outermost joint. (Chapter 10.9)

Synovial fluid: The lubricating fluid found between synovial joints. (Chapter 10.2)

Synovial joints: Fully movable joints; have a fluid-filled space where two bones come together. (Chapter 10.2)

Synovial membrane: The lining or covering of synovial joints. (Chapter 10.2)

Tarsals: Bones of the posterior half of the foot. (Chapter 10.2)

Temporal: Lower lateral sides of the skull. (Chapter 10.2)

Temporomandibular joint (TMJ): A hinge joint between the temporal bone and the mandible that allows for the opening, closing, protrusion, retraction, and lateral movement of the lower jaw. (Chapter 10.2)

Tendon: Narrow bands of fibrous connective tissue that connect a muscle to a bone. (Chapter 10.2)

Tendonitis: Refers to inflammation of a tendon, causing pain around a joint. (Chapter 10.10)

Thoracic: The 12 vertebrae that form the outward curvature of the spine, T1 to T12. (Chapter 10.2)

Tibia: The medial bone and main weight-bearing bone of the lower leg, commonly called the shin. (Chapter 10.2)

Toe or partial foot amputation: Removal of toes or a part of the foot that preserves the foot structure, aiding in maintaining balance and mobility. (Chapter 10.5)

Traction: Application of a pulling force to the affected limb or body part using weights and pulleys to align and immobilize the fracture. (Chapter 10.6)

Transverse fracture: Bone is broken straight across. (Chapter 10.5)

Traumatic amputation: Amputation that occurs due to accidents, injuries, or severe trauma, resulting in the sudden loss of a limb. (Chapter 10.5)

Triceps brachii: Muscle on the posterior of the upper arm. (Chapter 10.2)

True ribs: Ribs 1-7 that are attached to the front of the sternum. (Chapter 10.2)

Ulna: The fifth finger side of the forearm. (Chapter 10.2)

Ultrasound imaging: Ultrasound imaging uses sound waves to create images of soft tissues, tendons, and muscles. (Chapter 10.3)

Vertebrae: Bones of the back. (Chapter 10.2)

Vertebral column: Vertebrae that are separated by intervertebral disks. (Chapter 10.2)

Vertebroplasty: Involves the injection of cement into fractured vertebrae to stabilize the fracture areas. (Chapter 10.8)

Vomer: Bone that separates the left and right nasal cavity. (Chapter 10.2)

Wrist disarticulation: Amputation at the wrist joint. (Chapter 10.5)

Xiphoid process: The lower portion of the sternum made of cartilage. (Chapter 10.2)

Zygomatic: Pair of cheekbones. (Chapter 10.2)

PART XI

CHAPTER 11 GASTROINTESTINAL SYSTEM ALTERATIONS

11.1 Gastrointestinal Introduction

Learning Objectives

- Apply principles of evidence-based practice when using the nursing process
- Identify the roles and responsibilities of the nurse in caring for the client with gastrointestinal disorders
- Explain the pathophysiology of gastrointestinal system disorders
- Identify life span considerations of the client
- Apply principles of client-centered care when considering diversity of the client
- Apply therapeutic communication in caring for the client with gastrointestinal disorders
- Integrate pharmacological and nonpharmacological measures for the client with gastrointestinal disorders
- Interpret common laboratory and diagnostic tests

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=95#h5p-45

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As health care professionals, nurses play a pivotal role in recognizing and caring for clients with gastrointestinal disorders. This chapter will delve into the intricate workings of the gastrointestinal system, examining its anatomy, physiology, and the myriad of conditions that can affect its optimal function.

The gastrointestinal system, often referred to as the digestive or GI system, is a complex network of organs and structures responsible for the digestion and absorption of nutrients, as well as the elimination of waste. Its efficient functioning is essential for maintaining overall health and well-being. Nurses, as frontline caregivers, must possess a thorough understanding of the gastrointestinal system to provide effective and compassionate care to clients experiencing a wide array of gastrointestinal issues.

Throughout this chapter, we will navigate through the specifics of gastrointestinal anatomy, exploring the structure and function of each component from the mouth to the anus. By establishing a solid foundation in the normal physiology of digestion, nurses will be better equipped to recognize abnormalities and deviations from health. An overview of a comprehensive gastrointestinal assessment is included, as well as exploration of some risk factors that predispose clients to gastrointestinal illness. Common laboratory tests and diagnostics and life span considerations related to the gastrointestinal system are discussed. Several gastrointestinal disorders are described, including pathophysiology, signs and symptoms, diagnostic and lab tests, medical treatments, and nursing care that promotes optimal client outcomes.

11.2 Review of Anatomy & Physiology of the Gastrointestinal System

This section will review the anatomy and physiology of the gastrointestinal system, including the mouth, tongue, salivary glands, pharynx, esophagus, stomach, small intestine, and large intestine, as well as the accessory organs of the liver, pancreas, and gallbladder. See Figure 11.1[1] for an illustration of gastrointestinal system organs.

1. "abe85277d60c52f85be133e1b5ddc40aea009e1c.jpg" by J. Gordon Betts, et al. is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/23-1-overview-of-the-digestive-system

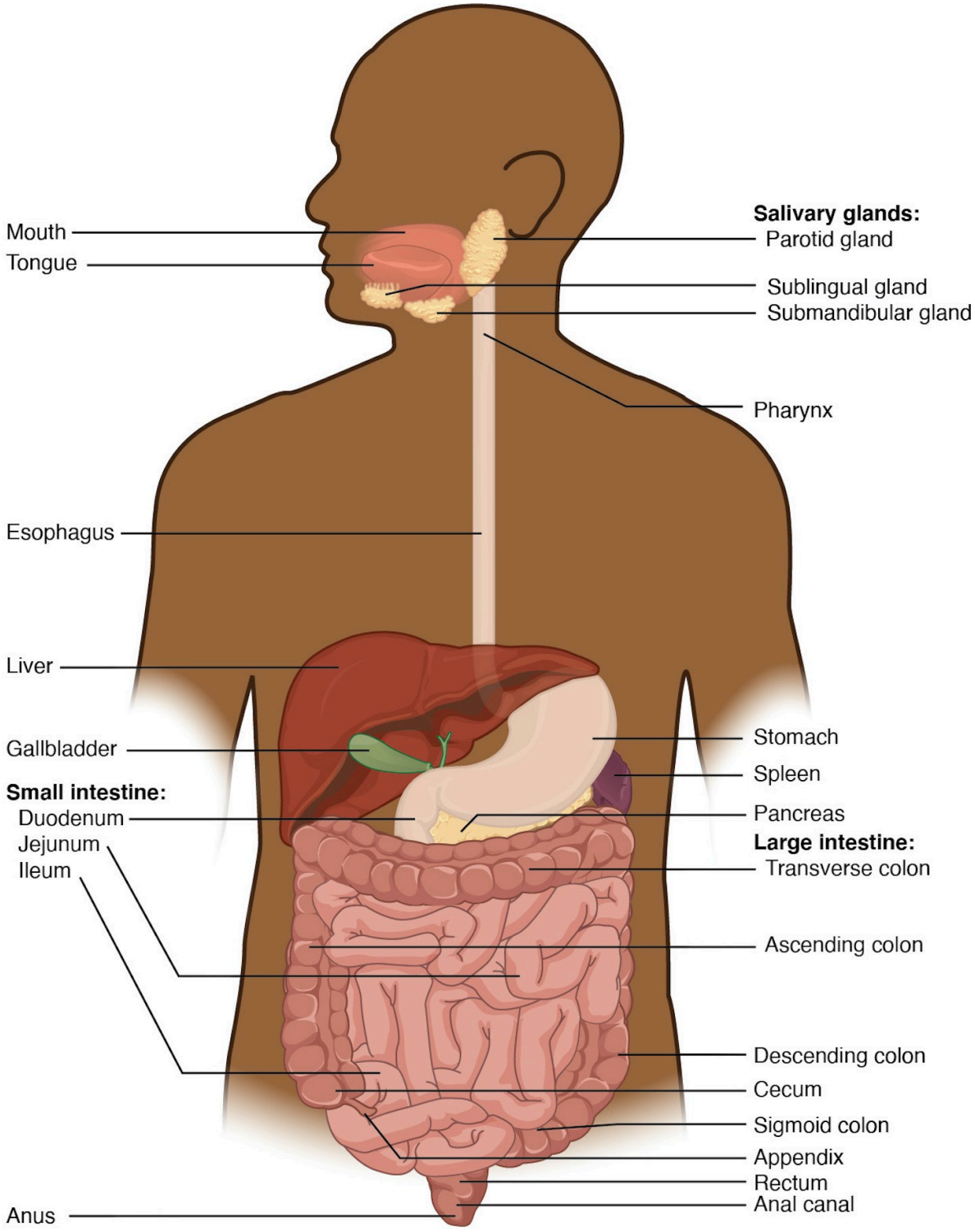


Figure 11.1 Gastrointestinal System

Mouth

The mouth, cheeks, tongue, and palate form the **oral cavity**. See Figure 11.2[2] for an illustration of the oral cavity. If you run your tongue along the roof of your mouth, you'll notice the roof of the mouth has an arch called a hard palate. The anterior region of the palate serves as a septum (i.e., wall) between the oral and nasal cavities, as well as a rigid shelf against which the tongue can push food when swallowing. The hard palate ends in the posterior oral cavity where the tissue becomes fleshier. This part of the palate, known as the soft palate, is composed mainly of skeletal muscle that can be manipulated for actions like swallowing or singing.[3]

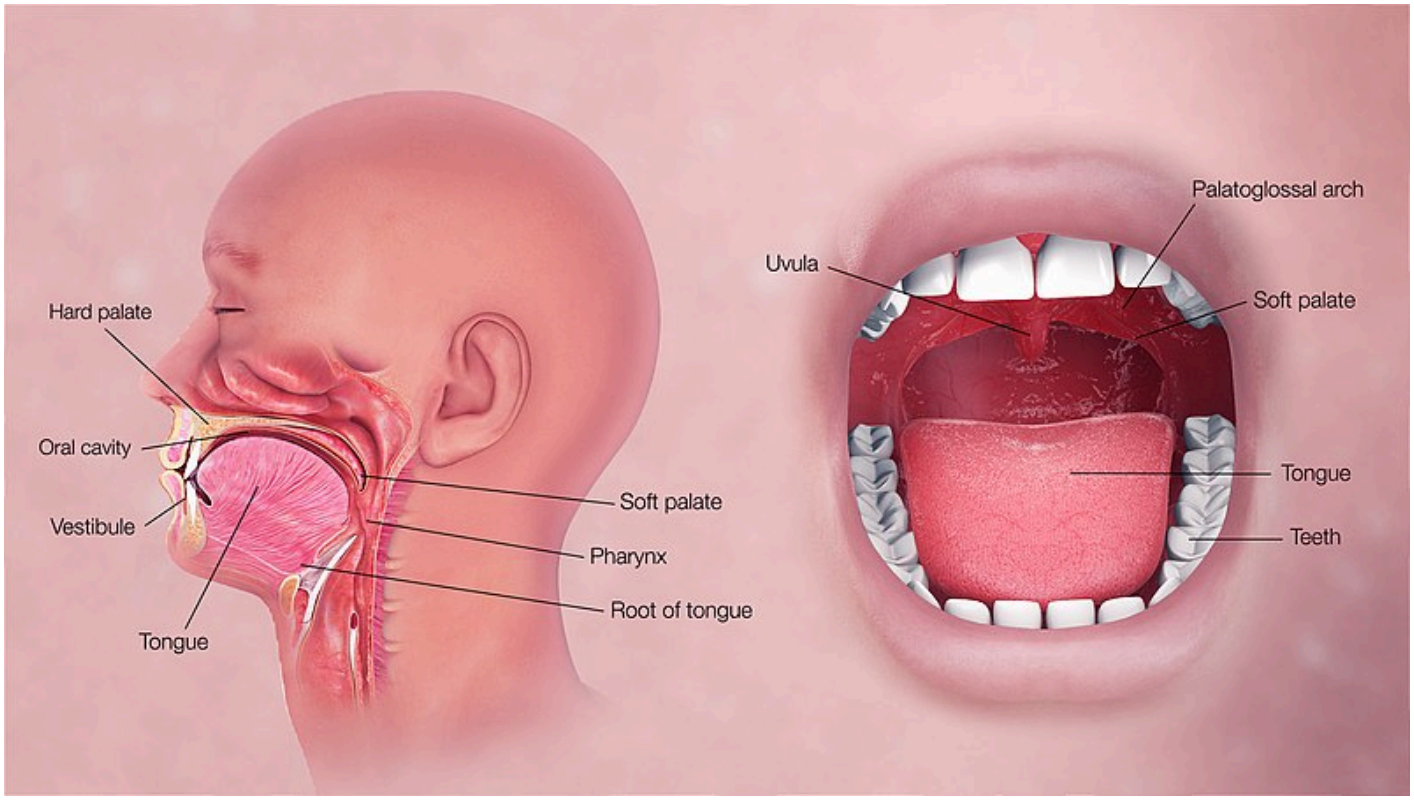


Figure 11.2 Oral Cavity

2. This image is a derivative of "3D_Medical_Animation_Oral_Cavity.jpg" by https://www.scientificanimations.com and is licensed under CC BY-SA 4.0

3. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

A fleshy extension of tissue called the **uvula** drops down from the center of the soft palate. When swallowing, the soft palate and uvula move upward, helping to keep foods and liquid from entering the nasal cavity and respiratory tract.[4]

Two muscular folds extend downward from the soft palate on either side of the uvula. Between these two folds are the palatine tonsils, clusters of lymphoid tissue that protect the pharynx. The lingual tonsils are located at the base of the tongue.[5]

Tongue

The **tongue** facilitates ingestion, digestion, sensation (of taste, texture, and temperature of food), swallowing, and vocalization. It has a mucous membrane covering and is composed of skeletal muscles that facilitate eating, swallowing, and speaking. The top and sides of the tongue are studded with papillae and taste buds to facilitate sensation. Lingual glands secrete mucus and a watery fluid that contains the enzyme lipase, which plays an initial role in breaking down food before it reaches the stomach.[6] See Figure 11.3[7] for an illustration of the papillae on the tongue.

4. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/
5. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/
6. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/
7. "2407_Tongue.jpg" by OpenStax College is licensed under CC BY 3.0

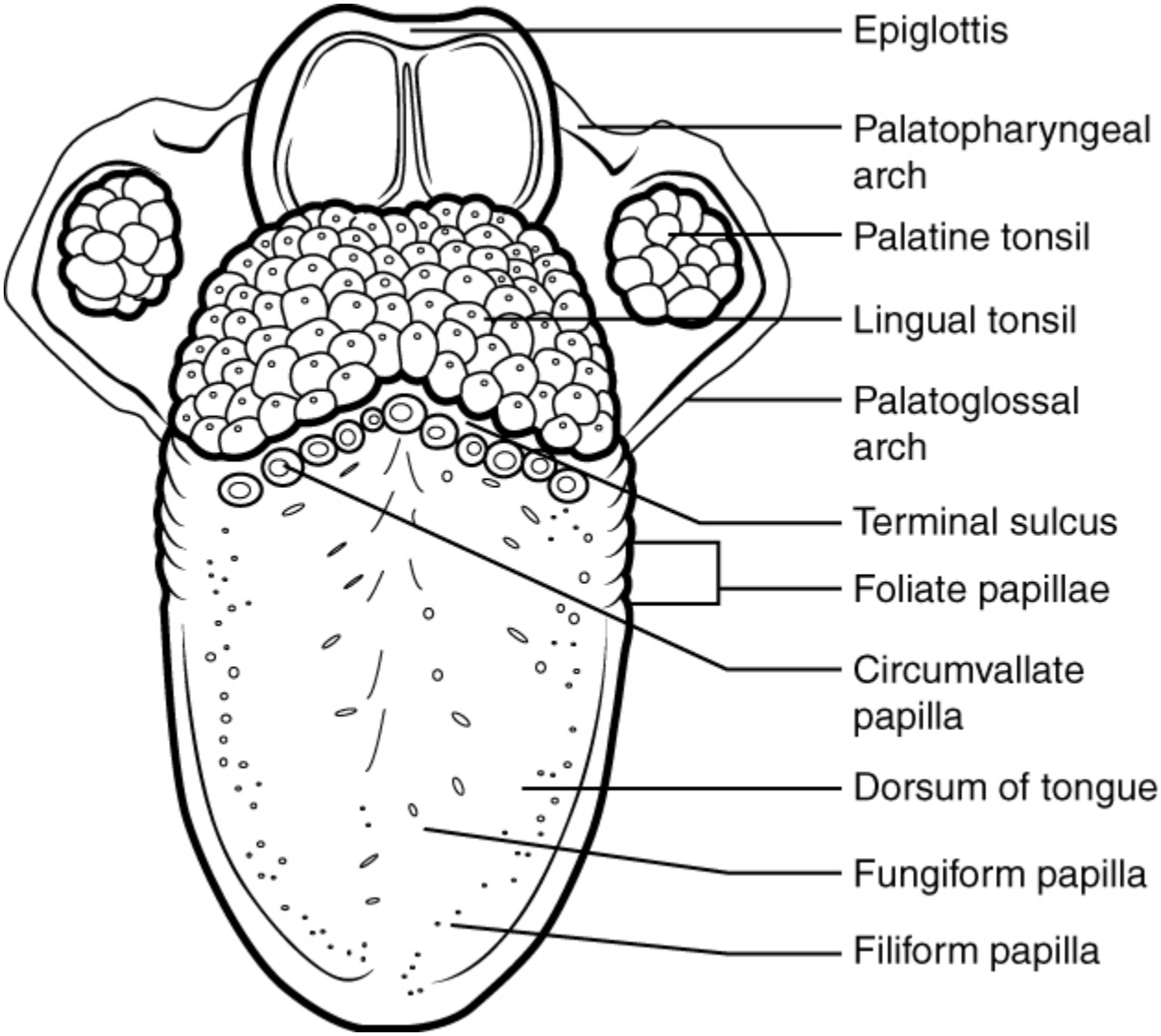


Figure 11.3 Tongue

Salivary Glands

Many small **salivary glands** are housed within the mucous membranes of the mouth and tongue that are constantly secreting saliva into the oral cavity or indirectly through salivary ducts. Saliva moistens the mouth and teeth and increases when eating to moisten food and initiate the chemical breakdown

of carbohydrates and fats.[8] See Figure 11.4[9] for an illustration of the salivary glands.

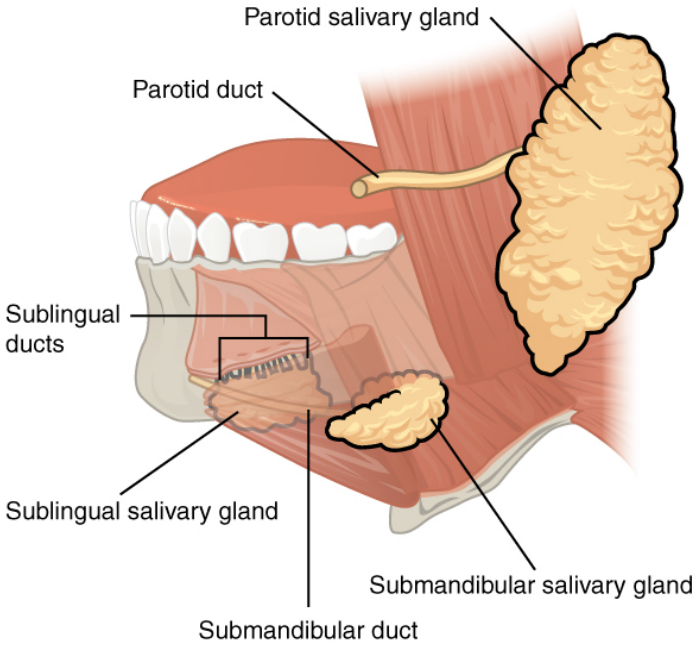


Figure 11.4 Salivary Glands

Pharynx

The **pharynx**, commonly called the throat, is a tube of muscle lined with a mucous membrane that runs from the posterior oral and nasal cavities to the opening of the esophagus and larynx.[10] See Figure 11.5[11] for an illustration of the pharynx.

8. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/
9. "2408_Salivary_Glands.jpg" by OpenStax College is licensed under CC BY 3.0
10. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/
11. "2411_Pharynx.jpg" by OpenStax College is licensed under CC BY 3.0

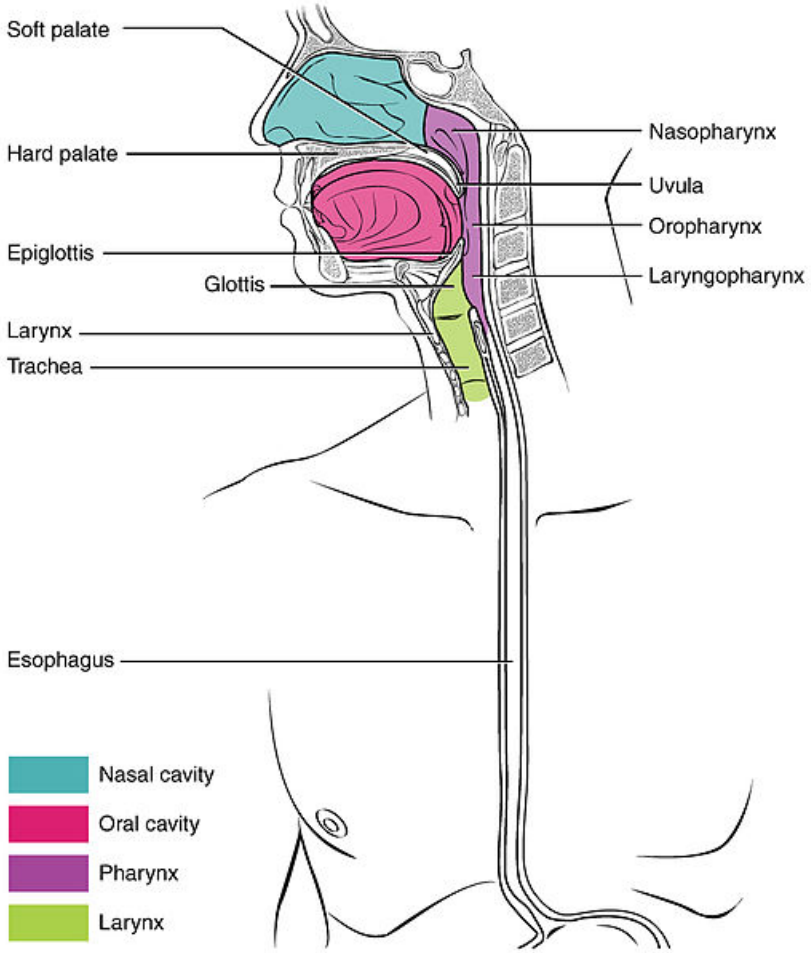


Figure 11.5 Pharynx

The pharynx has three subdivisions. The superior section, the nasopharynx, is involved only in breathing and speech. The other two subdivisions, the oropharynx and the laryngopharynx, are used for both breathing and digestion. The oropharynx begins inferior to the nasopharynx and continues to the laryngopharynx. The inferior border of the laryngopharynx connects to the esophagus, whereas the anterior portion connects to the larynx.[12]

The pharynx is involved in both digestion and breathing. It receives air from the mouth and nasal cavities and food from the mouth. When food enters

12. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

the pharynx, involuntary muscle contractions close the epiglottis to prevent food from entering the larynx and trachea, and food enters the esophagus.[13]

Esophagus

The **esophagus** is a muscular tube that connects the pharynx to the stomach. It is located posteriorly to the trachea and is approximately ten inches long. See Figure 11.6[14] for an illustration of the esophagus. The upper esophageal sphincter controls the movement of food from the pharynx to the esophagus. Recall that sphincters are muscles that surround tubes and serve as valves, closing the tube when the sphincters contract and opening it when they relax.[15]

13. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

14. "2412_The_Esophagus.jpg" by OpenStax College is CC BY 3.0

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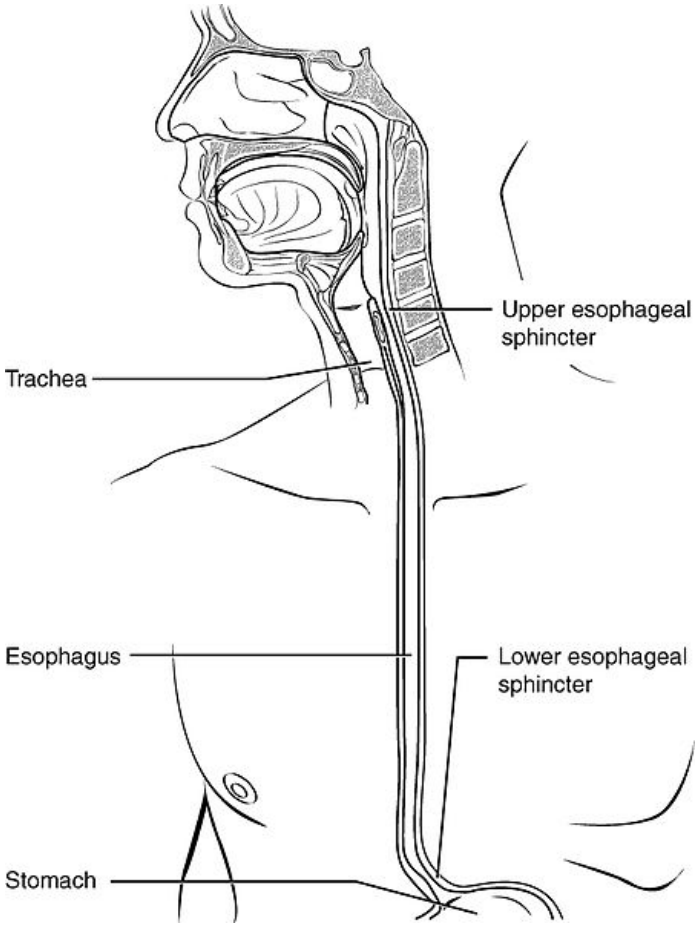


Figure 11.6 Esophagus

The upper two thirds of the esophagus consist of muscles. A series of contractions called **peristalsis** push food through the esophagus and into the stomach. Just before the opening to the stomach is a ring-shaped muscle called the **lower esophageal sphincter (LES)**. This sphincter opens to let food pass into the stomach and closes to keep it there.[16]

Stomach

The **stomach** is a sac-like organ where food is mixed with gastric juice. There are four main regions in the stomach: the cardia, fundus, body, and pylorus. The funnel-shaped pylorus connects the stomach to the duodenum, the first

16. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

part of the small intestine. The **pyloric sphincter** is located at this latter point of connection and controls stomach emptying into the small intestine.[17] See Figure 11.7[18] for an illustration of the stomach.

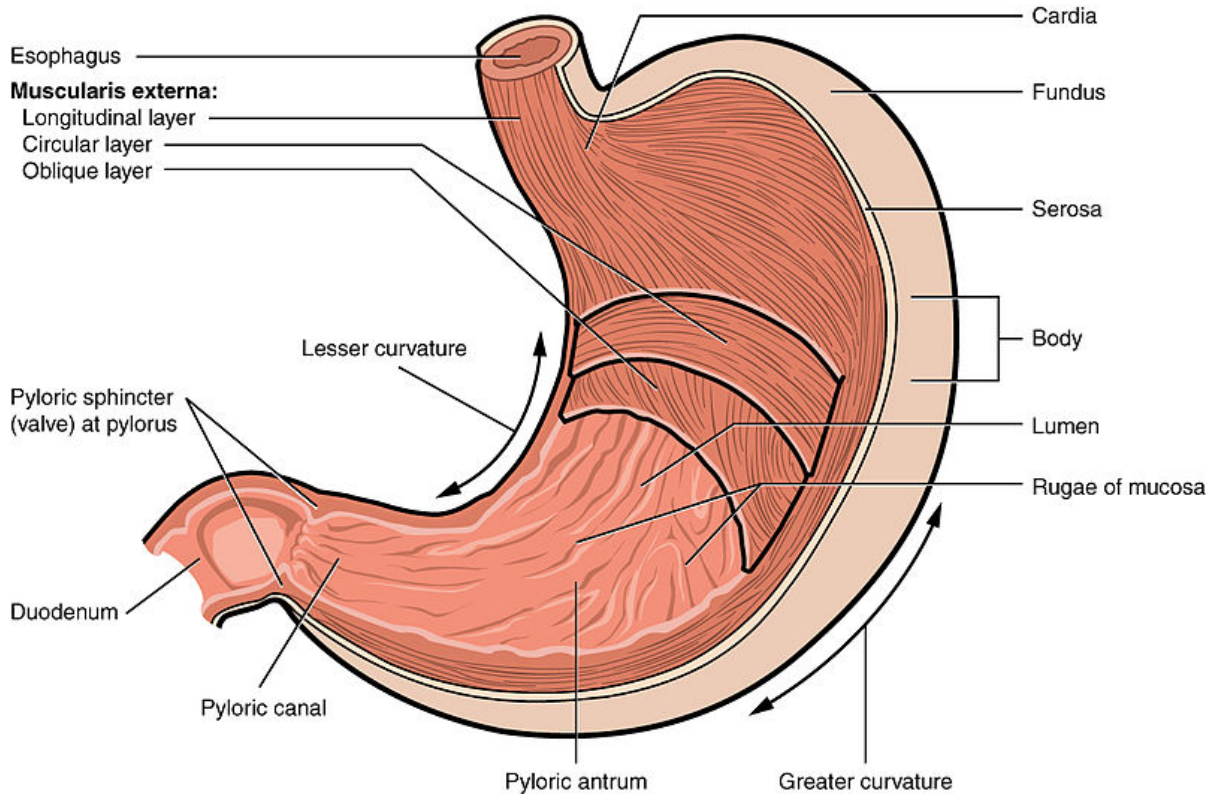


Figure 11.7 Stomach

The inner lining of the stomach is covered by a mucous membrane that secretes a protective coat of alkaline mucus. The mucus protects the stomach from corrosive stomach acid. Gastric glands lie under the surface of this lining and secrete a complex digestive fluid referred to as gastric juice. **Gastric juice** consists of the following components: water, mucus, hydrochloric acid, pepsin, and intrinsic factor. The purpose of gastric juice is not only to help with the breakdown of food, but also to protect the client against infectious

17. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

18. "2414_Stomach.jpg" by OpenStax College is licensed under CC BY 3.0

agents, which may be deterred by the acidic environment. Some of the components of gastric juice will be discussed in more detail below.[19]

Parietal cells and chief cells are found within the gastric glands. **Parietal cells** produce and secrete hydrochloric acid (HCl) to maintain the acidity of the environment with a pH of 1 to 4. Parietal cells also secrete a substance called **intrinsic factor**, which is necessary for the absorption of vitamin B12 in the small intestine. Parietal cells are the primary site of action for many drugs that treat acid-related disorders. **Chief cells** secrete pepsinogen that becomes pepsin when exposed to acid. **Pepsin** is a digestive enzyme that breaks down protein.[20,21,22,23,24]

The stomach also contains enteroendocrine cells (ECL or enterochromaffin-like cells) located in the gastric glands that secrete substances, including serotonin, histamine, and somatostatin. Serotonin, also known as 5-HT, aids in

19. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

20. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

21. Heda, R., Toro, F., & Tombazzi, C. R. (2023). *Physiology, Pepsin*. [StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537005/

22. Hsu, M., Safadi, A. O., & Lui, F. (2023). *Physiology, Stomach*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK535425/

23. Latorre, R., Sternini, C., De Giorgio, R., & Greenwood-Van Meerveld, B. (2015). Enteroendocrine cells: A review of their role in brain-gut communication. *Neurogastroenterology & Motility, 28*(5), 620-630. https://doi.org/10.1111/nmo.12754

24. Guzel, T., & Mirowska-Guzel, D. (2022). The Role of Serotonin Neurotransmission in Gastrointestinal Tract and Pharmacotherapy. *Molecules*, 27(5), 1680. https://doi.org/10.3390/molecules27051680

intestinal motility and nutrient absorption and also plays a role in gastrointestinal inflammation. Histamine and somatostatin help regulate the secretion of gastric acid. Histamine leads to the secretion of gastric acid by acting on parietal cells, and somatostatin inhibits parietal cells or histamine release to decrease gastric acid levels. Additionally, G cells in the stomach secrete gastrin that promotes secretions of digestive substances. Although all these cells play an important role in the digestive system, acid-related diseases, such as gastroesophageal reflux disease, can occur when there is an imbalance of secretions.[25,26,27,28]

The muscular walls of the stomach move food through the stomach and vigorously churn it, mechanically breaking it down into smaller particles.

Small Intestine

Partially digested food, called **chyme**, is released from the stomach via the pyloric sphincter and enters the **small intestine**, the part of the digestive tract where most of the digestion and absorption into the blood occurs. Approximately 90 percent of nutrients from food are absorbed through **villi**, small fingerlike extensions on the inner surface of the small intestine. The

25. Heda, R., Toro, F., & Tombazzi, C. R. (2023). *Physiology, Pepsin*. [StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537005/

26. Hsu, M., Safadi, A. O., & Lui, F. (2023). *Physiology, Stomach*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK535425/

27. Latorre, R., Sternini, C., De Giorgio, R., & Greenwood-Van Meerveld, B. (2015). Enteroendocrine cells: A review of their role in brain-gut communication. *Neurogastroenterology & Motility, 28*(5), 620-630. https://doi.org/10.1111/nmo.12754

28. Guzel, T., & Mirowska-Guzel, D. (2022). The Role of Serotonin Neurotransmission in Gastrointestinal Tract and Pharmacotherapy. *Molecules*, 27(5), 1680. https://doi.org/10.3390/molecules27051680

small intestine is about ten feet long. Its name derives from its small diameter of about one inch, compared to the large intestine's diameter of about three inches.[29]

The coiled tube of the small intestine is subdivided into three regions called the **duodenum**, **jejunum**, and **ileum**. The ileum joins the cecum of the large intestine at the ileocecal sphincter. The **ileocecal valve** controls the flow of chyme from the small intestine to the large intestine.[30] See Figure 11.8[31] for an illustration of these regions.

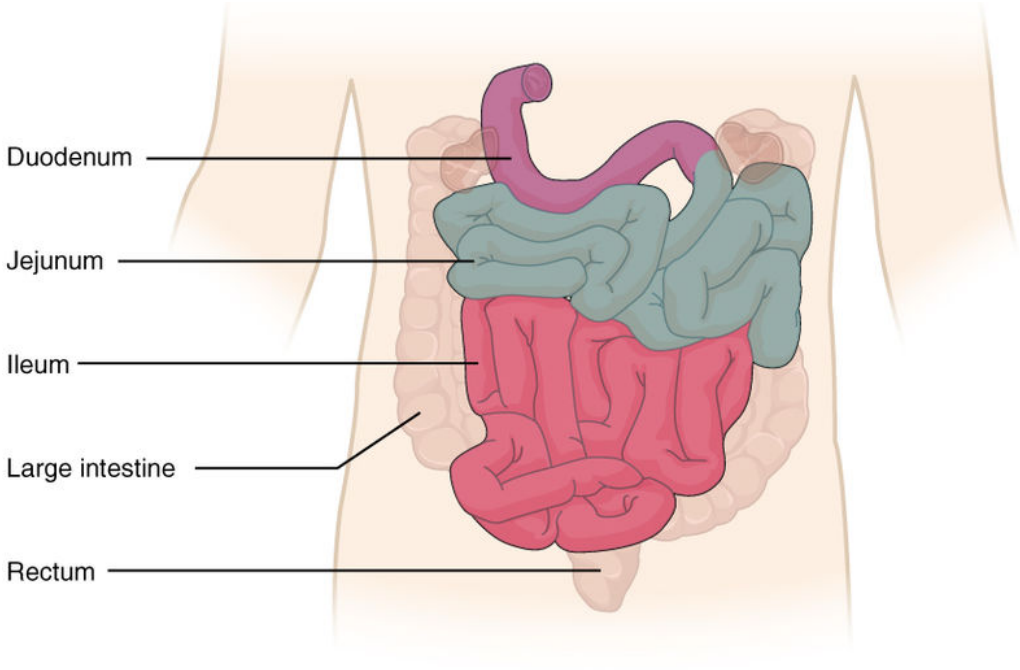


Figure 11.8 Small Intestine

Large Intestine

The **large intestine** runs from the cecum to the anus. The primary functions

29. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

30. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

31. "2417_Small_IntestineN.jpg" by OpenStax College is licensed under CC BY 3.0

of the large intestine are to finish absorption of nutrients and water, synthesize certain vitamins, and form and eliminate **feces**, also called stool. The large intestine is about one half the length of the small intestine but is called large because its diameter is three inches, about three times the diameter of the small intestine. The large intestine is subdivided into four main regions: the cecum, the colon, the rectum, and the anal canal. The colon is further subdivided into the ascending, transverse, descending, and sigmoid colon.[32] See Figure 11.9[33] for an illustration of the large intestine.

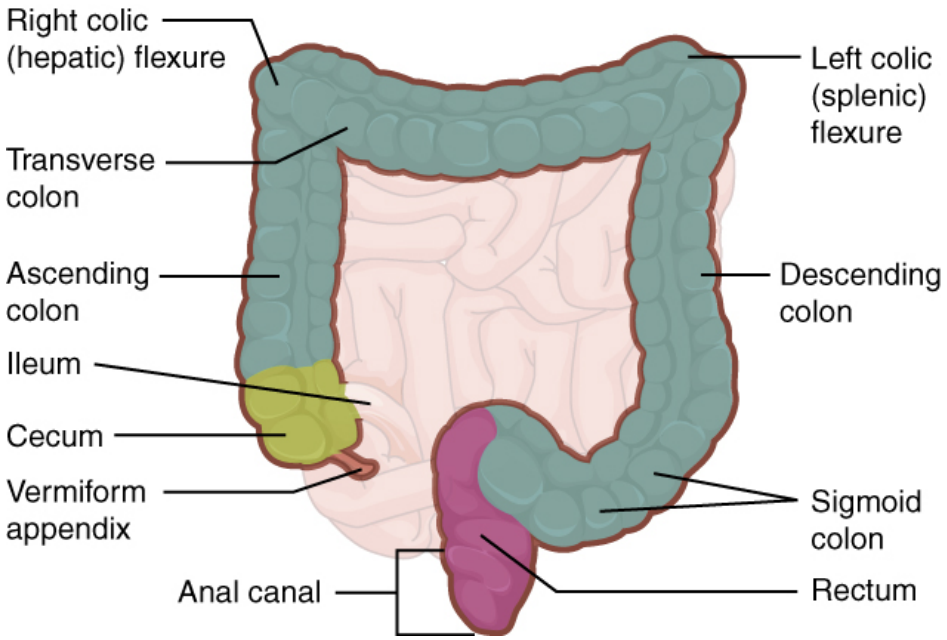


Figure 11.9 Large Intestine

Cecum

The **cecum** is the initial part of the large intestine. It receives the contents of the small intestine and continues absorbing water and salts. The **appendix** is a small pouch attached to the end of the cecum. Its twisted anatomy provides

32. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

33. "2420_Large_Intestine.jpg" by OpenStax College is licensed under CC BY 3.0

a haven for the accumulation and multiplication of enteric bacteria that can lead to **appendicitis**.[34]

Colon

Food residue entering the colon travels up the **ascending colon** on the right side of the abdomen. At the inferior surface of the liver, the colon bends to become the **transverse colon**, where it travels across to the left side of the abdomen. From there, chyme passes through the **descending colon**, which runs down the left side of the posterior abdominal wall and becomes the S-shaped **sigmoid colon**.[35]

Rectum

The **rectum** is the final eight inches of the large intestine. It has three folds, called the rectal valves, that help separate feces from **flatus**, commonly referred to as gas.[36]

Anal Canal

The **anal canal** is about three inches long and opens to the exterior of the body at the **anus**, the end of the digestive tract. The anal canal includes two sphincters. The internal anal sphincter is made of smooth muscle, and its contractions are involuntary. The external anal sphincter is made of skeletal

34. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

35. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

36. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

muscle, which is under voluntary control. Except when defecating, both sphincters usually remain closed.[37]

Accessory Organs of Digestion

Chemical digestion in the small intestine relies on the activities of three accessory digestive organs: the liver, pancreas, and gallbladder. See Figure 11.10[38] for an illustration of these accessory organs. The digestive role of the liver is to produce bile and export it to the duodenum. The gallbladder stores, concentrates, and releases bile. The pancreas produces pancreatic juice, which contains digestive enzymes and bicarbonate ions, and delivers it to the duodenum via the common bile duct.[39]

37. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

38. "2422_Accessory_Organs.jpg" by OpenStax College is licensed under CC BY 3.0

39. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

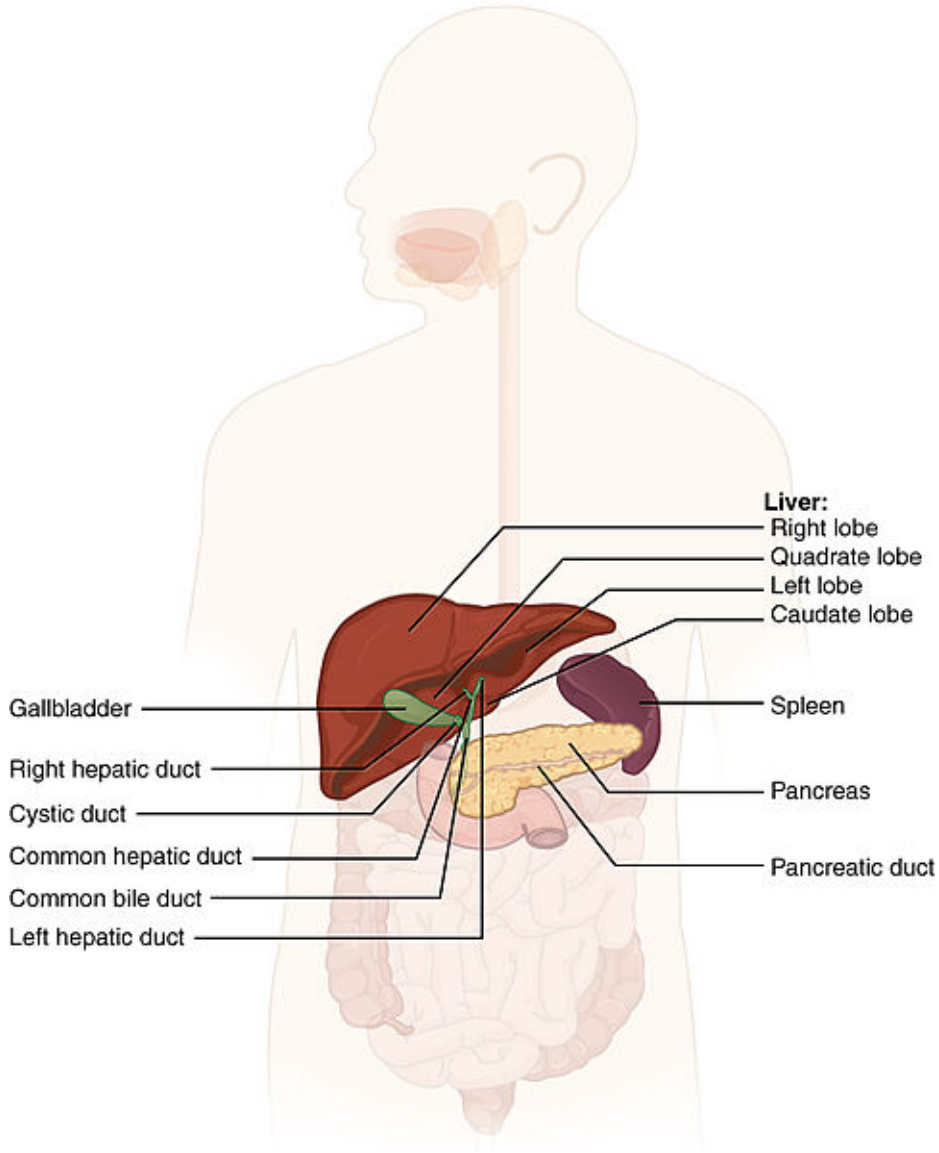


Figure 11.10 Accessory Organs: Liver, Pancreas, and Gallbladder

Liver

The **liver** weighs about three pounds in an adult. In addition to being an accessory digestive organ, it plays a number of roles in metabolism, blood clotting, protein creation, and cleansing the blood of toxins. The liver lies inferior to the diaphragm in the right upper quadrant of the abdominal cavity.

It is protected by the surrounding ribs. The liver is divided into two primary lobes, a large right lobe and a much smaller left lobe.[40]

HEPATIC PORTAL CIRCULATION

The portal vein delivers nutrient-rich blood from the small intestine to the liver. This blood contains nutrients, toxins, and medications that are absorbed and metabolized by the liver. The hepatic artery also delivers oxygenated blood from the heart to the liver. After the liver processes the blood and metabolizes nutrients and toxins, it releases blood through the hepatic vein into the inferior vena cava. This is referred to as hepatic portal circulation.[41] See Figure 11.11[42] for an illustration of hepatic portal circulation.

40. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

41. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

42. "Cenveo – Drawing Liver anatomy and vascularisation – English labels" by Cenveo is licensed under CC BY 4.0

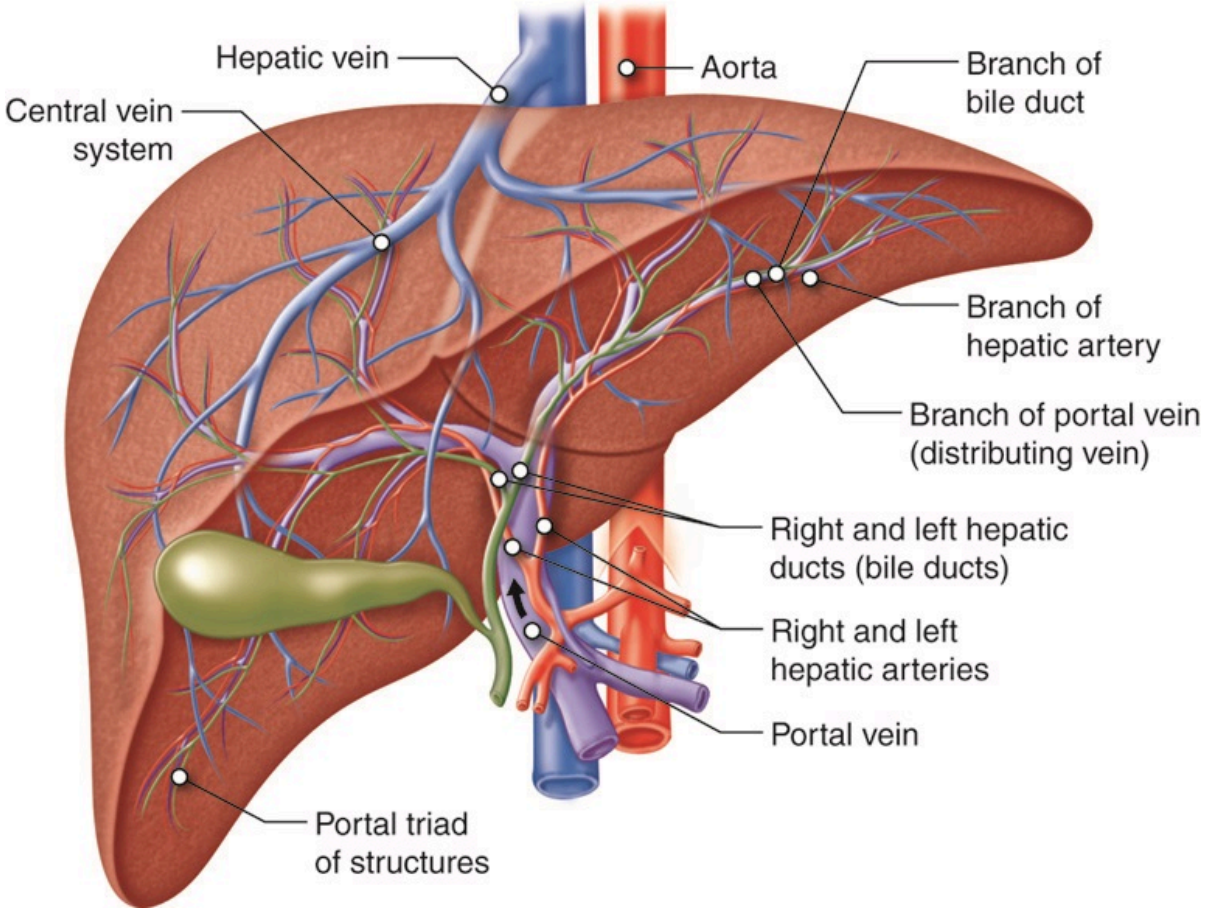


Figure 11.11 Hepatic Portal Circulation

BILE

Proteins, iron, and bilirubin are transported in the blood to the liver. In the liver, proteins and iron are recycled, whereas bilirubin is excreted in the bile. Bilirubin, a yellowish pigment produced by the breakdown of red blood cells, gives bile its color. **Bile** is a digestive fluid produced and secreted by the liver that breaks down lipids in the small intestine. **Bilirubin** is eventually transformed by intestinal bacteria into a brown pigment that gives stool its characteristic color.

In some diseases, bile does not enter the intestine, resulting in white stool

with a high fat content because virtually no fats are broken down by the bile. **Steatorrhea** refers to fatty stool.[43]

Pancreas

The soft, oblong, glandular **pancreas** lies transversely in the retroperitoneum behind the stomach. The pancreas has two functions referred to as **exocrine**, meaning secreting digestive enzymes, and **endocrine**, meaning releasing hormones into the blood.[44]

The pancreas produces protein-digesting enzymes in their inactive forms that are activated in the duodenum, so they don't attack the pancreas. Enzymes that don't attack the pancreas are secreted in their active forms, such as **amylase** that digests carbohydrates and **lipase** that digests fat. The pancreas delivers this **pancreatic juice** to the duodenum through the common bile duct (carrying bile from the liver and gallbladder) just before entering the duodenum. The pancreatic islet cells secrete hormones such as insulin and glucagon.[45] See Figure 11.12[46] for an illustration of the pancreas.

43. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

44. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

45. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

46. "2424_Exocrine_and_Endocrine_Pancreas.jpg" by OpenStax College is licensed under CC BY 3.0

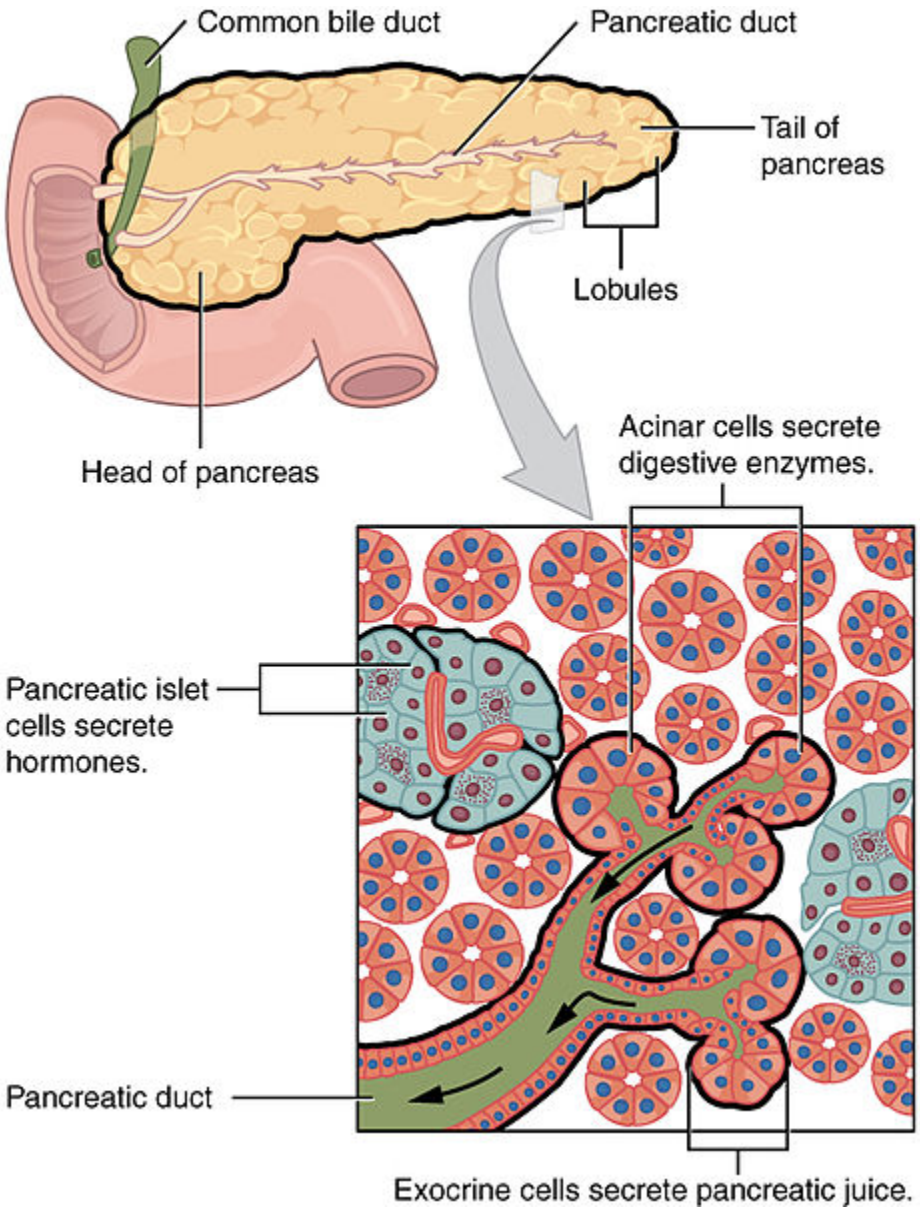


Figure 11.12 Pancreas

For more information on the hormone functions of the pancreas, view the "Endocrine Alterations" chapter.

Gallbladder

The **gallbladder** is about three to four inches long and is nested in a shallow

area on the posterior aspect of the right lobe of the liver. This muscular sac stores, concentrates, and propels bile into the duodenum via the common bile duct.[47] See Figure 11.13[48] for an illustration of the gallbladder.

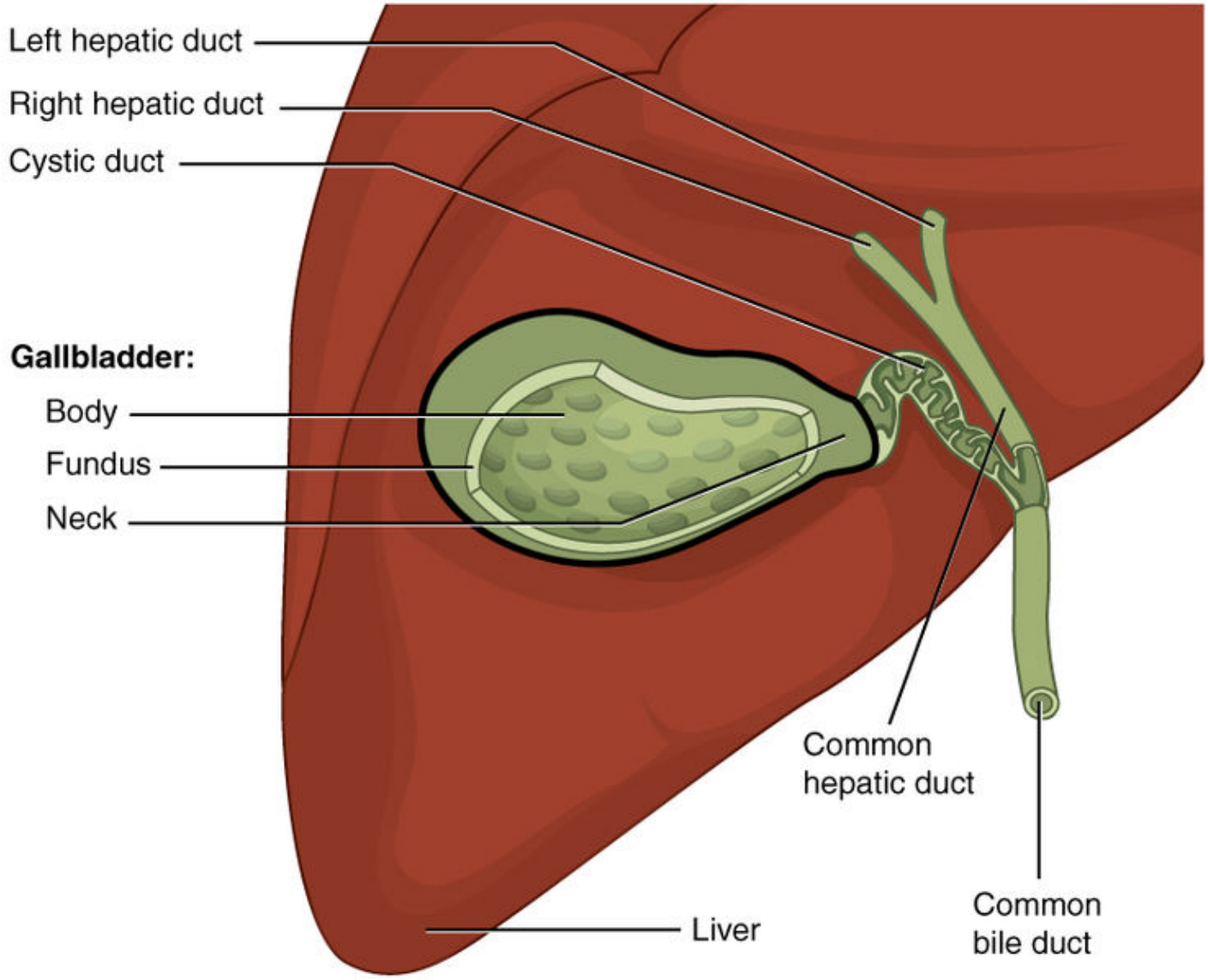


Figure 11.13 Gallbladder

47. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

48. "2425_Gallbladder.jpg" by OpenStax College is licensed under CC BY 3.0

Physiology of the Digestive System

The main functions of the digestive system are ingesting food, digesting food, absorbing nutrients, and eliminating waste products.[49] See Table 11.2 for an overview of the functions of the organs of the digestive tract.

Table 11.2. Functions of the Digestive Organs[50]

49. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

50. Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2022). *Anatomy and Physiology 2e*. OpenStax. https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

Organ	Major Functions	Other Functions
Mouth	Ingests food Chews and mixes food Begins chemical breakdown of carbohydrates via salivary amylase Moves food into the pharynx Begins breakdown of lipids via lingual lipase	Moistens and dissolves food, allowing taste Cleans and lubricates the teeth and oral cavity Promotes some antimicrobial activity
Pharynx	Propels food from the oral cavity to the esophagus	Lubricates food and passageways
Esophagus	Propels food to the stomach	Lubricates food and passageways
Stomach	Mixes and churns food with gastric juices to form chyme Begins chemical breakdown of proteins Releases food into the duodenum as chyme Absorbs some fat-soluble substances Possesses antimicrobial functions	Stimulates protein-digesting enzymes Secretes intrinsic factor required for vitamin B12 absorption in small intestine

Small Intestine	Mixes chyme with digestive juices Propels food at a rate slow enough for digestion and absorption Absorbs breakdown products of carbohydrates, proteins, lipids, and nucleic acids, along with vitamins, minerals, and water Performs physical digestion via **segmentation**, the mechanical mixing of food with digestive juices	Provides optimal medium for enzymatic activity
Large Intestine	Further breaks down food residues Absorbs most residual water, electrolytes, and vitamins produced by enteric bacteria Propels feces toward rectum Eliminates feces	Food residue is concentrated and temporarily stored prior to defecation Mucus eases passage of feces through colon
Accessory Organs	Liver produces bile salts, which emulsify lipids, aiding in their digestion and absorption Gallbladder stores, concentrates, and releases bile Pancreas produces digestive enzymes and bicarbonate	Bicarbonate-rich pancreatic juices help neutralize acidic chyme and provide optimal environment for enzymatic activity

Digestive Processes

Digestive processes involve the interaction of several organs and occur gradually as food moves through the gastrointestinal tract. The processes of

digestion include six activities: ingestion, propulsion, mechanical digestion, chemical digestion, absorption, and defecation.[51,52,53] See Figure 11.14[54] for an illustration of digestive processes.

51. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

52. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

53. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

54. "2405_Digestive_Process.jpg" by OpenStax College is licensed under CC BY 3.0

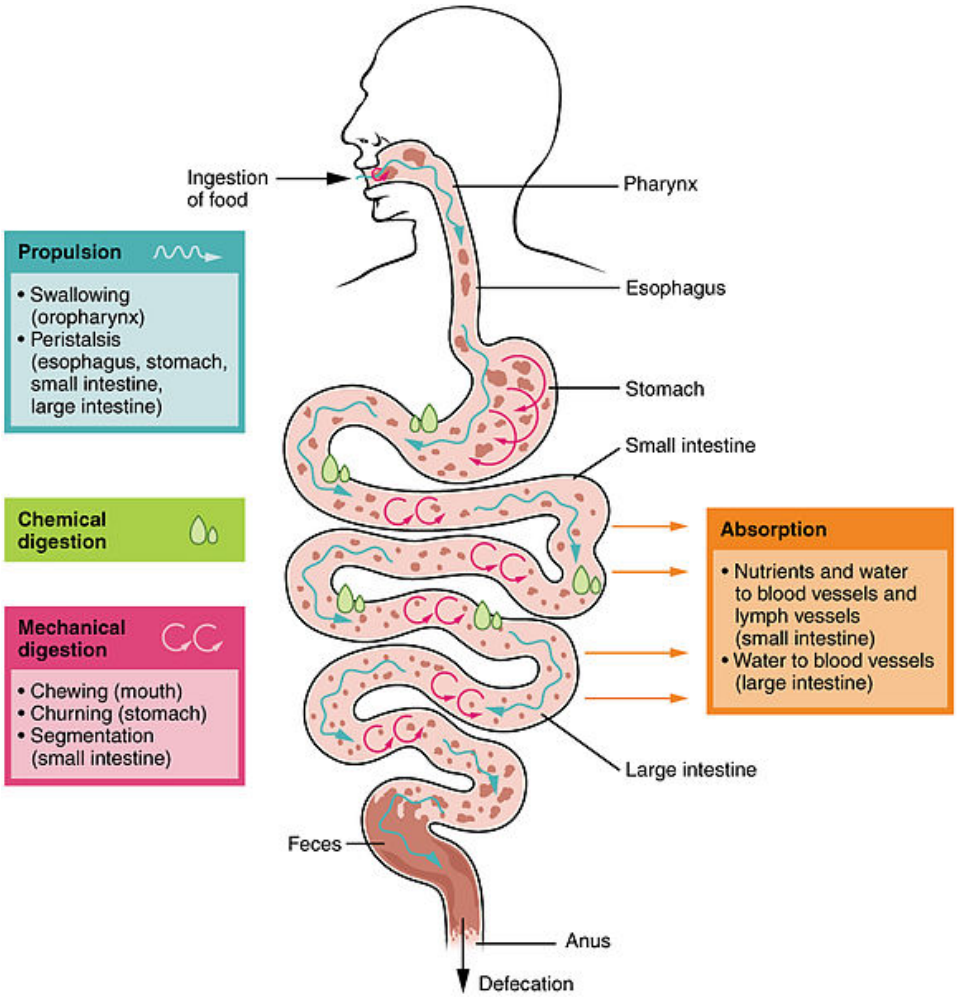


Figure 11.14 Digestive Processes

INGESTION

Ingestion refers to the entry of food through the mouth where it is chewed and mixed with saliva. Saliva contains enzymes that begin breaking down the

carbohydrates and fats in the food. Chewing produces a soft mass of food called a bolus that is an appropriate size for swallowing.[55,56,57]

PROPULSION

Food leaves the mouth when the tongue and pharyngeal muscles propel it into the esophagus. This act of swallowing is an example of propulsion, which refers to the movement of food through the digestive tract. It includes both the voluntary process of swallowing and the involuntary process of peristalsis. Peristalsis consists of sequential, alternating waves of contraction and relaxation of alimentary wall smooth muscles, which act to propel food. See Figure 11.15[58] for an illustration of peristalsis. Peristaltic waves also play a role in mixing food with digestive juices. Peristalsis is so powerful that swallowed foods and liquids enter the stomach even if you are standing on your head.[59,60,61]

55. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

56. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

57. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

58. "2404_PeristalsisN.jpg" by OpenStax College is licensed under CC BY 3.0

59. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

60. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

61. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

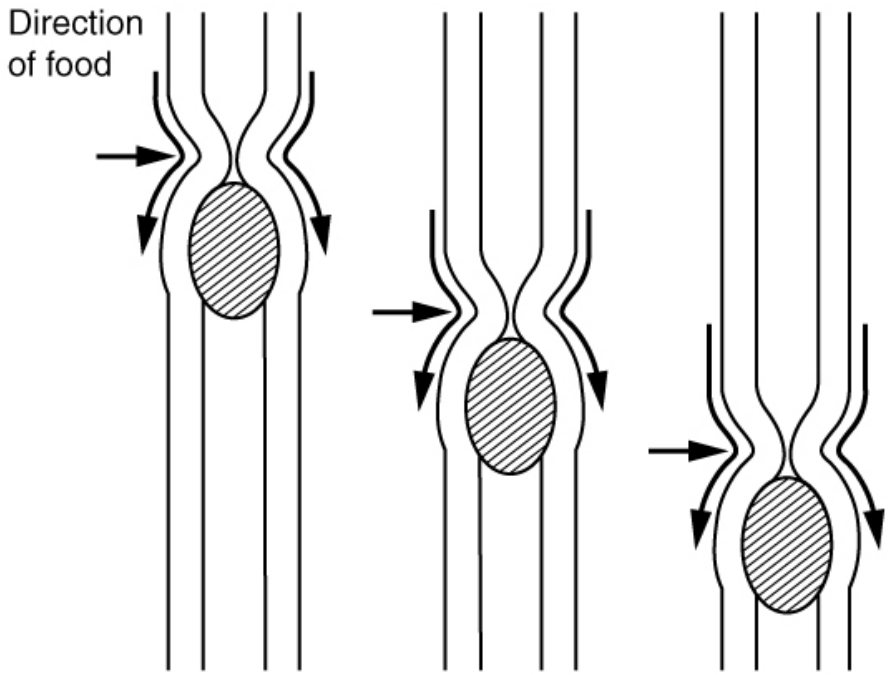


Figure 11.15 Peristalsis

MECHANICAL DIGESTION

Mechanical digestion is a physical process that does not change the chemical nature of the food but makes it smaller to increase its surface area and mobility. Mechanical digestion starts with chewing and then progresses to mechanical churning of food in the stomach. In the stomach, the bolus of food further breaks apart, allowing for more surface area to be exposed to the digestive juices of chemical digestion. Mechanical digestion also occurs in the small intestine, but to a lesser extent than what occurs in the stomach.[62,63,64]

62. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

63. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

64. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

CHEMICAL DIGESTION

Chemical digestion begins in the mouth and is completed in the small intestine. Digestive secretions contain water, enzymes, acids, and salts that create an acidic "soup" that breaks down food molecules into their chemical building blocks. For example, proteins are broken down into amino acids.[65,66,67]

ABSORPTION

Nutrients are substances that provide nourishment to cells. After food molecules have been broken down during chemical digestion, nutrients enter the bloodstream through the process of absorption. Absorption takes place primarily in the small intestine.[68,69,70]

DEFECATION

During defecation, the final step in digestion, undigested materials are removed from the body as feces. The process of defecation begins when

65. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

66. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

67. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

68. Ernstmeyer, K., & Christman, E. (Eds.). (2024). *Medical terminology 2e*. Open RN | WisTech Open. https://wtcs.pressbooks.pub/medterm/

69. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

70. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

mass movements, strong contractions that quickly move undigested materials, force feces from the colon into the rectum, stretching the rectal wall and provoking the defecation reflex, which eliminates feces from the rectum. This parasympathetic reflex is mediated by the spinal cord. It contracts the sigmoid colon and rectum, relaxes the internal anal sphincter, and initially contracts the external anal sphincter. Figure 11.16[71] reviews the anatomy of the rectum and its external and internal sphincters. The presence of feces in the anal canal sends a signal to the brain, which gives the person the choice of voluntarily opening the external anal sphincter (defecating) or keeping it temporarily closed. If defecation is delayed until a more convenient time, it takes a few seconds for the reflex contractions to stop and the rectal walls to relax. The next mass movement will trigger additional defecation reflexes until defecation occurs.[72,73,74]

71. "Anorectum.gif" by U.S. Government, National Institutes of Health is licensed under CC0

72. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

73. Patricia, J. J., & Dhamoon, A. S. (2022). *Physiology, Digestion*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK544242/

74. Azzouz, L. L., & Sharma, S. (2023). *Physiology, Large Intestine*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK507857/

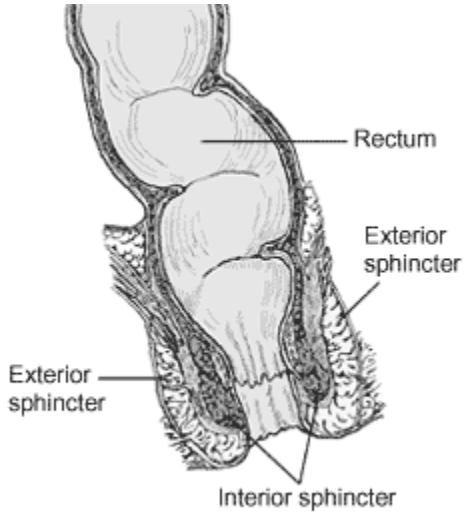


Figure 11.16 Anatomy of the Rectum

If defecation is delayed for an extended time, additional water is absorbed, making the feces firmer and potentially leading to constipation. Alternatively, if the waste matter moves too quickly through the intestines, not enough water is absorbed, and diarrhea can result. Figure 11.17[75] demonstrates the Bristol Stool Chart that is used to assess stool characteristics, ranging from very constipated to diarrhea.

75. "BristolStoolChart.png" by Cabot Health, Bristol Stool Chart is licensed under CC BY-SA 3.0

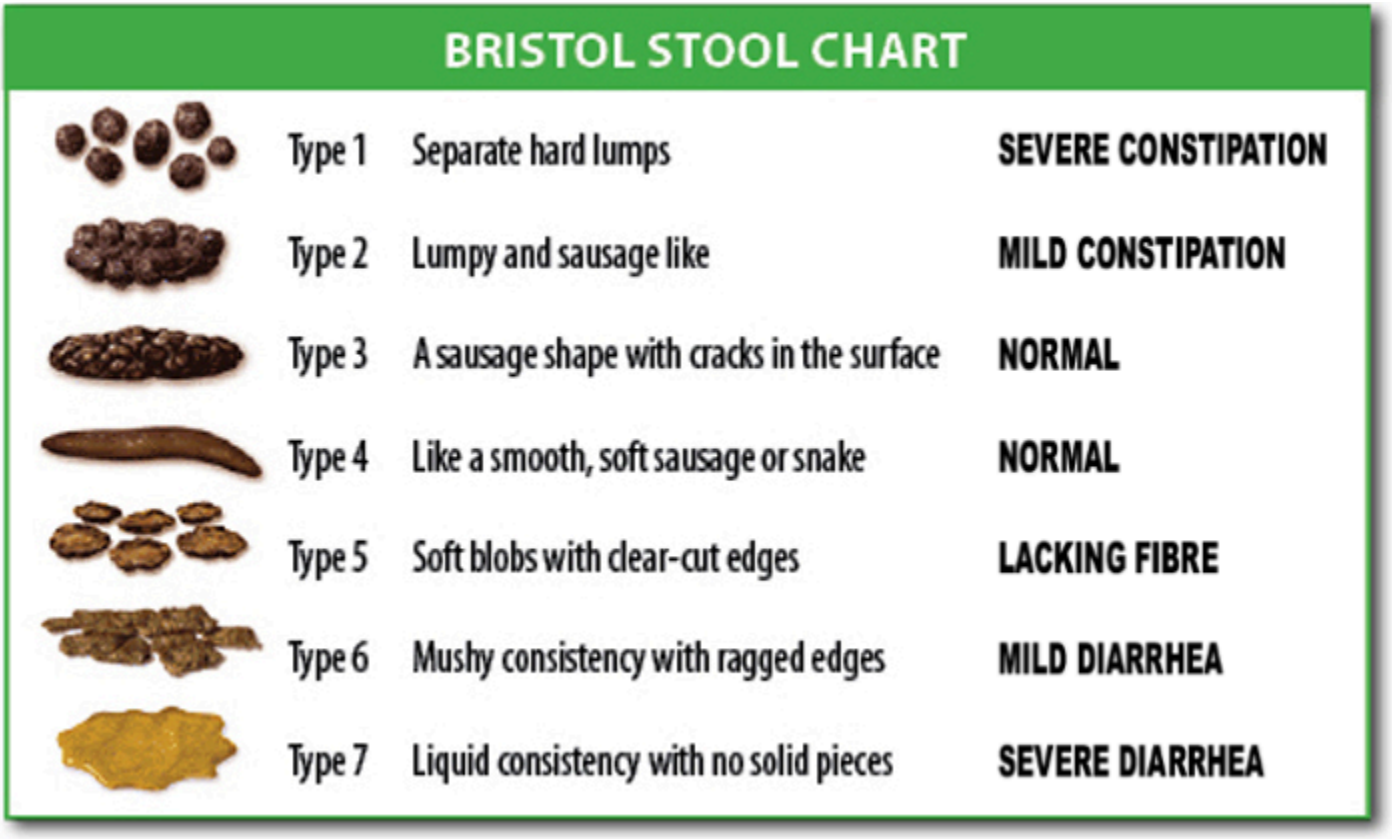


Figure 11.17 Bristol Stool Chart

11.3 General Assessment of the Gastrointestinal System

When evaluating a client with a potential gastrointestinal disorder, the nurse must pay special attention to their particular risk factors, as well as the influence of their cultural beliefs and socioeconomic factors. All these factors may affect their overall gastrointestinal health, as well as their response to treatment.

Risk Factors

There are several risk factors that, when present, can contribute to the development of gastrointestinal (GI) disorders, including the following[1,2,3,4,5]:

- Diet can play a large role in the development of gastrointestinal disorders.

1. Cleveland Clinic. (n.d.). *Gastrointestinal diseases*. https://my.clevelandclinic.org/health/articles/7040-gastrointestinal-diseases
2. Dumic, I., Nordin, T., Jecmenica, M., Stojkovic Lalosevic, M., Milosavljevic, T., & Milovanovic, T. (2019). Gastrointestinal Tract Disorders in Older Age. *Canadian journal of gastroenterology & hepatology*, 2019, 6757524. https://doi.org/10.1155/2019/6757524
3. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
4. Bode, C., & Bode, J. C. (1997). Alcohol's role in gastrointestinal tract disorders. *Alcohol health and research world*, 21(1), 76–83. https://pmc.ncbi.nlm.nih.gov/articles/PMC6826790/
5. Rohr, M. W., Narasimhulu, C. A., Rudeski-Rohr, T. A., & Parthasarathy, S. (2020). Negative effects of a high-fat diet on intestinal permeability: A review. *Advances in nutrition*, 11(1), 77–91. https://doi.org/10.1093/advances/nmz061

For instance, a low-fiber diet puts the client at risk for constipation, as well as diverticulosis. The use of alcohol can contribute to gastroesophageal reflux disease and can lead to impaired nutrition absorption and increased incidence of diarrhea, as well as the risk of esophageal cancer. Diets high in fat have also been linked to inflammatory bowel disease, as well as the immune health of the gastrointestinal system.

- Inactivity puts the client at risk for constipation due to reduced GI motility. Inactivity also promotes obesity, which is a risk factor for a variety of gastrointestinal disorders.
- The use of certain medications such as iron supplements and opioids can contribute to constipation.
- A family history of GI disorders can put the client at elevated risk. For instance, colon cancer and inflammatory bowel disease tend to run in families.
- Age is also a significant risk factor. The elderly undergo a number of physiologic changes that predispose them to gastrointestinal issues. For instance, elderly clients tend to experience alterations in taste, which may put them at risk for malnutrition. Elderly clients have a reduction in LES pressure, predisposing them to gastroesophageal disease. Additionally, they also have a reduction in blood flow to the stomach and decreased protective systems, putting them at greater risk for peptic ulcer disease.
- Stress resulting from acute illnesses and burns can contribute to the development of peptic ulcer disease.

Cultural Factors

A variety of cultural factors can also influence health and illness as it relates to the gastrointestinal tract. A client's ethnic heritage can affect how a gastrointestinal disorder presents. For instance, African Americans with inflammatory bowel disease tend to have more complex GI disorders and suffer from more complications when compared to other ethnicities. Food also plays a significant role in cultural traditions and can, therefore, affect the gastrointestinal system. For example, clients who are vegan avoid the ingestion of animal products. Therefore, nurses must take cultural beliefs into

account when counseling the client on dietary intake as it relates to a particular disorder.[6]

Client terminology and language can also be important when assessing the client's gastrointestinal system. Bloating is a common symptom of many GI disorders; however, this term does not translate well in many languages. Therefore, clients whose primary language is other than English may use the word "distention" instead. Clients may also treat their gastrointestinal ailments with complementary or alternative medications, so nurses must assess for the use of these treatments, in addition to mainstream medications.[7]

Cultural beliefs regarding family structure can also impact gastrointestinal health. Some clients have a wide network of extended family members they can rely on as a support system, whereas other clients have a smaller nuclear family with less social support available. Studies have shown that clients who have more family support tend to rate their symptoms as less distressing than those who do not have the same level of family support.[8]

A client's culture can have a significant impact on their health care outcomes. As health care professionals, we must demonstrate cultural

6. Francisconi, C. F., Sperber, A. D., Fang, X., Fukudo, S., Gerson, M-J., Kang, J-Y., & Schmulson, M. (2016). Multicultural aspects in functional gastrointestinal disorders (FGIDs). *Gastroenterology, 150*(6), 1344-1354. https://doi.org/10.1053/j.gastro.2016.02.013

7. Francisconi, C. F., Sperber, A. D., Fang, X., Fukudo, S., Gerson, M-J., Kang, J-Y., & Schmulson, M. (2016). Multicultural aspects in functional gastrointestinal disorders (FGIDs). *Gastroenterology, 150*(6), 1344-1354. https://doi.org/10.1053/j.gastro.2016.02.013

8. Francisconi, C. F., Sperber, A. D., Fang, X., Fukudo, S., Gerson, M-J., Kang, J-Y., & Schmulson, M. (2016). Multicultural aspects in functional gastrointestinal disorders (FGIDs). *Gastroenterology, 150*(6), 1344-1354. https://doi.org/10.1053/j.gastro.2016.02.013

humility and ask about and respect client's cultural values, perspectives, and beliefs.

Socioeconomic Factors

Socioeconomic factors refer to things like education levels, employment, access to health care, and access to healthy food. All these factors can directly impact the health of individuals and must be taken into account when assessing the gastrointestinal system. For example, individuals with less education may have difficulty obtaining a well-paying job with health insurance. They may be unable to afford medications required to manage chronic gastrointestinal conditions. Limited access to health care can also prevent them from obtaining a recommended health care screening like a colonoscopy, causing a delay in diagnosis and treatment of gastrointestinal disorders. Limited access to dental care can cause chronic issues with dental pain or difficulty chewing that impact oral intake and can result in poor nutrition.[9]

Food insecurity, a lack of food due to financial or other resources, is a risk factor for developing many chronic diseases and can make it difficult for clients to follow recommended dietary plans due to a lack of access to various food options. Nurses assess the impact of potential socioeconomic factors as a holistic approach to health care and address these factors in the nursing care plan to help the client achieve optimal health care outcomes.[10]

9. Division for Heart Disease and Stroke Prevention. (2023). *Socioeconomic factors. Centers for Disease Control and Prevention.* https://www.cdc.gov/nccdphp/priorities/index.html

10. Division for Heart Disease and Stroke Prevention. (2023). *Socioeconomic factors. Centers for Disease Control and Prevention.* https://www.cdc.gov/nccdphp/priorities/index.html

Assessment

Health History

A focused gastrointestinal subjective assessment collects data about the signs and symptoms of GI diseases, including any digestive or nutritional issues, relevant medical or family history of GI diseases, and any current treatment for related issues. Table 11.3 outlines interview questions used to explore medical and surgical history, symptoms related to the gastrointestinal system, and associated medications. Information gained from the interview process is used to tailor the subsequent physical assessment and create a plan for client care and education.[11]

Table 11.3. Interview Questions for Subjective Assessment of GI System[12]

11. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

12. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

Interview Questions	Follow-up
Have you ever been diagnosed with a gastrointestinal (GI) condition?	Please describe the conditions and treatments.
Have you ever had abdominal surgery?	Please describe the surgery and if you experienced any complications.
Are you currently taking any medications, herbs, or supplements?	Please describe.
Do you have any abdominal pain?	Are there any associated symptoms with the pain such as fever, nausea, vomiting, or change in bowel pattern? Are you having bloody stools (hematochezia); dark, tarry stools (melena); abdominal distention; or vomiting of blood (hematemesis)? When did the pain start to occur? (Onset) Where is the pain? (Location) When it occurs, how long does the pain last? (Duration) Can you describe what the pain feels like? (Characteristics) What brings on the pain? (Aggravating factors) What relieves the pain? (Alleviating factors) Does the pain radiate anywhere? (Radiation) What have you used to treat the pain? (Treatment) What effect has the pain had on you? (Effects) How severe is the pain from 0-10 when it occurs? (Severity)
Have you had any issues with nausea, vomiting, food intolerance, heartburn, ulcers, change in appetite, or weight?	Please describe. What treatment did you use for these symptoms? What is your typical diet in a 24-hour period?
Do you have any difficulty swallowing food or liquids (dysphagia)?	Please describe. Have you ever been diagnosed with a stroke or transient ischemic attack (TIA)?
When was your last bowel movement?	Describe your usual bowel pattern. Have there been any changes in pattern or consistency of your stool? Are you passing any gas?

Have you had any issues with constipation or diarrhea?	Please describe. How long have you had these issues? What treatment did you use for these symptoms? If constipation: • Has constipation been a problem for you throughout your life? • How frequently do you usually have a bowel movement? If diarrhea: • Are your stools watery, or is there some form to them? • How many episodes of diarrhea have you had in the past 24 hours?

Pain is the most common complaint related to abdominal problems and can be attributed to multiple underlying etiologies. Because of the potential variability of contributing factors, a thorough assessment of this common chief complaint should occur. Additional questions include asking if the client has bloody stools (**hematochezia**); dark, tarry stools (**melena**); bloating (abdominal distention); or vomiting of blood (**hematemesis**).[13]

Nausea, vomiting, diarrhea, and constipation are common issues experienced by hospitalized clients due to side effects of medications or medical procedures. Nausea is the unpleasant sensation of having the urge to vomit, and vomiting (emesis) is the forceful oral expulsion of gastric

13. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

contents.[14] There are many potential causes of nausea and vomiting, such as the following[15]:

- Morning sickness during pregnancy
- Gastroenteritis and other infections
- Migraines
- Motion sickness
- Food poisoning
- Side effects of medicines, including those for cancer chemotherapy
- GERD and ulcers
- Intestinal obstruction
- Poisoning or exposure to a toxic substance
- Diseases of other organs (cardiac, renal, or liver)

Nausea and vomiting are common and are usually not serious. However, the health care provider should be contacted immediately if the following conditions occur[16]:

- Vomiting for longer than 24 hours
- Blood in the vomit (**hematemesis**)
- Severe abdominal pain
- Severe headache and stiff neck
- Signs of dehydration, such as dry mouth, infrequent urination, or dark

14. Bashashati, M., & McCallum, R. (2014). Neurochemical mechanisms and pharmacologic strategies in managing nausea and vomiting related to cyclic vomiting syndrome and other gastrointestinal disorders. *European Journal of Pharmacology, 772*, 79. https://doi.org/10.1016/j.ejphar.2013.09.075

15. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

16. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing pharmacology – 2e*. Open RN. https://wtcs.pressbooks.pub/pharmacology2e/

urine

If a client is experiencing vomiting or diarrhea, nurses should assess for signs of dehydration or electrolyte imbalances. Dehydration can be indicated by dry skin, dry mucous membranes, or sunken eyes. These symptoms may require prompt notification of the health care provider for further treatment.[17]

> Read additional information about fluid and electrolyte imbalances in the "Fluids and Electrolytes" chapter in Open RN *Nursing Fundamentals, 2e*.

Additional specialized assessments of GI system function can include examination of the oropharynx and esophagus. For example, clients who have experienced a cerebrovascular accident (CVA), also called a stroke, may experience difficulty swallowing (**dysphagia**). The nurse is often the first to notice these difficulties in clients who are swallowing pills, liquid, or food and can advocate for treatment to prevent complications, such as **aspiration pneumonia**.[18]

Physical Assessment

In preparation for the physical assessment, the nurse should create an environment in which the client will be comfortable. Encourage the client to

17. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

18. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

empty their bladder prior to the assessment. Warm the room and stethoscope to decrease tensing during assessment.[19]

Physical examination of the abdomen includes inspection, auscultation, palpation, and percussion. Note that the order of physical assessment differs for the abdominal system compared to other systems. Palpation should occur after the auscultation of bowel sounds so that accurate, undisturbed bowel sounds can be assessed. The abdomen is divided into several abdominopelvic quadrants, as illustrated in Figure 11.18.[20] When assessing the abdomen, the nurse considers the organs located in the quadrant being examined.[21]

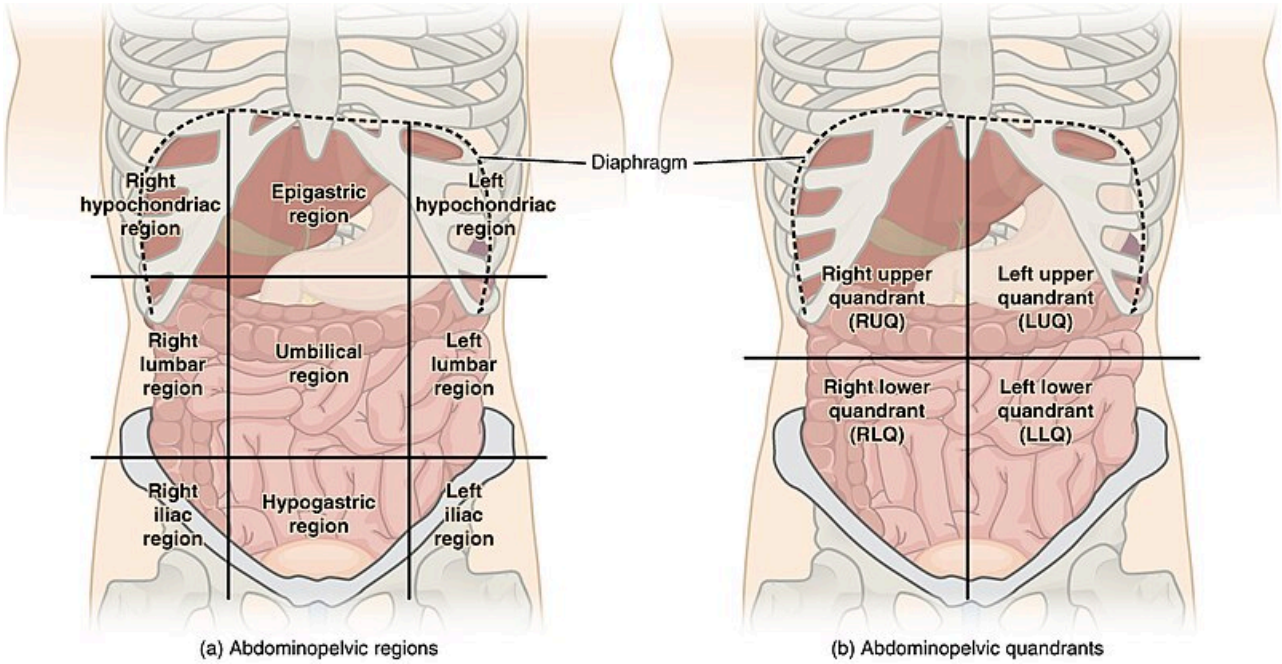


Figure 11.18 Abdominopelvic Quadrants

19. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

20. "Abdominal_Quadrant_Regions.jpg" by OpenStax is licensed under CC BY 3.0

21. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

INSPECTION

The abdomen is inspected by positioning the client supine on an examining table or bed. The head and knees should be supported with small pillows or folded sheets for comfort and to relax the abdominal wall musculature. The client's arms should be at their side and not folded behind their head because this position tenses the abdominal wall. Visually examine the abdomen for overall shape, masses, skin abnormalities, and any abnormal movements[22]:

- Observe the general contour and symmetry of the entire abdominal wall. The contour of the abdomen is often described as flat, rounded, **scaphoid** (sunken), or protuberant (convex or bulging).
- Assess for **distention**. Generalized distention of the abdomen can be caused by obesity, bowel distention from gas or liquid, or fluid buildup.
- Assess for masses or bulges, which may indicate structural deformities like hernias or be related to disorders in abdominal organs.
- Assess the skin for uniformity of color, integrity, scarring, or striae. **Striae** are white or silvery elongated marks that occur when the skin stretches, especially during pregnancy or excessive weight gain.
- Note the shape of the umbilicus; it should be inverted and midline.
- Carefully note any scars and correlate these scars with the client's recollection of previous surgeries or injury.
- Document any abnormal movement or pulsations. Visible intestinal peristalsis can be caused by intestinal obstruction. Pulsations of the aorta may be seen in the epigastric area in clients who are especially thin, but otherwise should not be observed. The presence of a strong pulsating mass could indicate an aortic abdominal aneurysm.[23]

22. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

23. de Boer, N. J., Knaap, S. F. C., & de Zoete, A. (2010). Clinical detection of abdominal aortic aneurysm in a 74-year-old man in chiropractic practice.

AUSCULTATION

Auscultation follows inspection for accurate assessment of bowel sounds. Use a warmed stethoscope to assess the frequency and characteristics of the client's bowel sounds, which are also referred to as peristaltic murmurs.[24]

Begin the assessment by gently placing the diaphragm of the stethoscope on the right lower quadrant (RLQ) because bowel sounds are consistently heard in that area. Bowel sounds are generally high-pitched, gurgling sounds that are heard irregularly. The stethoscope is moved to the next quadrant in a clockwise motion around the abdominal wall.[25]

It is not recommended to count abdominal sounds because the activity of normal bowel sounds may cycle with peak-to-peak periods as long as 50 to 60 minutes. The majority of peristaltic murmurs are produced by the stomach, with the remainder from the large intestine and a small contribution from the small intestine. Because the conduction of peristaltic murmur is heard throughout all parts of the abdomen, the source of peristaltic murmur is not always at the site where it is heard.[26]

Hyperactive bowel sounds may indicate bowel obstruction or gastroenteritis. Sometimes a client's bowel sounds can be heard without a stethoscope (**borborygmus**), often described as "stomach growling." This is a common example of hyperactive sounds. Hypoactive bowel sounds may be present with constipation, after abdominal surgery, peritonitis, or paralytic ileus. As the abdomen is auscultated, vascular sounds should not be heard,

Journal of Chiropractic Medicine, 9(1), 38-41. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3081239/

24. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

25. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

26. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

such as a bruit. Vascular sounds should be reported to the health care provider.[27]

PALPATION

Palpation of the abdomen involves using the flat of the hand and fingers (not the fingertips) to detect palpable organs, abnormal masses, or tenderness. If a client is reporting abdominal pain, that area should be palpated last. Light palpation is primarily used by bedside nurses to assess for musculature, abnormal masses, and tenderness. During light palpation, the skin of the abdomen is pressed about one centimeter beginning in the right lower quadrant, and then palpation is moved around the abdomen in a clockwise manner. Deep palpation is a technique used by advanced practice clinicians to assess for enlarged organs.

When palpating the abdomen, note the client's response, such as guarding, rigidity, or rebound tenderness. **Voluntary guarding** refers to voluntary contraction of the abdominal wall musculature, usually the result of fear, anxiety, or the touch of cold hands. **Involuntary guarding** is the reflexive contraction of overlying abdominal muscles as the result of peritoneal inflammation. **Rigidity** refers to involuntary contraction of the abdominal musculature in response to peritoneal inflammation, a reflex the client cannot control. **Rebound tenderness** is a sign of peritoneal inflammation. To elicit rebound tenderness, the clinician maintains pressure over an area of tenderness and then withdraws the hand abruptly. If the client winces with pain upon withdrawal of the hand, the test is positive.[28]

27. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

28. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

PERCUSSION

Percussion is typically performed by advanced practice registered nurses or other health care providers to assess the size of the liver and spleen or to determine if costovertebral angle (CVA) tenderness is present, a sign of inflammation of the kidney. Percussion can also indicate the presence of fluid or gas because the sound made during percussion changes based on density. For instance, tympanic sounds indicate the presence of gas or fluid, and dull sounds are heard over dense organs. The change in expected sounds heard during percussion can indicate abnormalities. For instance, the intestines normally elicit tympanic sounds. However, if dullness is heard while percussing the skin over the intestines, it can indicate that increased stool or a mass is present.[29]

Common Laboratory and/or Diagnostic Tests

Laboratory and/or diagnostic testing is often ordered by health care providers to help aid in the diagnosis of gastrointestinal alterations. Although each GI disorder described later in this chapter will specify typical labs and/or diagnostic tests used to diagnose that specific condition, this section will provide a general overview of common gastrointestinal diagnostic tests, including the categories of lab tests, imaging, and endoscopy.

LABORATORY TESTS

Common lab tests used to assess the gastrointestinal system are a complete

29. Lapum, J., Hughes, M., St-Amant, O., Garcia W., Verkurl, M. Petrie, P., Dimaranan, F., Permansani, M. & Savicevic, N.(2019). *Physical examination techniques: A nurse's guide*. Open Library. https://pressbooks.library.torontomu.ca/ippa/chapter/percussion/

blood count, a comprehensive metabolic panel, stool studies, serum lipase, and inflammatory markers[30,31,32,33,34,35,36,37]:

- A complete blood count (CBC) measures the levels of red blood cells, white blood cells, hemoglobin, hematocrit, and platelets in the blood. In cases of GI dysfunction, any of these values could be abnormal. For instance, if a client has peptic ulcer disease and a bleeding ulcer, they may become anemic due to blood loss, reflected by decreased red blood

30. Johns Hopkins Medicine. (n.d.). *Digestive diagnostic procedures*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/digestive-diagnostic-procedures
31. Mayo Clinic. (2023). *Complete blood count (CBC)*. https://www.mayoclinic.org/tests-procedures/complete-blood-count/about/pac-20384919
32. McDowell, C., Farooq, U., Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/
33. Cleveland Clinic. (n.d.). *Comprehensive metabolic panel (CMP)*. https://my.clevelandclinic.org/health/diagnostics/22058-comprehensive-metabolic-panel-cmp
34. MedlinePlus [Internet]. (2023). *Ova and parasite test*. https://medlineplus.gov/lab-tests/ova-and-parasite-test/
35. Pirahanchi, Y., Sharma, S. (2023). *Biochemistry, Lipase*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK537346/
36. Cleveland Clinic. (n.d.). *C-reactive protein (CRP) test*. https://my.clevelandclinic.org/health/diagnostics/23056-c-reactive-protein-crp-test
37. MedlinePlus [Internet]. (2022). *Erythrocyte sedimentation rate (ESR)*. https://medlineplus.gov/lab-tests/erythrocyte-sedimentation-rate-esr/

cells, hemoglobin, and hematocrit. Additionally, poor nutritional intake due to a chronic gastrointestinal condition can cause anemia. If a client has an infectious or inflammatory condition, such as appendicitis, white blood cells are typically elevated. Abnormal platelet levels may be seen in clients with inflammatory bowel disease.

- A comprehensive metabolic panel (CMP) can be helpful in assessing gastrointestinal conditions by analyzing bilirubin, liver enzymes, albumin, and electrolyte levels. Bilirubin levels and liver enzymes may be altered with pancreatic, gallbladder, or liver disorders. Albumin levels may be decreased in cases of malnutrition due to reduced intake or poor absorption of nutrients. Electrolyte levels, particularly potassium, may be decreased with diarrhea or vomiting.
- A variety of stool studies can be used to evaluate for the presence of blood, bacteria, or parasites in the stool. A fecal occult blood test involves placing feces on a testing card and applying a chemical that detects blood not visible to the naked eye. See Figure 11.19[38] for an example of a stool testing card. The stool sample is compared to the control window to determine if blood is present. Stool can also be cultured to check for the presence of specific bacteria. An example of a common stool culture is testing for *Clostridium difficile* (C. diff). Stool can also be examined under a microscope to look for the presence of ova and/or parasites.
- Serum lipase evaluates levels of lipase, an enzyme that breaks down fats. Elevated levels can be seen with pancreatic disorders.
- Two common inflammatory markers are C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR). CRP is released by the liver in response to inflammation. Although CRP is not specific, meaning the test does not show the source of the inflammation, it can be useful in assessing the extent of inflammation in the body. CRP levels are commonly elevated in inflammatory bowel disease. ESR is also a blood test that can measure levels of inflammation in the body. Like CRP, ESR

38. "Fecal_Occult_Blood_Test.jpg" by Ajay Kumar Chaurasiya is licensed under CC BY-SA 4.0

does not show the source of the inflammation, but it may be helpful in monitoring inflammatory conditions, such as inflammatory bowel disease.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."



Figure 11.19 Stool Testing Card for a Fecal Occult Blood Test

DIAGNOSTIC TESTING

Common imaging techniques used to assess the gastrointestinal system are X-rays, CT scans, MRI, MRCP, ultrasound, and barium studies[39,40,41,42,43,44]:

- **Abdominal X-ray:** An abdominal X-ray is an imaging exam that can be used to look for sources of abdominal pain. They can also be used to assess for blockages, masses, ingestion of foreign objects, or perforations in the intestine. They can be taken in a variety of positions (standing, lying, or side lying) and can provide basic information about abdominal organs.
    - Nursing considerations for an abdominal X-ray include ensuring that the client removes anything that may interfere with the exam. The client may be asked to remove their jewelry and put on a gown. The

39. Johns Hopkins Medicine. (n.d.). *Digestive diagnostic procedures*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/digestive-diagnostic-procedures

40. Johns Hopkins Medicine. (n.d.). *Abdominal x-ray*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/abdominal-x-ray

41. Johns Hopkins Medicine. (n.d.). *Computed tomography (CT or CAT) scan of the abdomen*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/computed-tomography-ct-or-cat-scan-of-the-abdomen

42. MedlinePlus [Internet]. (2022). *Abdominal MRI scan*. https://medlineplus.gov/ency/article/003796.htm

43. Cleveland Clinic. (n.d.). *Magnetic resonance cholangiopancreatography (MRCP)*. https://my.clevelandclinic.org/health/diagnostics/24457-magnetic-resonance-cholangiopancreatography-mrcp

44. Mayo Clinic. (2022). *Abdominal ultrasound*. https://www.mayoclinic.org/tests-procedures/abdominal-ultrasound/about/pac-20392738

nurse should educate the client to stay still during the X-ray and ensure that any parts of the body that are not being imaged are covered with a lead apron to protect against incidental X-ray exposure. X-rays should not be completed on those who are pregnant as the radiation can cause birth defects.

- **Abdominal CT Scan:** An abdominal CT scan is an imaging exam that combines the use of X-rays with computer equipment to provide detailed images of the body part that is being scanned. CT scans may be completed with or without the use of contrast, which is given orally or intravenously. When contrast is used, the body part that is being examined can be seen better than when contrast is not used. An abdominal CT scan can be done to look for causes of abdominal pain, bowel obstructions, tumors or masses, infections, or bleeding into the abdomen. A CT scan is often done when enough detail is not seen on a traditional X-ray, or the results are inconclusive.
    - Nursing considerations for an abdominal CT scan consist of assessing the client for allergies to contrast media, as well as kidney issues, as contrast dye is known to be nephrotoxic. Those who receive contrast should be encouraged to drink adequate fluids after the exam to help rid the body of the contrast. Nurses must also educate clients who take metformin about the risks associated with combining this medication with contrast media. Clients may be told to temporarily stop this medication. Prior to the exam, clients will be asked to remove their jewelry and change into a gown. Lastly, the client may need to be **NPO** prior to the CT scan. During the exam, the client will be encouraged to stay still.

- **Magnetic Resonance Imaging (MRI):** MRI is an imaging technique that uses a combination of strong magnets and radio waves to produce in-depth views of the body. Contrast dye may or may not be used with an MRI. An MRI can provide even more detail than a CT scan and does not use radiation. An MRI of the abdomen can be performed to assess for masses, infections, or causes of abdominal pain. It can also assess the

lymph nodes and blood vessels of the abdomen.

- Nursing considerations for an MRI include ensuring the client does not have any metal on or implanted within their body prior to entering the exam room due to the use of magnets. Although this list is not inclusive, clients with pacemakers, aneurysm clips, and certain implants may not be able to have an MRI performed. The client will need to change into a hospital gown that does not have any metal on it. Prior to the MRI, for better visualization of the GI tract, the client may need to be NPO. The client should also be encouraged to stay still during the exam. If contrast dye will be used, kidney function and allergies should be assessed first. Lastly, clients with claustrophobia may need to be sedated prior to receiving an MRI as it is an enclosed space. See Figure 11.20[45] for a photo of an MRI machine.

45. "23423505123_0228d6749c_o" by unknown author for National Institute of Mental Health, National Institutes of Health is in the Public Domain.



Figure 11.20 Client Undergoing an MRI

- **Magnetic Resonance Cholangiopancreatography (MRCP):** MRCP uses an MRI with contrast to examine the bile ducts. This can be helpful to assess disorders of the gallbladder, pancreas, or liver. Nursing considerations are similar to that for an MRI.
- **Ultrasound:** An ultrasound uses sound waves to create images of the body. During an ultrasound, ultrasound gel is placed on the area of the body to be visualized, and a transducer is then placed over it. The transducer emits sound waves that echo off organs to create an image on the computer screen. An abdominal ultrasound can be used to assess for causes of abdominal pain, masses, liver issues, and gallbladder or pancreatic disorders. An ultrasound can be a helpful assessment tool for those individuals who cannot undergo imaging procedures that use radiation, such as pregnant women. They are also helpful as a quick diagnostic tool. Please see Figure 11.21[46] for an image of a client

undergoing an abdominal ultrasound.

- Nursing considerations for an abdominal ultrasound include ensuring that the client removes anything that may interfere with the exam. The client may be asked to remove their jewelry and put on a gown. The client may need to be NPO prior to the ultrasound.



Figure 11.21 Client Receiving an Abdominal Ultrasound

- **Barium Studies:** Barium studies consist of a **barium enema** (also known as a lower GI series) and a **barium swallow** (also known as an upper GI series). The use of barium, which shows up as white on X-rays, allows for better visualization of the GI tract when compared to a regular X-ray. With a barium enema, barium is inserted into the rectum via an enema, and

46. "330-CFD-DF-SD-04-07421.jpeg" by SRA Stephen Schester, USAF for Combined Military Service Digital Photographic Files is licensed in the Public Domain.

then a series of X-rays are taken. This test allows for visualization of strictures or obstructions in the rectum, large intestine, or the most distal part of the small intestine. With a barium swallow, barium is ingested via the mouth, and then a series of X-rays are taken. With this imaging modality, the esophagus, stomach, and the initial part of the small intestine can be assessed.[47]

- Nursing considerations for a barium enema consist of educating the client on any necessary dietary restrictions prior to the exam. Generally, the client will need to be on a clear liquid diet the day prior, as well as be nothing by mouth after midnight. To clear the intestine of feces to enhance imaging, the client will need to take medications to help clear the bowel prior to the exam. After the exam, the client should be encouraged to drink fluids and eat foods that are high in fiber to help eliminate the remaining barium from the body. Initial stools may appear light in color due to the presence of barium.
- Nursing considerations for a barium swallow also consist of educating the client on any necessary dietary restrictions prior to the exam. An NPO order (nothing by mouth) is often implemented at midnight prior to the exam. Similar to a barium enema, the client will also need to consume adequate fluids and fiber to help the barium be excreted from the body after the exam.

47. Johns Hopkins Medicine (n.d.). *Barium x-rays (upper and lower GI)*. https://www.hopkinsmedicine.org/health/conditions-and-diseases/barium-xrays-upper-and-lower-gi

Endoscopy

Common endoscopy procedures used to assess the gastrointestinal system are colonoscopy, EGD, ERCP, and capsule endoscopy[48,49,50,51,52,53]:

- **Colonoscopy:** A colonoscopy refers to the insertion of a scope into the rectum to visualize the entire colon. It is used to visualize abnormal tissue growths, inflamed areas, gastrointestinal bleeding, and ulcers. During a colonoscopy, the provider can also take tissue samples to send for biopsies. The client will receive sedation for the procedure to ensure their comfort.
    - Nursing considerations for a colonoscopy consist of educating the client on the need for bowel preparation. To do this effectively, the client must be on a clear liquid diet for 24 or more hours prior to the

48. Johns Hopkins Medicine. (n.d.). *Digestive diagnostic procedures*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/digestive-diagnostic-procedures

49. Martin, P. (2024). *Colonoscopy*. https://nurseslabs.com/colonoscopy/

50. Ahlawat, R., Hoilat, G. J., & Ross, A. B. (2023). *Esophagogastroduodenoscopy*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK532268/

51. Meseeha, M., & Attia, M. (2023). *Endoscopic Retrograde Cholangiopancreatography*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493160/

52. Robertson, K. D., & Singh, R. (2023). *Capsule Endoscopy*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482306/

53. Johns Hopkins Medicine. (n.d.). *Upper GI endoscopy*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/upper-gi-endoscopy

exam and NPO (nothing by mouth) at midnight. The client must also complete the ordered laxative regimen per provider orders. The nurse will also ensure that the informed consent is completed prior to the procedure. During the colonoscopy, the nurse may assist with client positioning, monitoring of vital signs, and providing client support as needed. After the procedure, the nurse continues to monitor vital signs and for signs of colon perforation and any rectal bleeding.

- **Esophagogastroduodenoscopy (EGD):** An EGD, also referred to as an "upper GI endoscopy," is a procedure where a small tube is placed into a client's mouth and guided through the esophagus, stomach, and duodenum. It is completed to further assess client complaints of abdominal pain, difficulty swallowing, gastroesophageal reflux disease, blood in vomit, or gastrointestinal bleeding. An EGD is also commonly done to monitor certain conditions such as Barrett's esophagus, which is further discussed in the "Gastroesophageal Reflux Disease" section. During an EGD, the provider can also take tissue samples to send for biopsies, dilate strictures, remove foreign bodies, or treat areas that are bleeding. The client will receive sedation for the procedure to ensure their comfort.
    - Nursing considerations for an EGD consist of educating the client on the need for dietary modification prior to the exam. The client will need to be on a clear liquid diet and then NPO prior to the exam. The timing of these modifications will differ based on provider. The nurse will also ensure that the informed consent is completed prior to the procedure. During the EGD, the nurse may assist with client positioning, monitoring of vital signs, and providing client support as needed. After the procedure, the nurse continues to monitor vital signs and for signs of complications such as bleeding or bowel perforation. Due to a numbing spray that is used in the procedure, it may take some time for the client's gag reflex to return. The client should not eat or drink until this occurs.

View a supplementary YouTube video[54] on upper endoscopy: Upper endoscopy (EGD).

- **Endoscopic Retrograde Cholangiopancreatography (ERCP):** An ERCP is the process of inserting a scope into the client's mouth and then into the esophagus, stomach, and the first part of the small intestine. From there, other tools can then be inserted into the ducts of the biliary/pancreatic system, and tissue samples may be taken. Contrast dye may also be injected to allow for visualization of these ducts. An ERCP may be performed for clients who have stones in the bile duct, pancreatitis, pancreatic cancer, or strictures in the biliary system. The client will receive sedation for the procedure to ensure their comfort. See Figure 11.22[55] for an image of an ERCP.
    - Nursing considerations for an ERCP consist of educating the client on the need for dietary modification prior to the exam. The client will need to be NPO per provider order. If the client is undergoing an ERCP due to an obstruction in the biliary system, antibiotics may be ordered. During the ERCP, the nurse may assist with client positioning, monitoring of vital signs, and providing client support as needed. After the procedure, the nurse continues to monitor vital signs and for signs of complications such as pancreatitis, cholangitis (infection of the bile ducts), or biliary duct perforation.

54. Digestive Disease Specialists, Inc. (n.d.). *Upper endoscopy (EGD)* [Video]. Brightcove. All rights reserved. https://www.okddsi.net/upper-endoscopy

55. "640px-ERCP.png" by Drus1a is licensed under CC BY-SA 4.0

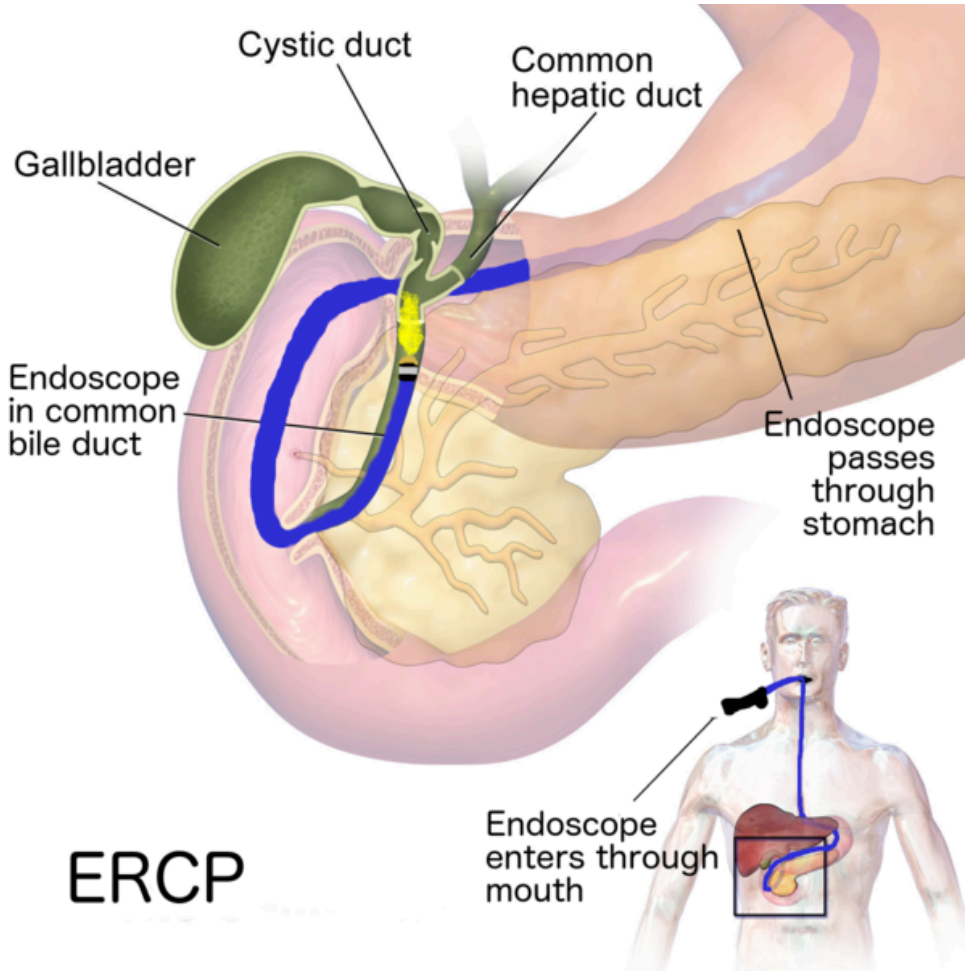


Figure 11.22 Endoscopic Retrograde Cholangiopancreatography (ERCP)

- **Capsule Endoscopy:** Capsule endoscopy is used to assess the small intestine as traditional scopes cannot assess the entire small intestine. With this procedure, the client will swallow a small pill containing a recording device. The pill will travel through the client's small intestine, collecting images as it passes through. As the pill travels through the digestive system, it sends data to a recorder that is secured externally on the client. This data will then later be reviewed by the provider to look for bleeding, abnormal tissue growth, ulcers, or the presence of inflammatory bowel disease that require additional testing such as a colonoscopy. The pill is then excreted in the stool, normally within 24 hours. Retention of the capsule can occur in those with strictures, obstructions, or fistulas and should not be performed on these clients. No sedation is required with this procedure. See Figure 11.23[56] for an image of a pill with a camera that can be used in a capsule endoscopy.

- Nursing considerations for a capsule endoscopy are similar to that of a colonoscopy, as the client will also need to modify their diet preprocedure and complete colon preparation with the use of laxatives. The nurse may also assist with fitting the recorder onto the client, as well as with ingestion of the pill camera. Lastly, the nurse should educate the client on when meal resumption can occur. Two hours after ingesting the device, the client can start a clear liquid diet. Four hours after ingestion, the client can have a meal.



Figure 11.23 Pill Camera Used in a Capsule Endoscopy

56. "ファイル:GivenimagingKK.JPG" by TMKO is licensed under CC BY 3.0

Life Span Considerations

When assessing infants, children, and older adults, the following life span considerations should be kept in mind[57,58,59]:

Infants and Children

- Eating and elimination patterns of infants require special consideration based on the stage of development. Ask parents about feeding habits. Is the baby being breastfed or formula fed? If formula fed, how does the child tolerate the formula?
- To assess for urine output in infants and toddlers, assess the frequency of wet diapers and the daily number of wet diapers. In hospitalized infants and toddlers, the diapers may be weighed for precise measurements of urine output. Urine output can be used to assess hydration status.
- Note that the expected abdominal contour of an infant is called **protuberant**, which means bulging. The expected abdominal contour of a child is protuberant until about the age of 4.
- Assess the umbilical cord of the neonate; it should dry and fall off on its own within two weeks of life.

57. Ernstmeyer, K., & Christman, E. (Eds.). (2023). *Nursing skills 2e*. Open RN. https://wtcs.pressbooks.pub/nursingskills/

58. National Academy of Sciences. (2010). Similarities and dissimilarities in physiology, metabolism, and disease states and responses to therapy in children and adults. In Yaffe, S. (Ed.), *Rational Therapeutics for Infants and Children: Workshop Summary* (pp. 14-33). National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK225509/

59. Dumic, I., Nordin, T., Jecmenica, M., Stojkovic Lalosevic, M., Milosavljevic, T., & Milovanovic, T. (2019). Gastrointestinal Tract Disorders in Older Age. *Canadian journal of gastroenterology & hepatology*, 2019, 6757524. https://doi.org/10.1155/2019/6757524

- Observe respiratory movement in the abdomen of the infant.
- The exocrine functions of the pancreas are not mature until one year of age.
- Infants have quicker gastric emptying times than compared to adults.
- Children often cannot provide more information than “my stomach hurts”; they may have symptoms of decreased school attendance due to abdominal discomfort.

Older Adult Considerations

- Constipation may be more common in older adults due to decreased physical mobility and oral intake, as well as polypharmacy.
- Older adults commonly have reduced saliva, which can lead to dry mouth and alterations in their ability to taste.
- Older adults have decreased LES pressure, making them more prone to gastroesophageal reflux disease.
- Decreased blood flow to the stomach, as well as decreased mucus production, put the older adult at risk for peptic ulcer disease and gastritis.
- Overgrowth of bacteria in the small intestine (leading to diarrhea, malabsorption of nutrients, and weight loss) is more common in older adults.

11.4 Gastrointestinal Disorders

The following sections will discuss common gastrointestinal disorders, including appendicitis, cholecystitis, gastroenteritis, diverticulitis, gastroesophageal reflux disease, peptic ulcer disease, inflammatory bowel disease, irritable bowel disease, bowel obstruction, hernia, and other disorders.

11.5 Appendicitis

Appendicitis is an inflammation of the appendix, a hollow appendage that extends off of the cecum of the large intestine in the right lower quadrant of the abdomen. The true purpose of the appendix is unknown. Some believe the appendix is an organ with no true function, while others believe it serves a purpose in the immune system by harboring good bacteria. Appendicitis can occur at any age, but it is more commonly seen in those between 5 and 45 years of age. Males experience appendicitis slightly more frequently than females.[1] See Figure 11.24[2] for an image of an inflamed appendix.

1. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/

2. "Depiction_of_a_person_suffering_from_Appendicitis.png" by https://www.myupchar.com/en is licensed under CC BY-SA 4.0

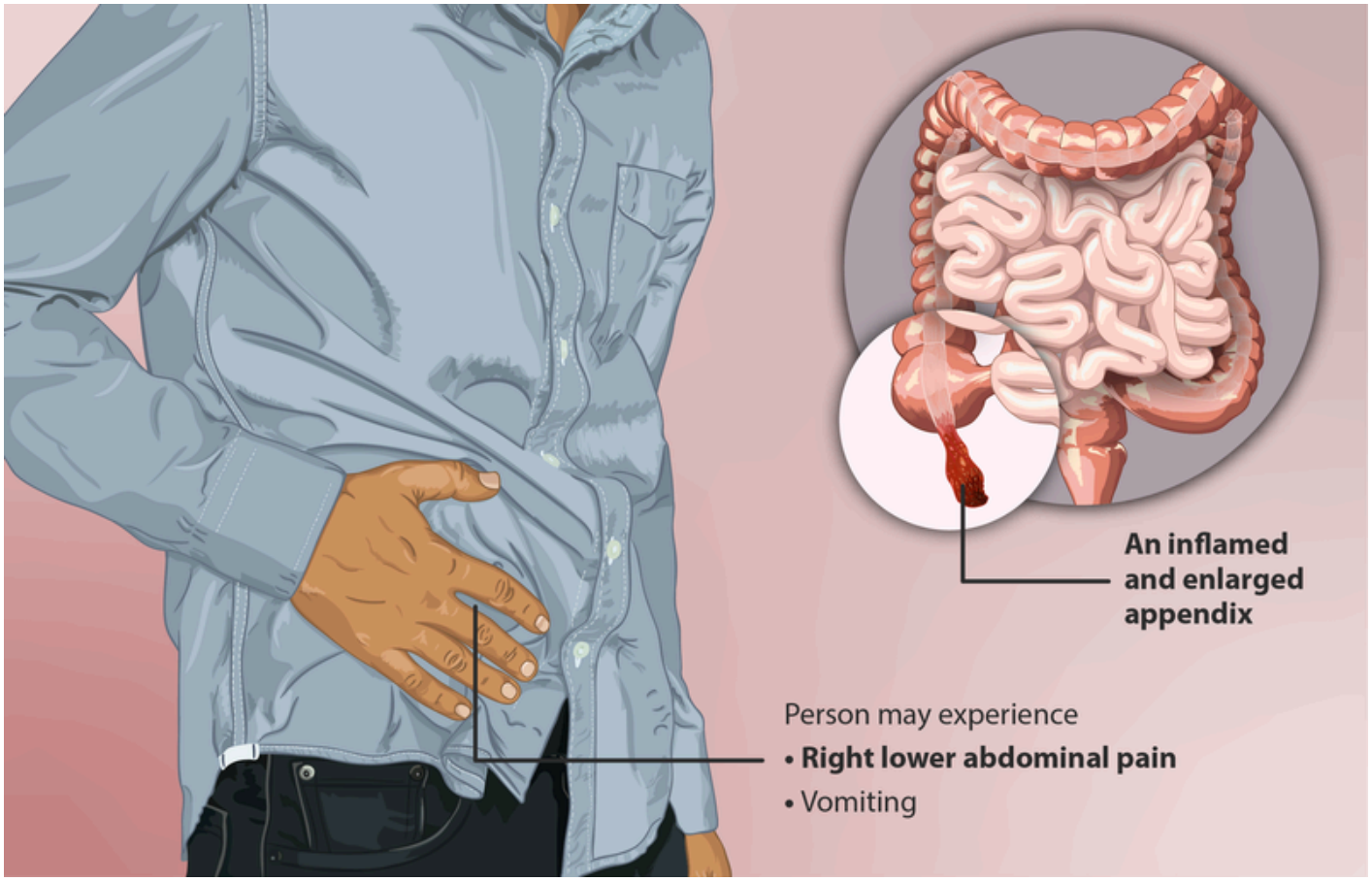


Figure 11.24 Inflamed Appendix

Pathophysiology

Appendicitis occurs when something obstructs the opening of the appendix, such as a **fecalith** (mass of hardened feces), tumors, or even parasitic infections. Once the appendix becomes obstructed, pressure increases inside the appendix and occludes small blood vessels. The appendix also fills with mucus, leading to further distention and reduced blood flow to the appendix, ultimately causing necrosis. Bacterial overgrowth also occurs at this time.[3,4]

Due to the large amount of inflammation, the appendix is at risk for rupture

3. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/

4. Belleza, M. (2023). *Appendicitis*. https://nurseslabs.com/appendicitis/

or abscess formation if not treated promptly. The risk of rupture drastically increases within 24-36 hours of symptom onset, so urgent medical care is essential. If the appendix does perforate, peritonitis may occur. **Peritonitis** is the inflammation of the peritoneum, the lining of the abdominal cavity.[5,6]

Assessment

Physical Exam

The most common presenting symptom of appendicitis is abdominal pain. Initially, the pain is generalized, but eventually it shifts to the lower right quadrant of the abdomen. **Rebound tenderness** (pain that is more severe when releasing pressure on a tender area during palpation than when actively pressing on it) is also common. The client may also present with loss of appetite, nausea/vomiting, diarrhea, and fever.[7]

Common Laboratory and Diagnostic Tests

LAB TESTS

Lab tests that are commonly ordered to diagnose appendicitis are a complete blood count (CBC) and C-reactive protein[8]:

5. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/
6. Belleza, M. (2023). *Appendicitis*. https://nurseslabs.com/appendicitis/
7. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/
8. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/

- Complete blood count (CBC) assesses for an elevated white blood cell count. Typically, white blood cells will be elevated in those with appendicitis. However, one third of clients can have appendicitis with a normal white blood cell count. Severely elevated white blood cell counts are linked to complications of appendicitis such as perforation and gangrene formation.
- C-reactive protein (CRP) measures levels of inflammation. In cases of appendicitis, elevated levels of C-reactive protein may occur.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

DIAGNOSTIC TESTING

A diagnosis of appendicitis can be confirmed with various imaging techniques such CT scan, ultrasound, or MRI[9]:

- Abdominal CT scan is the preferred imaging modality for diagnosing appendicitis due to its specificity and accuracy.
- Ultrasound is not as specific or accurate as a CT scan, but it may be used in instances where radiation should be avoided, such as with children or pregnant women.
- MRI may be used for pregnant clients or for those who have had an inconclusive ultrasound or CT scan. MRIs are very accurate but expensive.

Nursing Diagnoses

Nursing priorities for clients with appendicitis include managing pain, preventing complications from occurring, and preparing the client for surgery.

Nursing diagnoses for clients with appendicitis are created based on the

9. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/

specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client-specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Possible nursing diagnoses for clients with appendicitis are as follows[10,11]:

- Acute Pain
- Risk for Infection
- Deficient Fluid Volume
- Anxiety

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for some of the above nursing diagnoses are listed below:

- *The client will rate their pain three or less (on a pain scale of zero to ten) within four hours.*
- *The client will remain free from signs and symptoms of infection during their hospitalization stay.*
- *The client will exhibit blood pressures and heart rates within normal limits for age, moist mucous membranes, and urine output appropriate*

10. Belleza, M. (2023). *Appendicitis*. https://nurseslabs.com/appendicitis/

11. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

for their age during their hospitalization stay.
- *The client will describe three ways to manage preoperative anxiety by the end of the teaching session.*

Interventions

Medical Interventions

There is no conservative treatment for appendicitis because of the risk for rupture; it must be treated surgically with an **appendectomy** (surgical removal of the appendix). In uncomplicated cases, surgery is performed laparoscopically. However, in situations where complications are present, an open appendectomy may be warranted.[12]

The client will receive an NPO order to prepare for surgery and reduce the risk for aspiration. Intravenous fluids are administered to prevent or correct dehydration. Antibiotics are commonly administered preoperatively to prevent infection. For clients with complications, such as abscess formation, antibiotics will be continued postoperatively. Lastly, if perforation has occurred or an abscess has formed, a percutaneous drain may be placed to allow for continual drainage.[13]

Nursing Interventions

When caring for a client with appendicitis and/or after an appendectomy,

12. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/

13. Lotfollahzadeh, S., Lopez, R. A., & Deppen, J. G. (2024). *Appendicitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK493193/

nursing interventions can be divided into categories of nursing assessments, nursing actions, and client teaching.[14,15]

NURSING ASSESSMENTS

- Assess pain on a 0-10 scale. Note and document location and characteristics of pain.
- Monitor for changes in vitals, as well as changes in the location or characteristics of pain that could signal complications such as abscess formation, rupture, or peritonitis.
- After surgery, assess for the return of bowel sounds before the client starts oral intake. Once bowel sounds have returned, clients should start with eating clear liquids and then gradually progress to a normal diet.
- Assess the surgical site for healing and signs of infection.

NURSING ACTIONS

- Prior to surgery, complete the preoperative checklist. As with all urgent surgical procedures, nurses provide emotional support as needed to decrease client anxiety. For more information on preoperative checklists and preparing a client for surgery, review the "Preoperative Care" section in the "Perioperative Care" chapter.
- Administer prescribed pain medications. Ice may be used to manage pain, but heat should be avoided as it places the client at risk for rupture.
- Administer IV fluids as ordered. Monitor blood pressure, pulse, urine output, skin turgor, and mucous membranes to evaluate hydration status.
- Administer antibiotics per provider order.
- After surgery, encourage postoperative ambulation to prevent

14. Belleza, M. (2023). *Appendicitis*. https://nurseslabs.com/appendicitis/

15. Vera, M. (2023). *4 appendectomy (appendicitis) nursing care plans*. https://nurseslabs.com/appendectomy-nursing-care-plans/

complications such as deep vein thrombosis or pneumonia. Ambulation will also encourage the return of peristalsis.

CLIENT TEACHING

- Encourage clients to increase fluid intake to prevent constipation from pain medications, immobility, and abdominal surgery. Enemas and laxatives should be avoided because they increase intra-abdominal pressure and the risk for rupture.
- Teach clients to monitor their incision/dressing and notify the provider of any signs of infection (redness, warmth, drainage, increasing pain, or fever). The client should also be taught how to self-manage wound care as indicated.
- Teach coughing and deep breathing strategies, as well as how to use an incentive spirometer, to prevent respiratory complications. If excessive pain occurs with coughing, the client should be taught to splint the incision with a pillow. Review information on coughing and deep breathing and incentive spirometers in the "General Respiratory System Assessments and Interventions" section of the "Respiratory Alterations" chapter of this text.
- Reinforce prescribed activity restrictions, such as avoiding heavy lifting, as ordered postoperatively.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.

View a supplementary video on appendicitis: Appendectomy.[16]



RN Recap: Appendicitis

View a brief YouTube video overview of appendicitis[17].

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3230#oembed-1

16. Nucleus Medical Media. (2015) *Appendectomy* [Video]. All rights reserved. https://mdmercy.com/mercy-services/conditions/appendicitis

17. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Appendicitis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/nCxIgXEhBZ4?si=3knP_12cxZ4g2GMz

11.6 Cholecystitis

Cholecystitis is inflammation of the gallbladder due to impaired flow of bile due to blockage by gallstones or a poorly functioning gallbladder. Cholecystitis can be an acute or chronic condition. See Figure 11.25[1] for an image of a gallbladder containing gallstones that was surgically removed.



Figure 11.25 A Removed Gallbladder with Gallstones

Cholecystitis can occur in men or women. Certain populations have a higher risk of gallbladder disease such as females or clients who are overweight,

1. "Gallstones.JPG" by Alex Khimich (talk) is in the Public Domain

pregnant, in their 40s, or have experienced drastic weight loss. A family history of gallstone formation is also a risk factor.[2]

Pathophysiology

The purpose of the gallbladder is to store and concentrate bile, which is needed to break down fats. In normal digestion, the gallbladder releases bile through the cystic duct when fatty foods are eaten. The bile then travels to the duodenum to help break down fatty foods. This process becomes impaired with cholecystitis.

Cholecystitis can be further classified into two types: calculus and acalculous. Calculus cholecystitis means that a stone is present that is blocking the flow of bile. Although there are various potential locations of gallstones, the cystic duct is a common location. See Figure 11.26[3] for an image of the liver, gallbladder, and associated bile ducts. Gallstones can form from excess bilirubin, cholesterol, or calcium. Gallstones can also form when there is biliary stasis (lack of movement of bile), particularly when bile is very concentrated.[4]

In acalculous cholecystitis, there is no stone formation, but the gallbladder does not contract properly to release bile. Whether bile flow is impaired due to a stone or improper gallbladder contraction, the result is the same. Bile starts to build up, and the gallbladder becomes inflamed and edematous. If

2. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

3. "2425_Gallbladder.jpg" by OpenStax College is licensed under CC BY 3.0

4. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

this is not treated appropriately and it progresses, the gallbladder can become gangrenous and even rupture.[5]

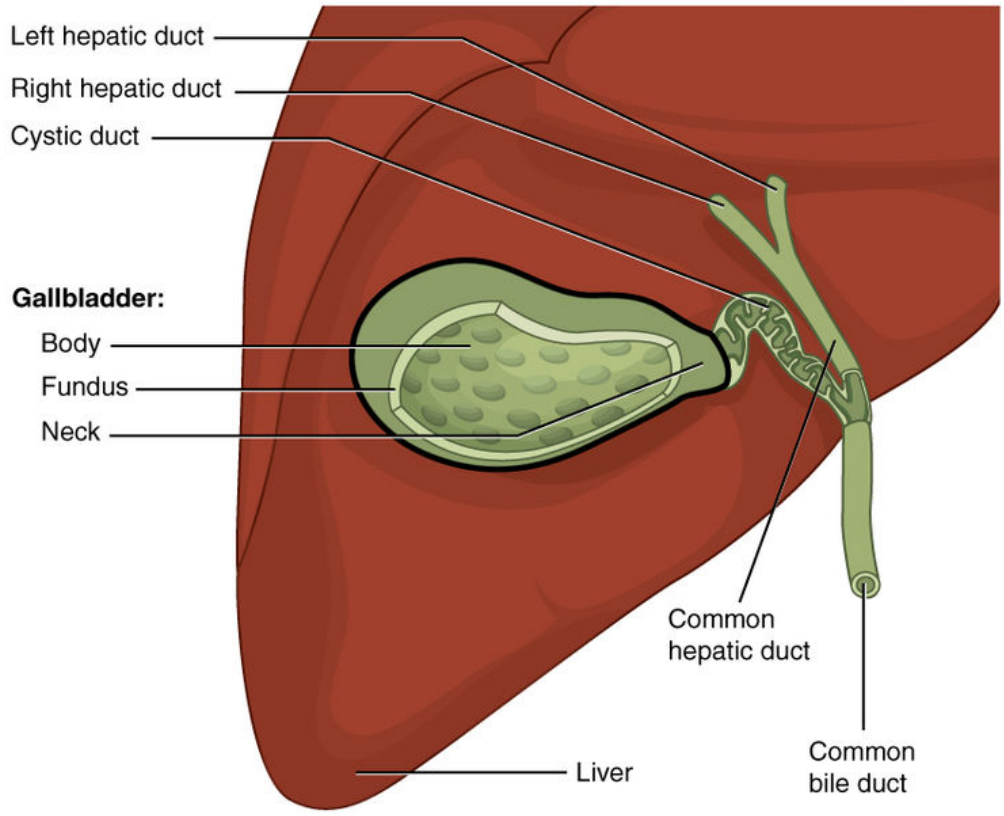


Figure 11.26 Liver, Gallbladder, and Bile Ducts

Assessment

Physical Exam

The most common presenting sign of cholecystitis is pain in the right upper quadrant of the abdomen. Murphy's sign (pain in the right upper quadrant with palpation) is also a common finding. Some clients may also have pain in the back or shoulder. Other symptoms may include bloating, flatulence, nausea/vomiting, and intolerance to fatty and/or spicy foods.

5. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

Common Laboratory and Diagnostic Tests

LAB TESTS

Lab tests commonly ordered by health care providers to diagnose cholecystitis are a complete blood count (CBC), a metabolic panel, and lipase levels[6]

- In chronic cholecystitis, a CBC may be normal. However, during acute cases there may be elevated white blood cells.
- A metabolic panel is performed to assess liver function and bilirubin levels. Both liver enzymes and bilirubin levels may be elevated with cholecystitis, particularly when a gallstone is blocking a bile duct.
- A lipase level may also be ordered to rule out pancreatitis. Gallstones can lead to pancreatitis when they become lodged near the pancreatic duct.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

DIAGNOSTIC TESTING

A diagnosis of cholecystitis can be confirmed with a CT scan, ultrasound, or hepatobiliary iminodiacetic acid scan[7]:

- A CT scan can show the presence of gallstones and cholecystitis.
- An ultrasound of the gallbladder can detect gallstones, as well as gallbladder thickening. Gallbladder thickening is commonly seen with cholecystitis.

6. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

7. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

- A hepatobiliary iminodiacetic acid (HIDA) scan can assess how well the gallbladder is functioning by tracing the flow of bile throughout the gastrointestinal tract using a radioactive tracer. A HIDA scan can also determine the ejection fraction (the amount of bile released with each contraction) of the gallbladder. An ejection fraction of 35% or less indicates acalculous cholecystitis.

Nursing Diagnoses

Nursing priorities for those suffering from cholecystitis include managing pain, preparing the client for surgery if indicated, and ensuring optimal nutrition.

Nursing diagnoses for clients with cholecystitis are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Possible nursing diagnoses for those with cholecystitis are as follows[8,9]:

- Acute Pain
- Anxiety
- Deficient Fluid Volume
- Imbalanced Nutrition: Less than Body Requirements

Outcome Identification

Outcome identification encompasses the creation of short- and long-term

8. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

9. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for some of the above nursing diagnoses are as follows:

- *The client will rate their pain at 3 or less on a scale of 0 to 10 within two hours.*
- *The client will describe three ways to manage preoperative anxiety after the teaching session.*
- *The client will exhibit blood pressure and heart rate within normal limits for age, moist mucous membranes, and urine output appropriate for age during their hospital stay.*
- *The client will achieve a weight within a healthy range according to their height within three months.*

Interventions

Medical Interventions

For clients with cholecystitis and gallstones who have minimal symptoms or those who are not surgical candidates, the provider may recommend a conservative approach with a low-fat diet to manage symptoms. However, cholecystitis is generally treated by surgically removing the gallbladder, also known as a **cholecystectomy**. The preferred approach is laparoscopic removal, but an open approach may be needed in some clients. For clients in which surgery is not a good option, a drain may be placed through the skin into the gallbladder to allow for bile drainage. Another option is to place the client on a medication that can dissolve gallstones, such as ursodiol. Clients with stones in the bile duct may require an ERCP prior to gallbladder

removal.[10] For more information on the ERCP procedure, review the "Common Laboratory and/or Diagnostic Tests" subsection of the "General Assessment of the Gastrointestinal System" of this chapter.

Nursing Interventions

For the client with cholecystitis, the following nursing interventions can be divided into nursing assessments, nursing actions, and client teaching.[11]

NURSING ASSESSMENTS

- Assess vital signs as changes in vitals could indicate that a complication is occurring.
- Complete focused abdominal assessments, noting abdominal pain, nausea, and/or vomiting.

NURSING ACTIONS

- Complete a preoperative checklist when preparing the client for a cholecystectomy. To review information on preoperative checklists and preparing a client for surgery, visit the "Perioperative Care" chapter.
- Administer IV fluids and pain medications as ordered by the provider.

CLIENT TEACHING

- Remain on a low-fat diet prior to surgery and during the initial postoperative period. After the gallbladder is removed, fat breakdown

10. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

11. Jones, M. W., Genova, R., & O'Rourke, M.C. (2023). *Acute Cholecystitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459171/

does not occur as quickly, and, therefore, fatty foods may cause gastrointestinal upset. With time, the liver will increase bile production, and these symptoms should improve.

- Report symptoms of jaundice (yellow eyes, light-colored stools, and dark urine) as this can indicate the presence of remaining gallstones or other complications. See Figure 11.27[12] for an image of a client with scleral icterus (yellowing of the eyes).
- Educate the postoperative client about shoulder pain. Right shoulder pain is common after a laparoscopic cholecystectomy due to the insertion of carbon dioxide during the surgery. Walking will help reduce the pain. Shoulder pain should completely resolve within two to three days after the surgery. Monitor the incision/dressing daily and notify the provider of any signs of infection (redness, warmth, drainage, increasing pain, or fever). Teach how to self-manage wound care as indicated.



Figure 11.27 Scleral Icterus due to Jaundice

12. "Scleral_Icterus.jpg" by Sheila J. Toro is licensed under CC BY 4.0

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.



RN Recap: Cholecystitis

View a brief YouTube video overview of cholecystitis[13]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3236#oembed-1

13. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Cholecystitis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/cTqorDEVA8o?si=77fpCynZluxUr0aD

11.7 Gastroenteritis

Gastroenteritis is an inflammation of the stomach and small intestine. It is classified as an increase in bowel movements that may also be associated with fever, vomiting, and abdominal pain. Although most cases of gastroenteritis are acute and last fewer than 14 days, it is also possible to have a chronic case lasting over 30 days.[1]

Gastroenteritis can be caused by bacteria, viruses, fungi, or parasites, but most cases are caused by viruses. Transmission generally occurs via the fecal-oral route, via contaminated food or water, or even airborne routes. Common bacterial causes of gastroenteritis in the United States are *Salmonella* and *Campylobacter*. Leading viral causes of gastroenteritis are rotavirus and norovirus. Antibiotics can also cause gastroenteritis as a side effect. This section will focus on viral and bacterial forms of gastroenteritis.[2]

Risk factors for contracting gastroenteritis include traveling to developing countries and consuming improperly prepared food. Viral outbreaks are also common in close quarters, putting clients who attend daycare, live in nursing facilities, or vacation on cruise ships at risk. Clients who are immunocompromised, very young, older adults, or suffer from chronic diseases are at the highest risk for complications related to dehydration.[3]

Pathophysiology

Fluids are normally absorbed in the small intestine, but during gastroenteritis this absorption does not occur normally due to inflammation. Additionally,

1. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/
2. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/
3. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

toxins associated with various bacteria and viruses can cause the lining of the intestine to also excrete fluid. These factors cause frequent, watery diarrhea that is associated with gastroenteritis.[4]

Assessment

Physical Exam

Signs and symptoms of gastroenteritis usually occur suddenly and improve within one to three days. Common signs and symptoms include the following[5]:

- Diarrhea (Diarrhea may or may not contain blood depending on the causative organism.)
- Nausea
- Vomiting
- Fever
- Abdominal pain

Dehydration can occur quickly in cases of gastroenteritis, so nurses must assess for signs and symptoms of fluid volume deficit that include the following:

- Dry mucous membranes
- Change in mental status
- Elevated heart rate
- Decreased blood pressure
- Poor skin turgor

4. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

5. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

Common Laboratory and Diagnostic Tests

LAB TESTS

Lab tests performed to diagnose gastroenteritis are a complete blood count, a metabolic panel, and stool testing[6,7]:

- A complete blood count (CBC) may show mildly elevated white blood cells with viral causes of gastroenteritis. Bacterial causes of gastroenteritis often cause a significantly elevated white blood cell count. Due to dehydration and the subsequent hemoconcentration, levels of red blood cells, hemoglobin, and hematocrit may appear falsely elevated.
- A complete metabolic panel (CMP) may show an elevated BUN and creatinine if dehydration is severe enough to cause injury to the kidneys. Additionally, vomiting and diarrhea may cause decreased electrolyte levels, particularly potassium.
- Various stool studies may be performed to establish a diagnosis. Specific stool studies can detect certain viral or bacterial causes of gastroenteritis. Stool may also be checked for ova and parasites, as well as the presence of white blood cells.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

DIAGNOSTIC TESTING

In the majority of cases of gastroenteritis, imaging will be normal. However, a

6. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

7. Sattar, S. B. A., & Singh, S. (2023). *Bacterial Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513295/

CT scan of the abdomen may show inflammation in the bowel that is nonspecific.[8,9]

Nursing Diagnoses

Nursing priorities for those suffering from gastroenteritis include preventing/treating dehydration, promoting good skin care, consuming optimal nutrition, and managing diarrhea.

Nursing diagnoses for clients with gastroenteritis are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Possible nursing diagnoses for those with gastroenteritis are as follows[10]:

- Fluid Volume Deficit
- Impaired Skin Integrity
- Imbalanced Nutrition: Less than Body Requirements
- Diarrhea
- Risk for Electrolyte Imbalance

Outcome Identification

Outcome identification encompasses the creation of short- and long-term

8. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

9. Sattar, S. B. A., & Singh, S. (2023). *Bacterial Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513295/

10. Stuempfig, N. D , Seroy, J., & Labat-Butler, J. R. (2023). *Viral Gastroenteritis (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568704

goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for some of the above nursing diagnoses are listed below:

- *The client will exhibit blood pressure and heart rate within normal limits for age, moist mucous membranes, and urine output appropriate for age during the course of the illness.*
- *The client will exhibit skin in the peri-area that is an appropriate color for race and free from skin breakdown during the course of the illness.*
- *The client will tolerate a bland diet without nausea, vomiting, or diarrhea within 24 hours.*
- *The client will exhibit a formed stool that occurs at the client's normal frequency within one week.*

Interventions

Medical Interventions

Specific medical interventions depend on the causative factor of gastroenteritis. Generally, viral gastroenteritis is treated with supportive care such as the following[11,12]:

- Prevent/treat dehydration by providing adequate fluids. IV fluids may be administered for clients who are dehydrated or cannot tolerate fluids by

11. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

12. Sattar, S. B. A., & Singh, S. (2023). *Bacterial Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513295/

mouth due to nausea/vomiting.

- Supplement electrolytes as needed via oral or IV routes, depending on the status of the client.
- Antiemetic medications may be prescribed to control nausea and vomiting. Commonly prescribed medications are ondansetron or metoclopramide. Clients are encouraged to adhere to a bland diet while symptomatic.
- Although antidiarrheal medications such as loperamide or diphenoxylate/atropine exist, their use in gastroenteritis (both viral and bacterial) is controversial.

For clients diagnosed with bacterial gastroenteritis, medical interventions include supportive care described above, as well as possible antibiotics to treat the infection. Generally, antibiotics are prescribed for clients with severe cases of bacterial gastroenteritis (defined as over six stools per day, febrile, and hospitalized), have blood in their stool, have *Clostridium difficile* (C. diff), are over 70 years in age, are immunocompromised, or have other comorbidities.[13]

Generally, clients with gastroenteritis can be managed at home, but hospital admission may be required for clients who are severely dehydrated, cannot stop vomiting, have significant electrolyte abnormalities or abdominal pain, or those who are pregnant.[14, 15]

13. Sattar, S. B. A., & Singh, S. (2023). *Bacterial Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513295/

14. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

15. Sattar, S. B. A., & Singh, S. (2023). *Bacterial Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513295/

Nursing Interventions

When providing nursing care for clients with gastroenteritis, the following nursing interventions can be divided into nursing assessments, nursing actions, and client teaching[16][17][18]:

NURSING ASSESSMENTS

- Assess client vital signs. Vital signs may be altered due to fever or dehydration.
- Assess intake and output.
- Assess for signs of dehydration (dry mucous membranes, decreased urine output, sunken fontanels in infants, poor skin turgor, elevated heart rate, or decreased blood pressure).
- For clients with diarrhea, assess skin in perineal area for breakdown.

NURSING ACTIONS

- Administer IV fluids as prescribed. Encourage oral intake if appropriate.
- Administer antiemetics as prescribed.
- Administer electrolyte supplements as prescribed.
- Ensure a hospitalized client is placed in a room according to transmission-based precautions (typically contact precautions). In cases of norovirus, contact and droplet precautions are also required.

16. Stuempfig, N. D., & Seroy, J. (2023). *Viral Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK518995/

17. Sattar, S. B. A., & Singh, S. (2023). *Bacterial Gastroenteritis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513295/

18. Stuempfig, N. D , Seroy, J., & Labat-Butler, J. R. (2023). *Viral Gastroenteritis (Nursing)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK568704/

CLIENT TEACHING

- Teach proper handwashing before eating, before preparing food, and after using the restroom to prevent the spread of gastroenteritis.
- Teach about consuming a bland diet while symptomatic, such as bananas, rice, and toast. Dairy and spicy/heavily seasoned food should be avoided until symptoms have resolved.
- Teach guidelines for using over-the-counter medications.
- Teach parents with children about the rotavirus vaccine and teach proper food preparation and storage methods as prevention interventions.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.



RN Recap: Gastroenteritis

View a brief YouTube video overview of gastroenteritis[19]:

19. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 –*

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3243#oembed-1

Gastroenteritis [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/IbJKcxLRpFQ?si=UhaAb7yjK5XZXyNH

11.8 Diverticulitis

A **diverticulum** is an out-pouching of the wall of the colon. The presence of many diverticula is known as diverticulosis. Clients with **diverticulosis** are generally asymptomatic, but a small percentage develop diverticulitis, inflammation of a diverticulum.[1,2] See Figure 11.28[3] for an image of a colon with diverticulosis.

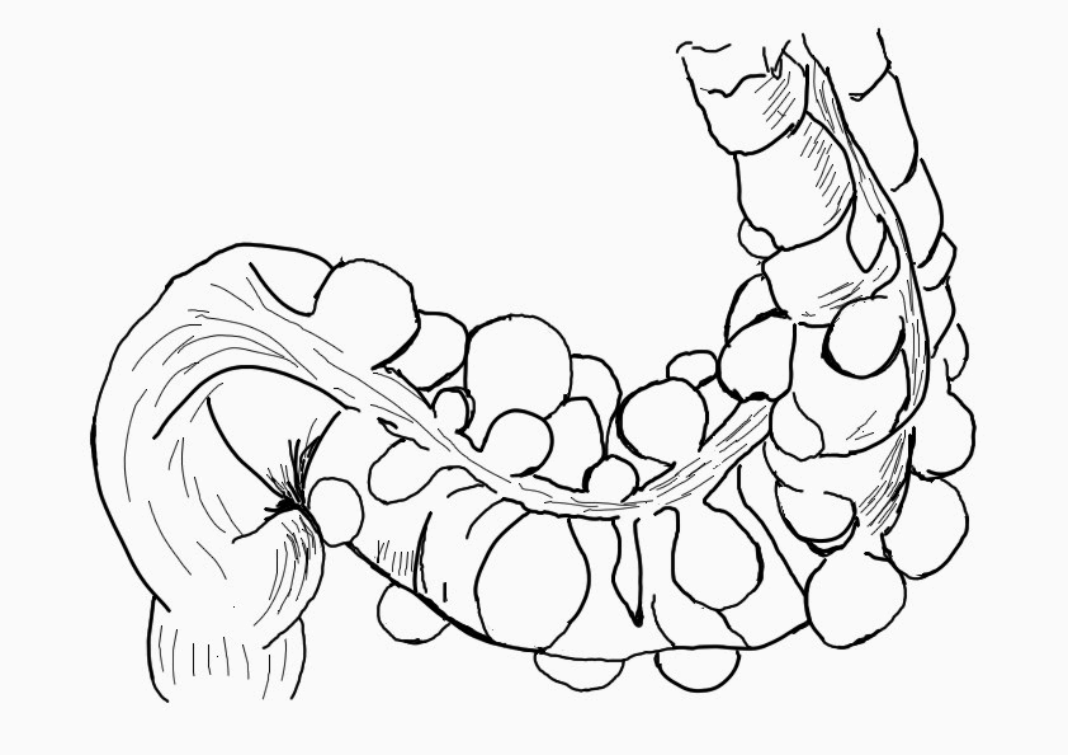


Figure 11.28 Sigmoid Colon with Diverticulosis

1. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

2. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

3. "Sigmoid_diverticulum_(diagram).jpg" by Anpol42 is licensed under CC BY-SA 4.0

Diverticulitis can be complicated or uncomplicated. Uncomplicated diverticulitis means there is inflammation with no complications present. Complicated diverticulitis refers to diverticulitis associated with an abscess, perforation, **fistula** (an abnormal connection between two organs), or a bowel blockage.[4,5]

Risk factors for diverticulosis and diverticulitis are the same, with the main risk factors being dietary intake. Clients with low-fiber intake or high intake of red meat and fatty foods are at increased risk for developing diverticulosis and diverticulitis. Other risk factors include obesity, tobacco usage, certain medications (NSAIDs, steroids, opioids and statins), and age, with 60% of clients aged 60 or older having diverticulosis.[6,7]

Pathophysiology

Diverticula form where the walls of the colon are weak. This weakness occurs due to increased pressures in the colon or a result of connective tissue disorders. Constipation and the straining that occurs during bowel

4. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

5. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

6. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

7. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

movements can play a role in diverticula forming due to the increased pressure within the colon.[8,9,10]

Obstruction from hardened stool or food eroding the wall of the diverticula causes inflammation and necrosis of the diverticulum, which lead to the perforation. Perforation can cause diverticulitis, which can also lead to formation of an abscess, fistula, or bowel obstruction. Major perforations can cause peritonitis.[11,12,13]

Assessment

Physical Exam

Clients with diverticulosis are often asymptomatic. However, blood may be present in the stool because diverticula bleed easily.

Clients with diverticulitis commonly present with abdominal pain, typically in the left lower quadrant. Clients may also experience altered bowel habits

8. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

9. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

10. Cleveland Clinic. (n.d.). *Diverticulosis*. https://my.clevelandclinic.org/health/diseases/24883-diverticulosis

11. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

12. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

13. Cleveland Clinic. (n.d.). *Diverticulosis*. https://my.clevelandclinic.org/health/diseases/24883-diverticulosis

such as diarrhea or constipation. Fever, nausea, and vomiting may also be present.

When completing a physical exam, if an abscess is present, the provider may be able to palpate a mass. Bowel sounds are commonly hypoactive.

Common Laboratory and Diagnostic Tests

LAB TESTS

Labs tests ordered to diagnose diverticulitis are a complete blood count and inflammatory markers[14, 15]:

- Complete blood count (CBC) will often show elevated white blood cells.
- Inflammatory markers such as erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are often elevated during diverticulitis.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

14. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

15. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

DIAGNOSTIC TESTING

Imaging modalities used to diagnose diverticulosis and diverticulitis are CT scan, abdominal ultrasound, and colonoscopy[16,17]:

- A CT scan of the abdomen with contrast is considered the gold standard for diagnosing diverticulitis.
- An abdominal ultrasound can also be used to diagnose diverticulitis with almost as much sensitivity as a CT scan and is more cost-effective.
- Although a colonoscopy is routinely used to diagnose diverticulosis, it should not be performed during suspected diverticulitis because it can cause perforation of the colon. Clients with diverticulitis are typically encouraged to undergo a colonoscopy six to eight weeks after their diverticulitis symptoms have improved. See Figure 11.29[18] for an image showing two diverticula that were discovered via colonoscopy.

16. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

17. Nallapeta, N. S., Farooq, U., & Patel, K. (2023). *Diverticulosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430771/

18. "Diverticulosis_(two_diverticula)_01.svg" by Jmarchn is licensed under CC BY-SA 3.0

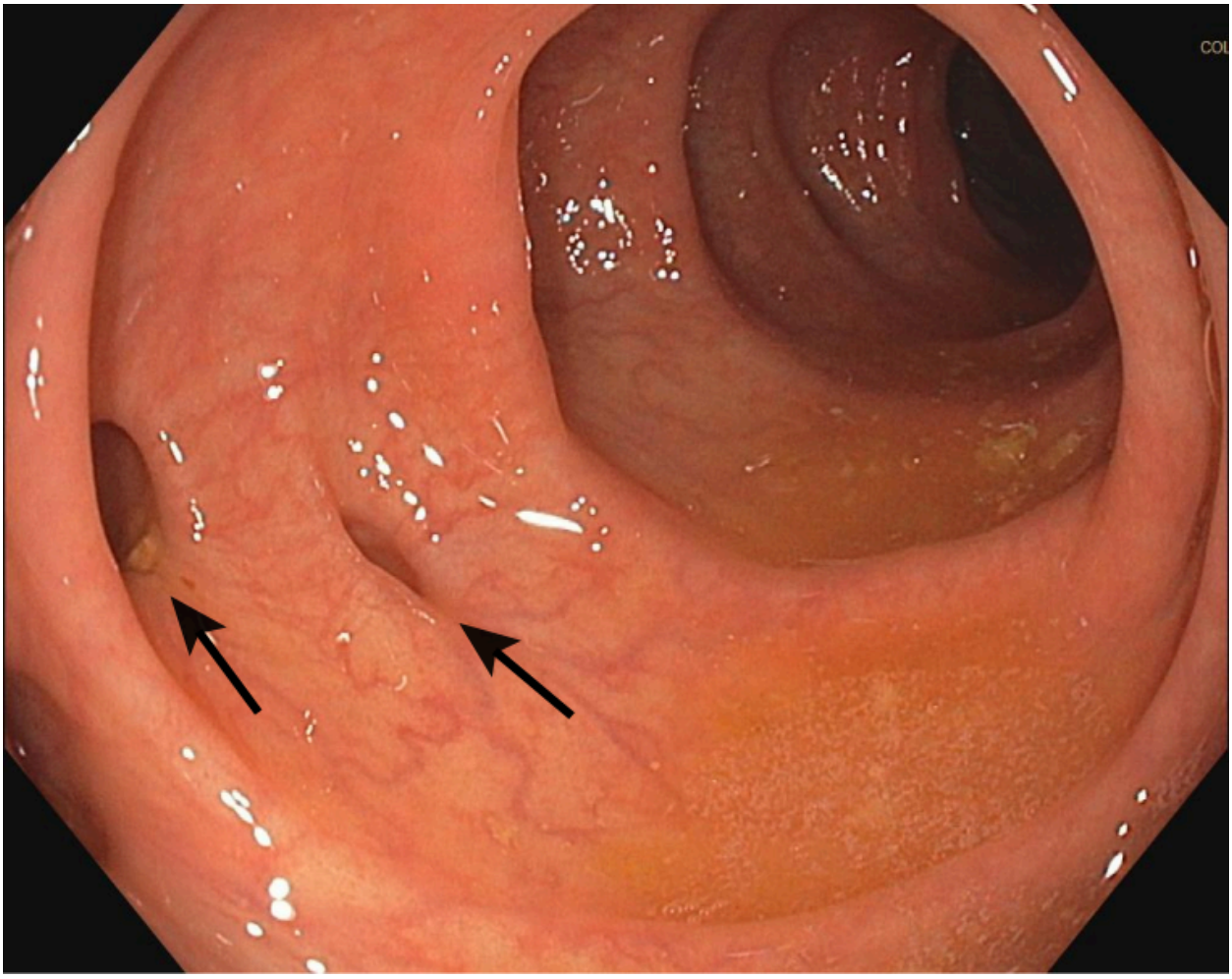


Figure 11.29 Arrows Indicate Two Diverticula on Colonoscopy

Nursing Diagnoses

Nursing priorities for clients with diverticulitis include managing pain, ensuring adequate nutritional intake, and optimizing stool consistency.

Nursing diagnoses for clients with diverticulitis are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Possible nursing diagnoses for those with diverticulitis are as follows[19,20]:

- Acute Pain
- Imbalanced Nutrition: Less than Body Requirements
- Constipation
- Diarrhea

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for some of the above nursing diagnoses include the following[21]:

- *The client will rate their pain at 3 or less on a scale of 0 to 10 within two hours*.
- *The client will maintain their weight within a healthy range that is appropriate for their height until the next follow-up appointment*.
- *The client will pass bowel movements without straining within three*

19. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

20. Wagner, M. (2023). *Diverticulitis: Nursing diagnoses, care plans, assessment & interventions*. https://www.nursetogether.com/diverticulitis-nursing-diagnosis-care-plan/

21. Wagner, M. (2023). *Diverticulitis: Nursing diagnoses, care plans, assessment & interventions*. https://www.nursetogether.com/diverticulitis-nursing-diagnosis-care-plan/

days.

- *The client will pass formed stools in a nonurgent manner until the next follow-up appointment*.

Interventions

Medical Interventions

Depending on the severity of the case of diverticulitis, the client may require inpatient care. Client characteristics that may require hospitalization include extreme vomiting, those who cannot take liquids by mouth, older adults, those who are immunocompromised, or those with signs of complications.

Regardless of the setting, treatment for diverticulitis consists of bowel rest, increased fluids, and antibiotics. Initially, hospitalized clients will have nothing by mouth (NPO) diet orders, whereas those undergoing outpatient treatment may be on a clear liquid diet. Fluids should be increased by mouth. In the inpatient setting intravenous fluids may be administered. Oral antibiotics are prescribed for those in the outpatient setting, and intravenous antibiotics are administered for hospitalized clients. Pain management may also be necessary depending on the comfort level of the client.[22,23]

Surgery may be required for clients who develop an abscess, fistula, perforation, bowel obstruction, or other complication. Clients who experience

22. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

23. Wagner, M. (2023). *Diverticulitis: Nursing diagnoses, care plans, assessment & interventions*. https://www.nursetogether.com/diverticulitis-nursing-diagnosis-care-plan/

recurring bouts of diverticulitis may require surgery to remove diseased portion(s) of the colon.[24,25]

Nursing Interventions

When providing nursing care to clients with diverticulitis, nursing interventions can be divided into the following: nursing assessments, nursing actions, and client teaching[26,27]:

NURSING ASSESSMENTS

- Assess the client's vitals and pain level on a 0-10 scale, as changes in vitals and/or the quality of their pain can indicate a complication is occurring.
- Assess the client's intake and output, including stool characteristics.
- Monitor lab results, such as white blood cell count.

NURSING ACTIONS

- Administer prescribed antibiotics, IV fluids, and pain medications.
- If surgery is required, complete a preoperative checklist. Review

24. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

25. Wagner, M. (2023). *Diverticulitis: Nursing diagnoses, care plans, assessment & interventions*. https://www.nursetogether.com/diverticulitis-nursing-diagnosis-care-plan/

26. Linzay, C. D., & Pandit, S. (2023). *Acute Diverticulitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459316/

27. Wagner, M. (2023). *Diverticulitis: Nursing diagnoses, care plans, assessment & interventions*. https://www.nursetogether.com/diverticulitis-nursing-diagnosis-care-plan/

preoperative checklists and preparing a client for surgery in the "Perioperative Care" chapter.
- Collaborate with a dietician to help optimize nutrition.

CLIENT TEACHING

- After the acute phase of diverticulitis has passed, teach the client to consume a diet that is rich in fiber to prevent constipation that can cause more diverticula. However, during the acute phase of diverticulitis, fiber-rich foods should be avoided because they increase GI motility in a time when bowel rest is desired.
- Reinforce increased fluid intake (2.5-3 liters per day) to prevent hard stools and straining.
- Encourage weight loss, if indicated, because of the association between obesity and diverticulitis.
- Teach the client to avoid anything that can increase intra-abdominal pressure (such as straining with bowel movements and heavy lifting) because this can lead to the formation of more diverticula. During the acute phase, this pressure can also increase pain.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.

View a supplementary YouTube video[28] on diverticulitis: Diverticulitis, causes, signs and symptoms, diagnosis and treatment.



RN Recap: Diverticulitis

View a brief YouTube video overview of diverticulitis[29]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3249#oembed-1

28. Medical Centric. (2021, March 9). *Diverticulitis, causes, signs and symptoms, diagnosis and treatment* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=k_9Gbn0TBz0

29. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Diverticulitis* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/F8lTgfp_de0?si=Qkr-KpnLEpA6rnyZ

11.9 Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) occurs when stomach contents flow backwards into the esophagus. GERD is a common, chronic disorder that develops in about 20% of adults in the United States.[1] Please see Figure 11.30[2] for an image of what occurs with GERD.

1. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

2. "GastroEsophageal_Reflux_Disease_(GERD).jpg" by BruceBlaus is licensed under CC BY-SA 4.0

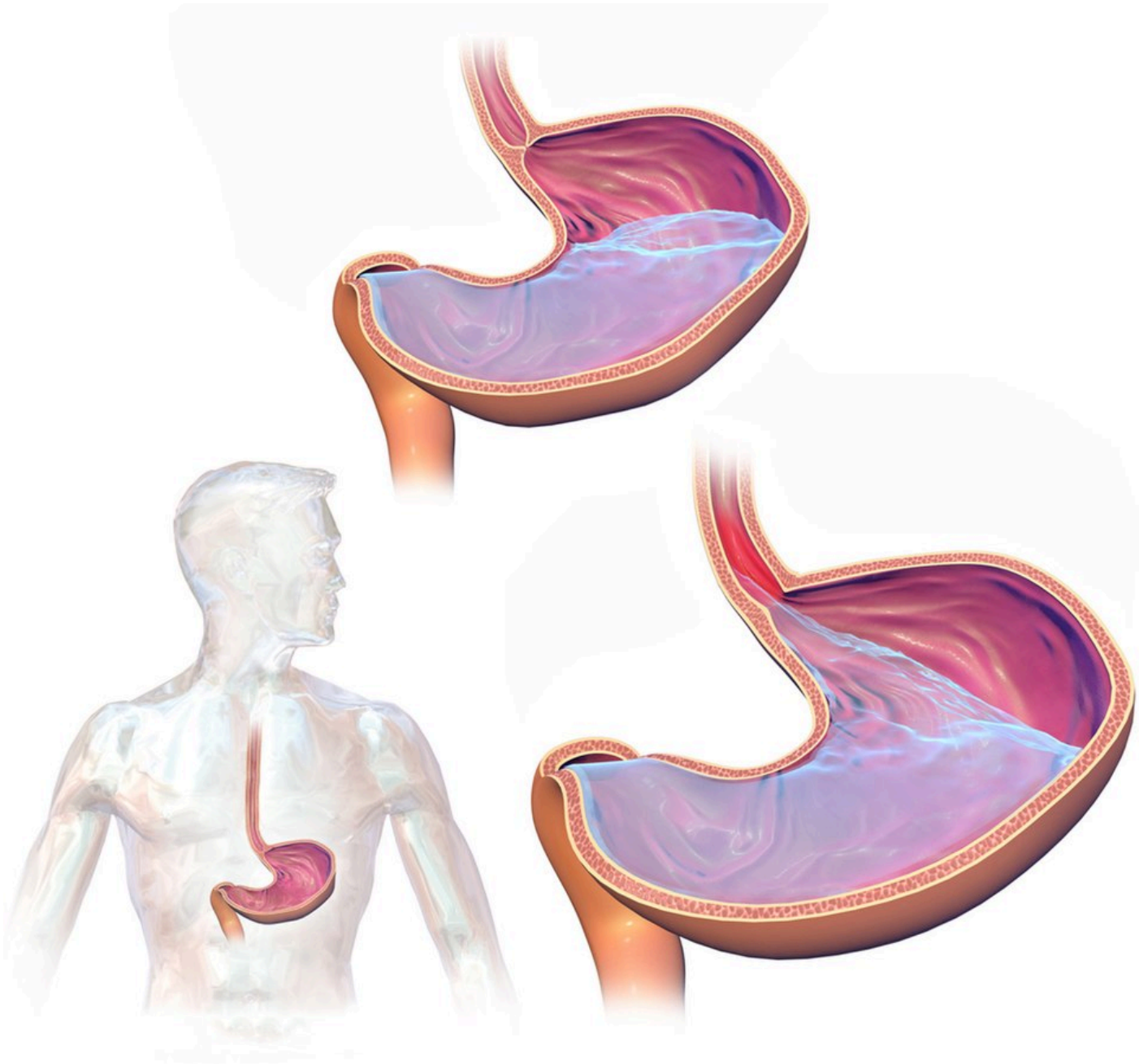


Figure 11.30 Backflow of Stomach Contents That Occurs With GERD

GERD can be classified into three different types, based on whether or not damage is occurring to the esophagus: nonerosive reflux disease (no damage to the esophagus), erosive esophagitis (formation of ulcers or erosions in the

esophagus), and Barrett's esophagus. Barrett's esophagus is further described in the "Pathophysiology" subsection.[3]

Common risk factors for the development of GERD include the following[4]:

- Poor muscle tone in the lower esophageal sphincter
- Hiatal hernia
- Slow gastric contents emptying
- Obesity
- Hiatal hernia
- Age over 50 years old
- Tobacco usage
- Excessive alcohol use
- Pregnancy
- Low socioeconomic status
- Medications such as calcium channel blockers, anticholinergics, benzodiazepines, NSAIDs/aspirin, some antidepressants, albuterol, and nitroglycerin

Pathophysiology

There are several abnormalities that can cause GERD, such as impaired lower esophageal sphincter (LES) tone, the presence of a hiatal hernia, impaired esophageal mucosa, and altered esophageal peristalsis.[5]

The LES is a ring of smooth muscle located between the esophagus and stomach to prevent backward flow of stomach contents. In clients who do not

3. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

4. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

5. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

have GERD, the LES is a high-pressure area that only opens when food is present, allowing food to flow to enter the lower pressure area of the stomach. However, in clients with GERD, the LES may inappropriately relax, allowing stomach contents to flow backwards into the esophagus.[6]

A hiatal hernia is a condition in which the upper part of the stomach abnormally bulges through the hiatus of the diaphragm. When there is laxity in this hiatus, gastric content can back up into the esophagus.[7] Read more about hiatal hernias in the "Hernia" section of this chapter.

Esophageal mucosa normally functions as a protective defensive barrier against acid gastric contents, but with repeated exposure to stomach contents (which are highly acidic), the mucosa can become damaged. Clients with chronic GERD can develop **Barrett's esophagus**. Chronic exposure to acidic stomach contents causes squamous epithelial cells that line the esophagus to transition into columnar epithelium, also known as Barrett's epithelium. Barrett's epithelium is more resistant to acid exposure but can become cancerous. Therefore, Barrett's esophagus is considered a precancerous condition that is closely monitored.[8,9]

Normally, the acidic gastric contents that enter the esophagus are cleared by frequent esophageal peristalsis and neutralized by salivary bicarbonate. Clients with GERD may have impaired esophageal peristalsis, leading to

6. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

7. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

8. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

9. Khieu, M., & Mukherjee, S. (2024). *Barrett Esophagus.* StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK430979/

decreased clearance of gastric contents, resulting in reflux symptoms and mucosal damage.[10]

Assessment

Physical Exam

The most common symptoms of GERD are heartburn and regurgitation of gastric contents. **Heartburn** is defined as a retrosternal burning sensation or discomfort that may radiate into the neck and typically occurs after the ingestion of meals or when in a reclined position. **Regurgitation** refers to backwards flow of acidic gastric contents into the esophagus or mouth. Clients may also have difficult or painful swallowing, nausea, epigastric area pain, and increased belching. Some clients have atypical symptoms of GERD such as chest pain, persistent coughing, new-onset asthma, laryngitis, dental cavities, or a hoarse voice.[11]

Common Laboratory and Diagnostic Tests

GERD is typically diagnosed based on clinical signs and symptoms or by trialing a proton pump inhibitor (PPI) medication to determine if symptoms improve with treatment. In clients with significant symptoms, such as difficult or painful swallowing, reduced red blood counts, hematemesis, or unintended weight loss, an esophagogastroduodenoscopy (EGD) may be performed to rule out complications of GERD such as erosions, Barrett's esophagus, narrowing of the esophagus (caused by scar tissue formation),

10. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

11. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

and esophageal cancer.[12] To review information on an EGD, please visit the "Common Laboratory and/or Diagnostic Tests" subsection of the "General Assessment of the Gastrointestinal System."

In clients with GERD whose symptoms do not respond to medications, health care providers may order ambulatory esophageal reflux monitoring. This test entails inserting a catheter into the client's nose with the distal tip near the LES. The catheter is used to monitor acid levels at the LES and help link the occurrence of symptoms with the presence of high acid levels.[13]

Nursing Diagnoses

Nursing priorities for those suffering from GERD include symptom management, lifestyle changes, dietary education, and preventing complications.

Nursing diagnoses for clients with GERD are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

12. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

13. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

Common nursing diagnoses for clients diagnosed with GERD are as follows[14,15,16]:

- Acute Pain
- Deficient Knowledge
- Imbalanced Nutrition: Less than Body Requirements
- Impaired Tissue Integrity

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes include the following:

- *The client will rate their pain at 3 or less on a scale of 0 to 10 within 24 hours*.
- *The client will verbalize three lifestyle modifications that will help reduce the prevalence of GERD symptoms after the teaching session*.
- *The client will achieve a weight within a healthy range appropriate for their height within six months*.

14. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

15. Curran, A. (2023). *GERD nursing diagnosis and nursing care plan*. https://nursestudy.net/gerd-nursing-diagnosis/

16. Vera, M. (2023). *8 gastroesophageal reflux disease (GERD) nursing care plans*. https://nurseslabs.com/gastroesophageal-reflux-disease-gerd-nursing-care-plans/

- *The client will verbalize the importance of medication adherence to prevent complications by the end of the teaching session.*

Interventions

Medical Interventions

Medical treatment for GERD can be categorized as lifestyle changes, medication therapy, and surgical management.[17]

LIFESTYLE CHANGES

Lifestyle changes are typically the first step for treating GERD. The client is taught to stop consuming food three hours before bed and to elevate the head of the bed if possible. Clients are also taught to modify their diet to reduce GERD symptoms. Although there is some disagreement on the necessities of eliminating certain foods, clients are typically taught to avoid chocolate, caffeine, coffee, heavily spiced foods, foods with high citrus content, and carbonated beverages. If the client is obese, weight loss is encouraged.[18]

MEDICATIONS

If lifestyle changes do not effectively manage GERD symptoms, medications are prescribed. Commonly prescribed classes of medications are proton pump inhibitors (PPIs), histamine 2 receptor antagonists (H2RAs), and prokinetics. PPIs are considered the gold standard of medical treatment for GERD due to their effectiveness in treating both nonerosive and erosive

17. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

18. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

GERD. Some PPIs and H2RAs are available as over-the-counter medications, and some require a prescription. Prokinetic medications help promote esophageal peristalsis. Although some clients may benefit from prokinetic medications like metoclopramide, their use is controversial due to the side effects that can occur with long-term use.[19]

> For more information about medications used to treat GERD, visit the "Antiulcer Medications" and "Antiemetics" sections in the "Gastrointestinal System" chapter in Open RN *Nursing Pharmacology, 2e*.

SURGICAL MANAGEMENT

If GERD does not respond to typical medication therapy or unacceptable side effects occur, surgery may be an option, especially if a large hiatal hernia is present. The most common surgical procedure for GERD is a laparoscopic Nissen fundoplication. In this procedure, the upper portion of the stomach is wrapped around the lower portion of the esophagus to prevent the reflux of gastric contents into the esophagus. See Figure 11.31[20] for an illustration of the laparoscopic Nissen fundoplication procedure. Common postoperative complications are abdominal bloating, difficulty swallowing, and increased

19. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

20. "Nissen_fundoplication.png" by Xopusmagnumx at English Wikipedia is in the Public Domain.

burping, although most clients experience an improvement in GERD symptoms.[21,22]

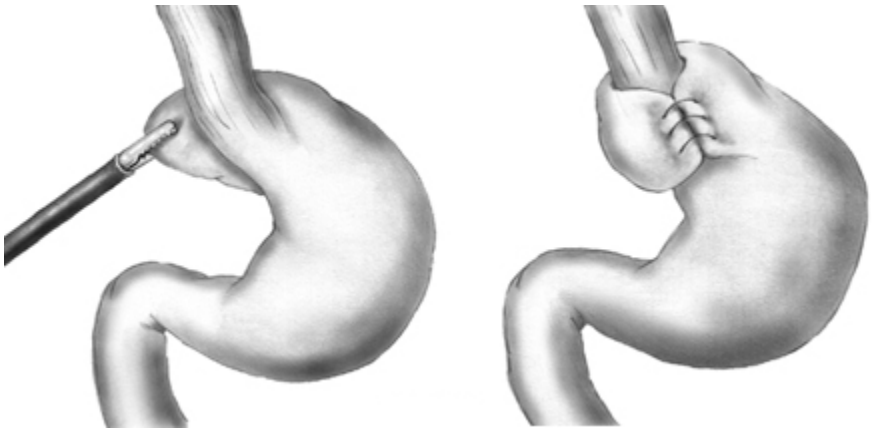


Figure 11.31 Nissen Fundoplication Procedure

View a supplementary YouTube video[23] on surgery used to treat GERD: Anti-reflux surgery, fundoplication-Mayo Clinic.

Nursing Interventions

When providing nursing care to clients with GERD, the following nursing

21. Antunes, C., Aleem, A., & Curtis, S. A. (2023). *Gastroesophageal Reflux Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441938/

22. Cleveland Clinic. (n.d.). *Nissen fundoplication*. https://my.clevelandclinic.org/health/treatments/4200-nissen-fundoplication

23. Mayo Clinic. (2010, April 22). *Anti-reflux surgery, fundoplication-Mayo Clinic* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=X840-6PyO4c

interventions can be categorized as nursing assessments, nursing actions, and client teaching[24,25]:

NURSING ASSESSMENTS

- Assess the client's nutritional status because it can be impacted by GERD symptoms and avoidance of triggering foods.
- Perform a comprehensive assessment of chest pain symptoms because the pain caused by GERD can be similar to symptoms of a myocardial infarction, especially in female clients.
- Assess for signs and symptoms of aspiration caused by GERD (i.e., wheezing, new onset asthma, chronic cough, and hoarseness).
- Assess complete blood count results for signs of anemia as a result of erosive GERD. Cardiac labs may be ordered by the health care provider to rule out a myocardial infarction when atypical chest pain is present.

NURSING ACTIONS

- Obesity can increase GERD symptoms, so weight loss is encouraged. A typical goal is to lose one pound per week until a desired weight is achieved. The client can also be referred to a dietician to help develop a healthy eating plan. Gastric bypass surgery is an option for severely obese clients with GERD.
- Small, frequent meals are encouraged instead of large meals because they are easier to digest and may reduce GERD symptoms.
- Administer prescribed GERD medications.

24. Curran, A. (2023). *GERD nursing diagnosis and nursing care plan*. https://nursestudy.net/gerd-nursing-diagnosis/

25. Vera, M. (2023). *8 gastroesophageal reflux disease (GERD) nursing care plans*. https://nurseslabs.com/gastroesophageal-reflux-disease-gerd-nursing-care-plans/

- Elevate the head of bed of clients in inpatient care to prevent GERD symptoms and decrease the risk of aspiration.

CLIENT TEACHING

The following topics are typically included when providing health teaching about GERD:

- Understand the GERD disease process and medications prescribed to manage the condition.
- Sit upright during and after meals.
- Avoid eating three hours before bedtime and elevate the head of the bed using boards or other devices.
- Follow dietary restrictions to help manage symptoms.
- Monitor the stool and vomit for the presence of blood because this can indicate erosive GERD.
- Encourage smoking cessation and avoidance of alcohol because these symptoms can cause increased production of acid, as well as relaxation of the LES, leading to increased GERD symptoms.
- Avoid bending over, coughing, and straining with bowel movements, as these actions can raise intra-abdominal pressure and increase reflux.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.

View a supplementary YouTube video[26] on GERD: Treatments for Heartburn | Gastroesophageal Reflux Disease (GERD) | Gastrointestinal Society.

View a supplementary video[27] on GERD and hiatal hernias: Heartburn and hiatal hernia.



RN Recap: GERD

View a brief YouTube video overview of GERD[28]:

One or more interactive elements has been excluded from this

26. Gastrointestinal Society. (2017, October 24). *Treatments for heartburn | Gastroesophageal reflux disease (GERD) | Gastrointestinal Society* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=wzdb4x0rAE4

27. Mayo Clinic. (n.d.). *Heartburn and hiatal hernia* [Video]. Unknown platform. All rights reserved. https://www.mayoclinic.org/diseases-conditions/heartburn/multimedia/heartburn-gerd/vid-20084644

28. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – GERD* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/DEq57OCB0L4?si=6g2xwVjRO-s_zXsP

version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3255#oembed-1

11.10 Peptic Ulcer Disease

Peptic ulcer disease (PUD) is characterized by erosions or ulcers in the gastrointestinal tract. PUD most commonly affects the duodenum and stomach, but it may also occur in the esophagus or jejunum.[1]

There are a variety of causes of PUD, but the most common causes are NSAID use and/or infection with *Helicobacter pylori* (H. pylori) bacteria. Other causes of PUD are stress due to severe illness or burns, the use of chemotherapy or radiation, or certain cancers. Other medications linked to PUD are steroid medications, potassium chloride, and bisphosphonates.[2]

Risk factors for developing PUD are low socioeconomic status, smoking, alcohol use, and obesity. Additionally, men have ulcers in the duodenum more frequently than women.[3]

Pathophysiology

Although there are a variety of causes of PUD, this section will focus on PUD caused by NSAID use and H. pylori bacterial infection. When PUD is caused by NSAID use, it is related to the blockage of COX enzymes. The COX-1 enzyme is responsible for prostaglandin production that protects gastrointestinal mucosa from acid. NSAIDs block the COX-1 enzyme and its protective effects on the gastrointestinal tract, leaving it vulnerable to ulcer formation.[4]

1. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
2. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
3. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
4. Qureshi, O., & Dua, A. (2024). *COX Inhibitors*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK549795/

H. pylori is a gram-negative bacteria that leads to inflammation in the mucosa of the gastrointestinal tract that ultimately leads to erosions and ulcerations. H. pylori also disrupts the release of bicarbonate, causing increased acidity and also cellular changes in the GI tract that increase the risk for cancer.[5]

Assessment

Physical Exam

The signs and symptoms of PUD are determined by the location of the ulcer. Clients with a gastric ulcer generally experience epigastric pain soon after consuming a meal. Clients with an ulcer located in the duodenum typically have pain two to three hours after eating a meal. Duodenal ulcers can also cause pain that awakens the client at night. In addition to abdominal pain, clients with PUD may experience bloating, feelings of fullness in the abdomen, nausea, and vomiting.[6]

Complications of PUD, such as a perforated or bleeding ulcer, are suspected in clients with decreased red blood cell counts, blood in their stool or emesis, and unintended weight loss.[7] See Figure 11.32[8] for an image of a bleeding stomach ulcer.

5. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
6. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
7. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/
8. "Bleeding_gastric_ulcer.png" by Jeremias is licensed under CC BY-SA 3.0

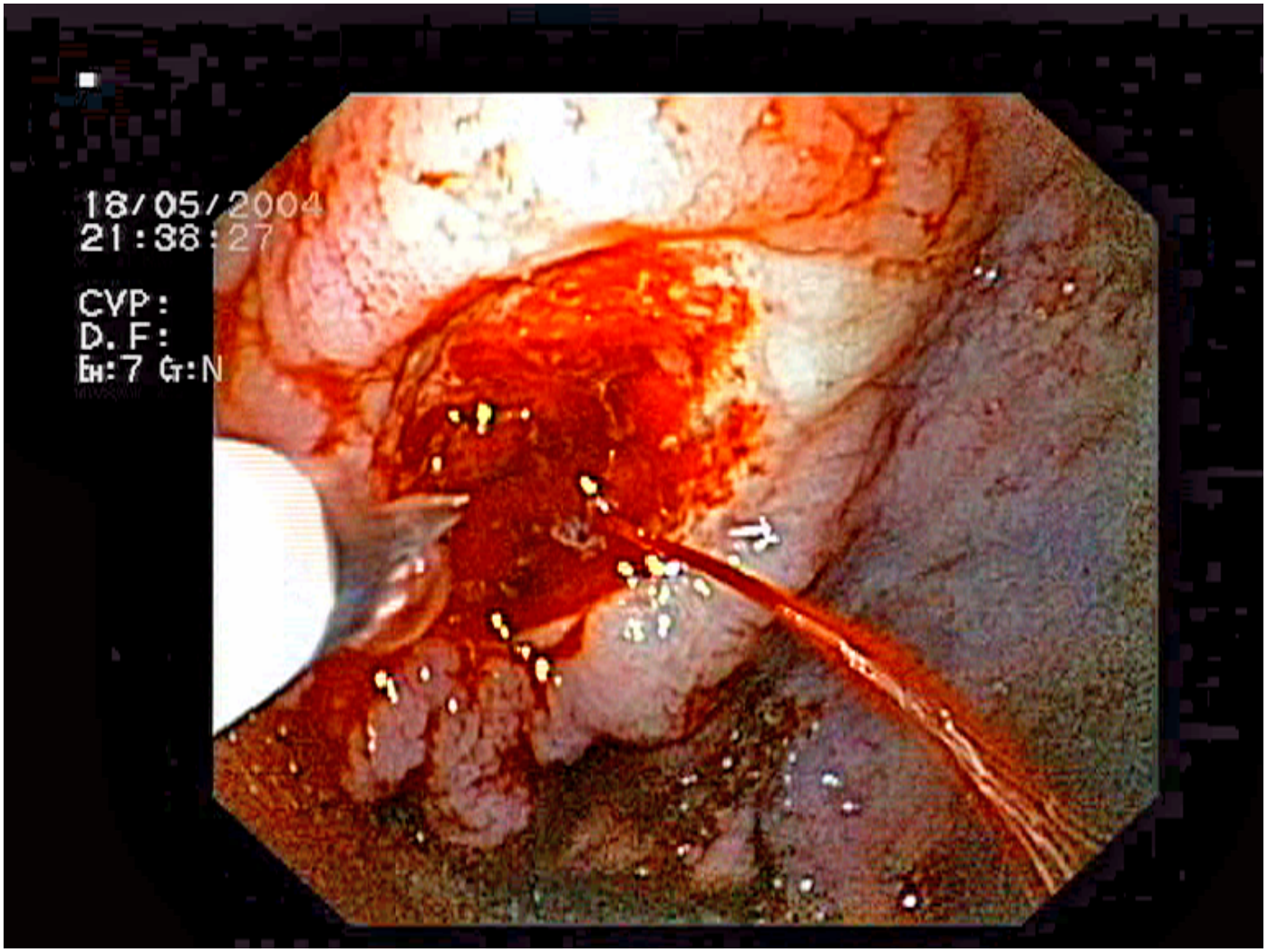


Figure 11.32 Bleeding Gastric Ulcer

Common Laboratory and Diagnostic Tests

Several laboratory and diagnostic tests may be ordered by the health care provider to diagnose PUD, but the gold standard is an esophagogastroduodenoscopy (EGD) because it allows visualization of ulcers. Biopsies can also be taken during an EGD to assess for the presence of H. pylori. If a client cannot undergo an EGD, a barium swallow is another diagnostic test used to diagnose PUD. In clients where a complication is

suspected, such as perforation of the ulcer, a CT scan of the abdomen may be ordered. Client stool can also be tested for occult blood.[9,10,11]

In addition to diagnostic testing, blood work may also be performed[12,13,14]

- A complete blood count (CBC) may be ordered to assess for anemia related to bleeding ulcers.
- Blood testing can determine if there are antibodies to H. pylori present. Stool and urine tests are also available to check for the presence of H. pylori.
- Urea breath tests are very specific for the presence of H. pylori. In this test, the client ingests a urea-containing compound, and their breath sample is collected. If H. pylori is present, it will break down the urea, which can be detected in the sample.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

9. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

10. Sankararaman, S., & Moosavi, L. (2024). *Urea Breath Test*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK542286/

11. Belleza, M. (2024). *Peptic ulcer disease*. https://nurseslabs.com/peptic-ulcer-disease/

12. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

13. Sankararaman, S., & Moosavi, L. (2024). *Urea Breath Test*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK542286/

14. Belleza, M. (2024). *Peptic ulcer disease*. https://nurseslabs.com/peptic-ulcer-disease/

Nursing Diagnoses

Nursing priorities for clients with PUD include managing pain, preventing complications, educating the client, and promoting nutrition.

Nursing diagnoses for clients with peptic ulcer disease are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Possible nursing diagnoses include the following[15]:

- Acute Pain
- Risk for Bleeding/Hemorrhage
- Readiness for Enhanced Knowledge
- Imbalanced Nutrition: Less than Body Requirements

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for clients with PUD include the following:

- *The client will rate their pain at 3 or less on a scale of 0 to 10 within four hours.*
- *The client will demonstrate stool/vomit that is free from blood until their next follow-up appointment.*

15. Belleza, M. (2024). *Peptic ulcer disease.* https://nurseslabs.com/peptic-ulcer-disease/

- *The client will describe common causes and treatment of peptic ulcer disease after the teaching session.*
- *The client will achieve a weight within a healthy range appropriate for their height within six months or less.*

Interventions

Medical Interventions

Medical treatment for PUD can be categorized as lifestyle changes, medication therapy, and surgical management.[16]

LIFESTYLE CHANGES

Clients are taught lifestyle changes that can improve their outcomes, such as the following:

- Smoking cessation
- Avoiding digestive system irritants such as alcohol, caffeine, and heavily spiced foods
- Losing weight

MEDICATIONS

Typical treatments for PUD are medications that decrease acid production and secretion. Commonly prescribed medications are proton pump inhibitors (PPIs) and H2 receptor antagonists (H2RAs). PPIs reduce the production of stomach acid, which not only provides symptomatic relief, but also promotes healing of ulcers. However, long-term use of PPIs has been associated with an increased occurrence of fractures, so calcium supplements may be

16. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

recommended.[17] In addition to increase occurrence of fractures, research also indicates a higher risk of developing dementia with long-term use of PPIs.[18]

If PUD was caused by NSAIDs or other medications, these medications should be discontinued when possible or taken at a lower dosage. If clients have other medical conditions requiring NSAID treatment, prostaglandin analogs such as misoprostol may be prescribed to help prevent ulcer formation.[19]

If PUD was caused by the presence of H. pylori, treatment consists of prescriptions of a PPI with antibiotics to eradicate the bacteria.[20]

> For more information on the medications used to treat PUD, visit the "Antiulcer Medications" section in the "Gastrointestinal System" chapter in Open RN *Nursing Pharmacology, 2e*.

17. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

18. Northuis, C. A., Bell, E. J., Lutsey, P. L., George, K. M., Gottesman, R. F., Mosley, T. H., Whitsel, E. A., & Lakshminarayan, K. (2023). Cumulative use of proton pump inhibitors and risk of dementia: The Atherosclerosis Risk in Communities Study. *Neurology, 101*(18), e1771-e1778. https://doi.org/10.1212/WNL.0000000000207747

19. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

20. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

SURGERY

Surgery may be indicated for clients with PUD who do not respond to medications or have complications present. Common surgical procedures to treat PUD are vagotomy or a partial gastrectomy. A vagotomy severs part of the nerve supply to the stomach, which decreases acid production. A partial gastrectomy involves removing the ulcerated portion of the stomach.[21]

Nursing Interventions

When providing nursing care to a client with PUD, nursing interventions can be divided into nursing assessments, nursing actions, and client teaching[22,23]:

NURSING ASSESSMENTS

- Assess the client's nutritional status because it can be impacted by the symptoms of PUD. Clients may exhibit weight gain if eating causes a reduction in ulcer pain or weight loss if eating causes increased pain.
- Perform a comprehensive pain assessment because pain caused by PUD can be similar to pain caused by a myocardial infarction. Sudden changes in pain can occur with ulcer perforation.
- Monitor vital signs, as changes could indicate a potential complication such as perforation of the ulcer or hemorrhage.
- Assess emesis/stool for the presence of blood.
- Assess lab values such as hemoglobin and hematocrit for decreases

21. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

22. Malik, T. F., Gnanapandithan, K., & Singh, K. (2023). *Peptic Ulcer Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534792/

23. Belleza, M. (2023). *Peptic ulcer disease.* https://nurseslabs.com/peptic-ulcer-disease/

associated with a bleeding/hemorrhaging ulcer.

NURSING ACTIONS

- Administer medications as prescribed by the provider.
- Encourage smoking cessation.
- During inpatient care, a nasogastric tube may be ordered.

CLIENT TEACHING

Teaching topics for clients with PUD typically include the following topics:

- Avoid taking aspirin and other NSAIDs or reduce their dosage, if possible.
- Avoid acidic, spicy, or oily foods, as these can exacerbate symptoms.
- Avoid caffeinated beverages and decaffeinated coffee, as these can increase the production of stomach acid.

View a supplementary video on PUD: Peptic Ulcer.[24]

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation

24. Mercy Baltimore, MD. (n.d.). *Peptic ulcer* [Video]. Wistia. All rights reserved. https://mdmercy.com/mercy-services/conditions/peptic-ulcer-disease

of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.



RN Recap: Peptic Ulcer Disease

View a brief YouTube video overview of peptic ulcer disease[25]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3295#oembed-1

25. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Peptic ulcer disease* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/dr3SpNbKiCM?si=qdFBSRmyshrHXWNy

11.11 Inflammatory Bowel Disease

Inflammatory bowel disease (IBD) is a chronic disorder that is characterized by inflammation in the gastrointestinal tract. IBD is an umbrella term used to describe two disorders called ulcerative colitis and Crohn's disease. In ulcerative colitis (UC), this inflammation is limited to the two layers of the colon, the mucosa and submucosa, most commonly in the rectum. In Crohn's disease (CD), inflammation can occur anywhere in the GI tract, from the mouth to the anus, and the inflammation affects all three layers of the colon. With both disorders, signs and symptoms can also occur outside the GI tract, commonly referred to as **extraintestinal manifestations**. Neither ulcerative colitis or Crohn's disease can be cured, and both disorders carry an increased risk for cancer of the GI tract.[1,2,3]

Both UC and CD are linked to an autoimmune response; however, the exact cause is unknown. It is thought that this autoimmune response could be

1. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

2. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

3. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

triggered by normal intestinal bacteria, certain drugs/toxins, or infectious processes. There are also several risk factors for developing IBD[4,5,6]:

- Genetics/family history of IBD
- Clients aged 15-30 years and 60 or older
- Northern European/Jewish ancestry

IBD is also more common in developed countries and in cold climates.[7,8,9]

Pathophysiology

In IBD, extreme inflammation leads to breakdown of the mucosal layer of the

4. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

5. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

6. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

7. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

8. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

9. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

GI tract. This breakdown allows exposure to intestinal viruses or bacteria that can also cause increased inflammation.[10,11,12]

In clients with UC, inflammation leads to edema and ulcerations that can bleed. This inflammation spreads in a uniform fashion, starting in the rectum and proceeding up the colon. Over time, the colon becomes inflexible and shortened, ultimately losing the folds (**haustra**) in the colon.[13,14,15]

In clients with CD, the inflammation starts out with a singular lesion, which goes on to develop into a deeper ulceration. Unlike UC, which has a uniform spread, a hallmark sign of CD are **skip lesions**. These are lesions that "skip" around the GI tract, leaving areas of normal or unaffected bowel between them. Over time, the affected areas develop a "cobblestone" appearance. The continued inflammation and resulting scar tissue can lead to the formation of **strictures** (narrowing) or **fistulas** (an abnormal passageway between two

10. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

11. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

12. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

13. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

14. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

15. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

organs), causing bowel obstruction.[16,17,18] See Figure 11.33[19] for an illustration of the differences between CD and UC.

The inflammation of IBD is not limited to the GI tract and can occur in joints/bones, bile ducts, mouth (e.g., canker sores), eyes, and skin.[20,21,22]

16. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

17. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

18. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

19. "Crohn%27s_Disease_vs._Ulcerative_Colitis.jpg" by RicHard-59 is licensed under CC BY-SA 4.0

20. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

21. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

22. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

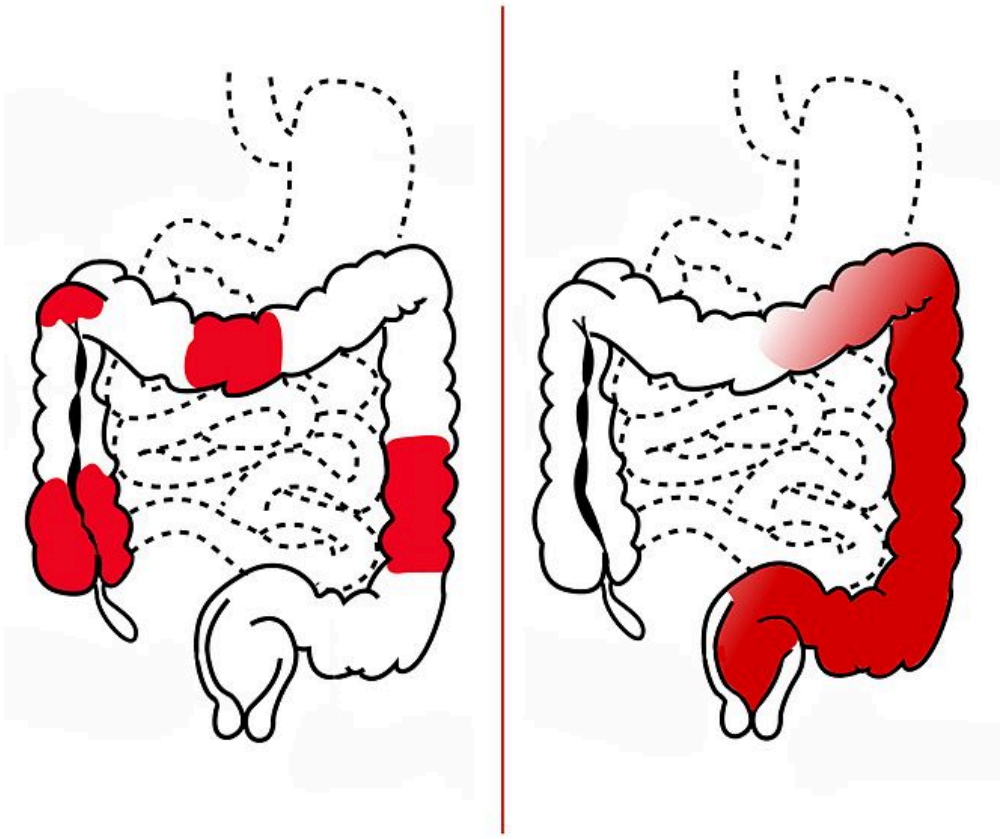


Figure 11.33 Comparison of Locations of Inflammation in Crohn's Disease (CD) and Ulcerative Colitis (UC). (Left side): CD with skip lesions and (Right side): UC with widespread inflammation

Assessment

Physical Exam

Although UC and CD share similar characteristics, there are some key differences between the two in signs and symptoms that may be found

during assessment. See Table 11.11 for the similarities and differences between the signs and symptoms of UC and CD.[23,24,25]

Table 11.11. Comparison of Ulcerative Colitis and Crohn's Disease

Ulcerative Colitis	**Crohn's Disease**
Affects only mucosa and submucosa layers of bowel	Affects all layers of bowel
Ulcerations confined to large intestine	Ulcerations anywhere in the GI tract, but most commonly appear in small and large intestine
Uniform spread of lesions	Skip lesions
Diarrhea, may contain blood and mucus	Non-bloody diarrhea
Abdominal pain, left upper or left lower quadrant	Abdominal pain, right lower quadrant
Tenesmus (Frequent urge to have a bowel movement/ sensation that bowels are not empty)	Tenesmus rare
Fistulas, abscesses, strictures are rare	Fistulas, abscesses, strictures, fissures may be present
Weight loss is rare	Weight loss is common
Elevated heart rate, fever, dehydration	Elevated heart rate, fever, dehydration
Nausea/vomiting rare	Nausea/vomiting common
Symptoms can remit and relapse	Symptoms can remit and relapse

23. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

24. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

25. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312/

Common Laboratory and Diagnostic Tests

A variety of laboratory and diagnostic tests may be used to diagnose IBD, as well as to rule out other disorders that can cause similar symptoms[26,27]:

LABORATORY TESTS

- A complete blood count (CBC) may indicate anemia due to blood loss in stool and an elevated white count due to inflammation. Elevated platelet levels may be seen with Crohn's disease, increasing the client's risk for developing deep vein thrombosis (DVT), pulmonary embolism, and cerebrovascular accident (CVA).
- A comprehensive metabolic panel (CMP) may show decreased albumin levels if malnutrition is occurring. Altered electrolyte levels may also occur with severe diarrhea.
- Elevated markers of inflammation such as a C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) may occur.
- A variety of stool studies can be used to help diagnose IBD, as well as rule out other conditions. For example, fecal calprotectin levels may be elevated due to inflammation. Stool can also be examined for ova and parasites to rule out a parasitic infection.[28,29]

26. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

27. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

28. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

29. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

DIAGNOSTIC TESTING

- Endoscopy is the gold standard for confirming the presence of IBD by taking a biopsy of the affected tissue. This can be done via EGD but is more commonly done via a colonoscopy.
- Barium studies can also be useful in diagnosing IBD because they can show the characteristic "lead pipe appearance" that is common with UC and the skip lesions that are common in CD.
- Ultrasounds, abdominal X-rays, CT scans, and MRIs can also be ordered to assess for complications caused by IBD such as perforation, bowel obstructions, fistulas, and strictures.[30,31]

Nursing Diagnosis

Nursing priorities for those suffering from inflammatory bowel disease include symptom management, preventing complications, and ensuring adequate nutrition.

Nursing diagnoses for clients with inflammatory bowel disease are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

30. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

31. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

Possible nursing diagnoses for those with inflammatory bowel disease are as follows[32,33,34]:

- Diarrhea
- Acute Pain
- Deficient Fluid Volume
- Impaired Skin Integrity
- Risk for Infection
- Imbalanced Nutrition: Less than Body Requirements
- Risk for Infective Coping

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes include the following:

- *The client will exhibit formed stool that occurs at the client's normal frequency until the next follow-up appointment.*
- *The client will rate their pain at 3 or less on a scale of 0 to 10 within two*

32. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

33. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

34. Curran, A. (2022). *Inflammatory bowel disease nursing diagnosis and nursing care plan.* https://nursestudy.net/inflammatory-bowel-disease-nursing-diagnosis/?expand_article=1

hours.

- *The client will exhibit blood pressure and heart rate within normal limits for age, moist mucous membranes, and urine output appropriate for their age during hospitalization.*
- *The client will exhibit skin in the peri-area that is an appropriate color for race and free from skin breakdown during symptoms of diarrhea.*
- *The client will verbalize three methods to reduce their risk of contracting an infection after the teaching session.*
- *The client will maintain a weight within a healthy range that is appropriate for their height until their next follow-up appointment.*

Interventions

Medical Interventions

Medical treatment for IBD can be categorized as medication therapy and surgical management.

Specific interventions for IBD will depend on the severity of the disorder, but the ultimate goal is to achieve remission.[35,36]

MEDICATIONS

Medication therapy for IBD is often prescribed in a stepwise approach to achieve symptom management. The first step is the use of aminosalicylates, such as mesalamine. If the client does not achieve symptom control with aminosalicylates, the second step adds a steroid medication until inflammation is decreased. Step-three drugs, also known as immune-modifying agents (i.e., thiopurines) or biological drugs (i.e., anti-TNF-alpha

35. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

36. Lynch, W. D., & Hsu, R. (2023). *Ulcerative Colitis.* StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459282/

medications), are used when steroids do not achieve the desired effect. Step-four medications are disease specific (i.e., for UC or CD) and tend to be experimental with multiple side effects. Many medications used to treat IBD suppress the immune system, increasing the client's risk for infection.[37,38,39]

An alternative approach to stepwise therapy is a step-down approach. This type of therapy refers to the prescription of potent medications first that are then scaled back after symptoms are under control. This approach is generally used for clients with severe cases of IBD or at high-risk for complications.[40,41,42]

Lastly, probiotics and antidiarrheals may be used in some clients. Probiotics

37. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

38. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

39. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

40. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

41. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

42. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

will help replenish natural flora, and antidiarrheals will help reduce the frequency of stools.[43,44,45]

View a supplementary YouTube video[46] on medications used to IBD: Medications for IBD (Crohn's and Colitis) Featuring Dr. Alan Low | GI Society.

SURGICAL MANAGEMENT

Surgical removal of the colon (**total colectomy**) may be required for clients with UC if the disease cannot be controlled with medications or if complications are present. After surgery, the client has a stoma and colostomy collection bag. Although this surgery will cure the gastrointestinal

43. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

44. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

45. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

46. Gastrointestinal Society. (2020, November 5). *Medications for IBD (Crohn's and Colitis) featuring Dr. Alan Low | GI Society* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=QFtqqGAvy0Y

symptoms of UC, it will not cure any extraintestinal manifestations of the disorder.[47,48,49]

Surgery may be required for clients with severe CD disease or when complications are present. The site of the surgery is determined by the affected portion of the GI tract and the purpose of the surgery.[50,51,52]

47. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

48. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

49. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

50. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

51. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

52. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

Nursing Interventions

When providing nursing care to clients with IBD, nursing interventions can be divided into nursing assessments, nursing actions, and client teaching[53,54,55,56]:

NURSING ASSESSMENTS

- Assess the client for signs and symptoms of malnutrition and anemia, as these can be caused by poor intake or poor absorption of nutrients.
- Assess the intake and output of the client, noting the number of calories consumed, as well as consistency, characteristics, and frequency of stools.
- Assess for elevated temperature, elevated heart rate, increased white blood cell count, and increased pain, as these could indicate a complication such as perforation and peritonitis. Low blood pressure, elevated heart rate, and low-grade fever may also occur with dehydration.
- Assess the client's weight daily to monitor for malnutrition, as well as fluid loss due to diarrhea.
- Assess electrolyte levels (particularly potassium and magnesium), as levels can be decreased due to diarrhea.
- Complete frequent abdominal assessments, as altered bowel sounds, increased pain, or distention may mean that a complication such as

53. Ranasinghe, I. R., Tian, C., & Hsu, R. (2024). *Crohn Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK436021/

54. McDowell, C., Farooq, U., & Haseeb, M. (2023). *Inflammatory Bowel Disease*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470312

55. Vera, M. (2023). *10 inflammatory bowel disease (IBD) nursing care plans*. https://nurseslabs.com/inflammatory-bowel-disease-nursing-care-plans/

56. Curran, A. (2022). *Inflammatory bowel disease nursing diagnosis and nursing care plan.* https://nursestudy.net/inflammatory-bowel-disease-nursing-diagnosis/?expand_article=1

bowel obstruction or perforation has occurred.

NURSING ACTIONS

- Encourage frequent colonoscopies (every one to two years) due to the high risk of cancer development.
- Seek referrals to mental health services if needed as anxiety and depression are common.
- Encourage the client to receive appropriate vaccinations due to their increased risk for illness.
- Administer intravenous fluids or total parenteral nutrition (TPN) as ordered. TPN may be needed for clients with severe disease or during acute flare-ups.
- Ensure referrals to a stoma nurse if the client has a stoma present.
- Administer IBD medications per provider order.
- Encourage the client to drink two liters of fluid per day to prevent dehydration.
- Encourage the client to join a support group consisting of others with IBD to strengthen their support system.
- Provide peri-care after bowel movements and apply barrier cream as needed.

> Review information about parenteral nutrition in the "Applying the Nursing Process" section of the "Nutrition" chapter of Open RN *Nursing Fundamentals, 2e*.

CLIENT TEACHING

The following teaching topics are typically included in health teaching about IBD:

- Teach the client about the disease process, treatment, and self-managing the disorder. Many medications used to treat IBD have serious side effects that should be reported to the health care provider.
- Review symptoms of perforation and when to seek emergency care.
- Encourage bone mineral density testing as prescribed by their health care provider due to the increased risk of osteoporosis from steroid medications.
- Avoid NSAIDs because they may increase symptoms.
- Avoid foods that may increase symptoms such as dairy, caffeine, alcohol, and foods high in fat and fiber. Clients may benefit from a diet that is bland and high in protein, calories, and vitamins.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.



RN Recap: Inflammatory Bowel Disease

View a brief YouTube video overview of inflammatory bowel disease[57]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3300#oembed-1

57. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Inflammatory bowel disease* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/FnIXCLwgbt8?si=-Jk5Su-tBFY4Bt3I

11.12 Irritable Bowel Syndrome

Irritable bowel syndrome (IBS) is a chronic gastrointestinal disorder in which there is abdominal discomfort, along with a change in bowel patterns. There are three different subclasses of IBS: IBS-C, IBS-D, and IBS-M. In IBS-C, constipation is the predominant stool pattern. In IBS-D, diarrhea is the predominant stool pattern. With IBD-M, there is a mix of bowel movement types, alternating between diarrhea and constipation.

IBS is most common in women younger than 50 years old. Additionally, clients with anxiety, depression, or increased stress are more likely to experience IBS. Family history/genetics is a risk factor, and IBS is most common in clients from South America and least common in clients from Southeast Asia. Certain foods can also trigger IBS symptoms, such as dairy products; gas-producing foods such as cabbage and beans; carbonated beverages; and citrus fruits.

Pathophysiology

IBS is a functional disorder, meaning there are symptoms present but there is no correlating gastrointestinal disease. The cause of IBS is unknown, but there are many theories regarding the development of this disorder such as the following[1,2]:

- Alterations in intestinal muscle contractions, with increased muscle contractions causing diarrhea and decreased or weak contractions causing constipation.
- Inappropriate nervous system signaling in the GI tract.

1. Patel, N., & Shackelford, K. B. (2022). *Irritable Bowel Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534810/

2. Curran, A. (2023). *Irritable bowel syndrome (IBS) nursing diagnosis and care plan.* https://nursestudy.net/irritable-bowel-syndrome-nursing-diagnosis/

- Alterations in the normal intestinal flora when compared to clients without IBS.
- Changes in the immune response of the gastrointestinal tract.
- Environmental factors such as significant stress early in life, antibiotic use, infections such as gastroenteritis, and the inability to tolerate certain foods.

Assessment

Physical Exam

Common signs and symptoms of IBS include the following[3]:

- Abdominal pain
- A change in bowel habits such as diarrhea, constipation, or alternating diarrhea and constipation
- Abdominal distention or bloating
- Correlation of symptoms with intake of certain foods that are relieved by bowel movements

There is no specific diagnostic test for IBS, but it is typically diagnosed by a health care provider using **Rome IV criteria.** Criteria include recurrent abdominal pain at least one day per week associated with two or more of the following symptoms over a three-month time span[4]:

- Abdominal pain that improves after having a bowel movement
- Alterations in stool frequency
- Alterations in the appearance of stool

3. Patel, N., & Shackelford, K. B. (2022). *Irritable Bowel Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534810/

4. Patel, N., & Shackelford, K. B. (2022). *Irritable Bowel Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534810/

Common Laboratory and Diagnostic Tests

There are no diagnostic tests for IBS. However, if other alarming symptoms are present, such as blood in stool or unexpected weight loss, blood tests such as a complete blood count or metabolic panel may be done to rule out other causative factors. If diarrhea is an associated symptom, stool tests may be ordered to rule out an infectious cause. A colonoscopy may also be ordered, especially if there is a family history of gastrointestinal cancer or IBD.[5]

Nursing Diagnosis

Nursing priorities for those suffering from irritable bowel syndrome include managing symptoms, promoting good nutrition, and preventing dehydration.

Nursing diagnoses for clients with irritable bowel syndrome are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Possible nursing diagnoses for those with irritable bowel syndrome are as follows[6,7]:

- Acute Pain
- Constipation

5. Patel, N., & Shackelford, K. B. (2022). *Irritable Bowel Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534810/

6. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

7. Curran, A. (2023). *Irritable bowel syndrome (IBS) nursing diagnosis and care plan.* https://nursestudy.net/irritable-bowel-syndrome-nursing-diagnosis/

- Diarrhea
- Imbalanced Nutrition: Less than Body Requirements
- Risk for Fluid Volume Deficit

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes include the following:

- *The client will rate their pain at 3 or less on a scale of 0 to 10 on a daily basis.*
- *The client will pass bowel movements without straining until their next scheduled appointment.*
- *The client will exhibit a formed stool that occurs at the client's normal frequency until their next scheduled appointment.*
- *The client will maintain a weight within a healthy range that is appropriate for their height over the next six months.*
- *The client will exhibit blood pressure and heart rate within normal limits for age, moist mucous membranes, and urine output appropriate for age until their next scheduled appointment.*

Interventions

Medical Interventions

The goal of IBS treatment is to control symptoms that are experienced by the

client. This can be accomplished with lifestyle changes and the use of medications.[8]

LIFESTYLE CHANGES

- Increased physical activity can decrease symptoms because it increases the amount of time it takes for food to move through the colon.
- Avoid foods that are poorly absorbed that increase symptoms such as wheat products, onions, dairy, and some fruits and vegetables.

MEDICATIONS

- For clients with constipation as the predominant symptom, fiber supplements and/or laxatives may be prescribed.
- For clients with diarrhea as the predominant symptom, antidiarrheals and/or probiotics may be prescribed.
- Low doses of antidepressants such as tricyclic antidepressants (TCAs) or selective serotonin reuptake inhibitors (SSRIs) can be helpful for clients with severe symptoms.
- Alosetron has shown symptom improvement in women with IBS-D.
- Rifaximin, an antibiotic, has also reduced the occurrence of diarrhea and abdominal pain in those with IBS.

Nursing Interventions

When providing nursing care to a client diagnosed with IBS, nursing

8. Patel, N., & Shackelford, K. B. (2022). *Irritable Bowel Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534810/

interventions can be divided into nursing assessments, nursing actions, and client teaching[9,10]:

NURSING ASSESSMENTS

- Assess the client's daily intake of food to establish a baseline of their dietary status.
- Assess the client's weight daily to monitor their progress towards weight-related goals.
- Assess the frequency, consistency, and amount of stool.
- Monitor electrolytes levels and replenish if necessary if diarrhea is present.
- Assess for signs of dehydration due to fluid loss: dry skin and mucous membranes, increased heart rate, low blood pressure, and decreased urine output.

NURSING ACTIONS

- Administer IBS medications as prescribed by the provider to help manage symptoms.
- Encourage referral to gastroenterologist because they can individualize the client's IBS treatment plan.
- Encourage referral to a dietician to help create a dietary plan that is client specific.
- Encourage oral fluid intake/administer intravenous fluids to prevent/treat dehydration when diarrhea is present. Cold liquids should be avoided as they can increase gastrointestinal motility.

9. Patel, N., & Shackelford, K. B. (2022). *Irritable Bowel Syndrome*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK534810/

10. Curran, A. (2023). *Irritable bowel syndrome (IBS) nursing diagnosis and care plan*. https://nursestudy.net/irritable-bowel-syndrome-nursing-diagnosis/

CLIENT TEACHING

- Avoid food triggers, such as gas-producing foods, gluten, and carbohydrates that contain lactose and fructose. A diet high in fiber and increased fluid intake should be encouraged if constipation is an issue.
- Use stress management strategies (such as deep breathing and meditation) to help decrease symptoms.
- Keep a food diary to help identify personal food triggers.
- For clients with IBS-C, monitor stool pattern and frequency to identify when additional medications are needed to treat constipation.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.

View a supplementary YouTube video[11] on IBS: Irritable bowel syndrome (IBS) – causes, symptoms, risk factors, treatment, pathology,

11. Osmosis from Elsevier. (2022, September 13). *Irritable bowel syndrome (IBS) – causes, symptoms, risk factors, treatment, pathology* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=E86eXpVBTcI



RN Recap: Irritable Bowel Syndrome

View a brief YouTube video overview of irritable bowel syndrome[12]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3313#oembed-1

12. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Irritable bowel syndrome* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/u62j5GCSkGk?si=JsvdvCKSD5pseFBG

11.13 Bowel Obstruction

A **bowel obstruction** is a blockage of the intestines caused by a mechanical or nonmechanical condition. A **mechanical blockage** is when something is physically blocking the inside of the bowel and inhibiting the passage of bowel contents. Potential causes of a mechanical bowel obstruction are adhesions or scar tissue that occurs after surgery, tumors, incarcerated hernias, strictures, or the ingestion of a foreign object. A mechanical bowel obstruction can also be caused by a **volvulus** (twisting of the intestines) or **intussusception** (part of the bowel telescopes into itself).[1,2,3,4] See Figures 11.34[5] and 11.35[6] for illustrations of a volvulus and an intussusception.

1. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

2. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

3. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

4. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

5. "EB1911_Intestinal_Obstruction_-_volvulus.jpg" by Unknown author is licensed in the Public Domain

6. "Intussusception.png" by BruceBlaus is licensed under CC BY-SA 4.0

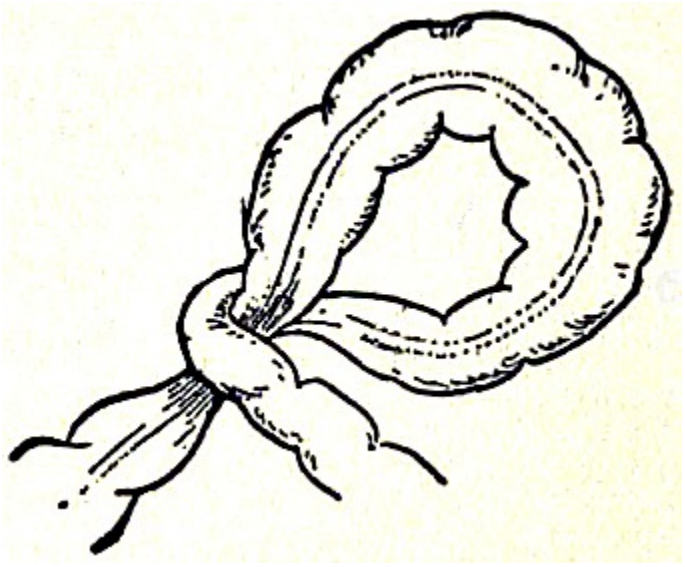


Figure 11.34 Volvulus (Twisting of the Intestine)

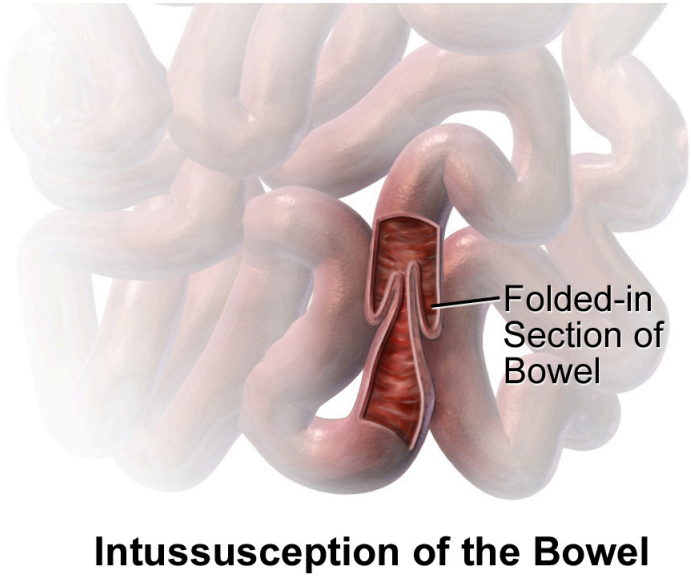


Figure 11.35 Bowel intussusception

A nonmechanical blockage means that nothing is physically blocking the lumen of the bowel, but peristalsis is not occurring, and bowel contents are not moving forward through the intestines normally. An example of a

nonmechanical bowel obstruction is an ileus. An ileus is commonly caused by manipulation of the bowels during abdominal surgeries.[7,8,9,10]

Bowel obstructions can cause either a partial or complete blockage. Furthermore, a bowel obstruction can occur in the small or large intestine, but they occur more commonly in the small bowel.[11,12,13,14]

7. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

8. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

9. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

10. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

11. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

12. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

13. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

14. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

Risk factors for a bowel obstruction include the following[15,16,17,18]:

- Abdominal surgery
- Cancer of the gastrointestinal tract
- Chronic inflammatory disorders affecting the GI tract, such as Crohn's disease
- Presence of hernias (abdominal or inguinal)
- Prior radiation
- Opioid medications
- Severe constipation/impacted stool
- GLP-1RA medications used to treat type 2 diabetes and nondiabetes obesity[19]

Pathophysiology

The purpose of the small intestine is to break down ingested food and absorb the resulting nutrients. The goal of the large intestine is to continue digestive processes and absorb water. When an obstruction occurs, the intestine

15. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

16. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

17. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

18. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

19. Sodhi, M., Rezaeianzadeh, R., Kezouh, A., & Etminan, M. (2023). Risk of gastrointestinal adverse events associated with glucagon-like peptide-1 receptor agonists for weight loss. *JAMA, 330*(18), 1795-1797. https://doi.org/10.1001/jama.2023.19574

cannot move digested food and fluid through the gastrointestinal tract, resulting in the accumulation of intestinal contents above the level of the obstruction and visible abdominal distension. The body tries to compensate by increasing secretions to help move the contents through, which leads to further obstruction. As the obstruction continues, the bowel becomes edematous, and increased capillary permeability causes plasma to leak into the peritoneal cavity, trapping fluid in the intestinal lumen and reducing the absorption of fluid and electrolytes into the bloodstream. As a result, blood flow is compromised, leading to hypovolemia and electrolyte imbalances, as well as bowel necrosis, perforation, and peritonitis.[20,21,22,23]

Assessment

Physical Exam

Signs and symptoms of a bowel obstruction may differ based on the location

20. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

21. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

22. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

23. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

and cause of the obstruction. Common signs and symptoms of a bowel obstruction are as follows[24,25,26,27]:

- Abdominal pain
- Nausea
- Vomiting (Vomit may contain or smell like stool.)
- Abdominal distention/bloating
- Changes in bowel movements (Inability to pass stool or diarrhea as only liquid stool can pass obstruction.)
- Inability to pass gas
- Changes in bowel sounds (May have increased bowel sounds in early stages of obstruction and decreased or absent bowel sounds in later stages. Bowel sounds may also be increased above the obstruction and decreased or absent below the obstruction.)

Common Laboratory and Diagnostic Tests

Bowel obstructions can be confirmed by an abdominal CT scan with the use of contrast. Test results allow the provider to locate the site of the obstruction and any potential complications to determine if surgical intervention is

24. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

25. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

26. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

27. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

required. An abdominal X-ray may be completed prior to a CT scan, but it may not give enough detail to determine the type of obstruction present.[28,29]

A number of labs may also be done to evaluate for the presence of complications[30,31]:

- Complete blood count (CBC) results may show elevated white blood cell count in cases of bowel necrosis.
- Electrolytes (particularly potassium) may be decreased due to vomiting.
- Lactic acid can be elevated in cases of sepsis or bowel perforation.

Review normal reference ranges for common diagnostic tests in "Appendix A – Normal Reference Ranges."

Nursing Diagnosis

Nursing priorities for those suffering from bowel obstruction include symptom management, promoting nutrition, and preventing complications from occurring.

Nursing diagnoses for clients with bowel obstruction are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve

28. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

29. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

30. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

31. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

as a guide for client treatment. Possible nursing diagnoses for those with a bowel obstruction are as follows[32,33]:

- Acute Pain
- Constipation
- Imbalanced Nutrition: Less than Body requirements
- Fluid Volume Deficit

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for some of the above nursing diagnoses are listed below:

- *The client will rate their pain at 3 or less on a scale of 0 to 10 within four hours.*
- *The client will pass bowel movements without straining within 48 hours.*
- *The client will maintain a weight within a healthy range that is appropriate for their height until their follow-up appointment.*
- *The client will exhibit blood pressure and heart rate within normal limits for age, moist mucous membranes, and urine output appropriate for age during their hospitalization stay.*

32. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023* (12th ed.). Thieme.

33. Curran, A. (2024, January 28). *Bowel obstruction nursing diagnosis and care plan.* https://nursestudy.net/bowel-obstruction-nursing-diagnosis/

Interventions

Medical Interventions

A bowel obstruction is medically managed based on the type of bowel obstruction and its severity. A mainstay of bowel obstruction treatment is the insertion of a nasogastric (NG) tube. The nasogastric tube serves a variety of purposes. Primarily, an NG tube allows for decompression of the bowel to prevent vomiting, and it also allows for measurement of output. If a volvulus occurs in the sigmoid portion of the colon, a rectal tube may be inserted for decompression.[34,35,36,37]

Some clients may only require nasogastric tube insertion and supportive care as needed. Supportive care measures include nothing by mouth (NPO) diet order, administration of intravenous fluids, electrolyte replacement, and encouragement of ambulation. If the client is unable to take food by mouth for an extended period of time, total parenteral nutrition may be needed.

34. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

35. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

36. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

37. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

Limiting opioid use is also warranted, and antibiotics may also be prescribed in some instances.[38,39,40,41]

Some clients may require surgical intervention to treat the blockage. The surgical procedure needed will depend on the degree and type of obstruction, but may include removing the affected portion of the bowel and creating a stoma.[42,43,44,45]

Nursing Interventions

When providing nursing care for a client with a bowel obstruction, nursing

38. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

39. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

40. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

41. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

42. Beach, E. C., & De Jesus, O. (2023). *Ileus*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK558937/

43. Smith, D. A., Kashyap, S., & Nehring, S. M. (2023). *Bowel Obstruction(Archived)*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441975/

44. Schick, M. A., Kashyap, S., Collier, S. A., et al. (2025). *Small Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK448079/

45. Lieske, B., Marietta, M., & Meseeha, M. (2024). *Large Bowel Obstruction*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK441888/

interventions can be divided into nursing assessments, nursing actions, and client teaching[46]:

NURSING ASSESSMENTS

- Assess the contour of the client's abdomen and the presence of bowel sounds and flatus. The return of bowel sounds and flatus could indicate an improvement in the obstruction.
- Assess intake and output. Due to their NPO status and vomiting, the client is at risk for dehydration. The amount/color/consistency of NG tube drainage should also be monitored.
- Monitor the client's vital signs. Vital signs may be altered due to dehydration, pain, or complications such as perforation/peritonitis.
- Monitor lab results, including WBCs, for signs of infection and electrolyte levels, particularly sodium, potassium, and magnesium, as these may be altered due to vomiting and NG suctioning.
- Assess skin around NG tube and output of NG tube.

NURSING ACTIONS

- Employ nonpharmacological methods to reduce pain such as distraction, deep breathing techniques, meditation, or the use of hot or cold.
- Insert a nasogastric tube per provider order and assess the tube every shift and as needed. Provide frequent oral care.
- Encourage ambulation, as this can help increase peristalsis.
- When the client is able to resume intake, encourage small, frequent meals and advance the client's diet as tolerated/ordered by the provider.
- Administer intravenous fluids and electrolyte replacements as ordered by the provider.
- Provide oral care as needed while the nasogastric tube is in place.

46. Curran, A. (2024). *Bowel obstruction nursing diagnosis and care plan*. https://nursestudy.net/bowel-obstruction-nursing-diagnosis/

- Consult with a dietician as indicated to review potential nutritional causes of bowel obstruction and create a diet plan.

CLIENT TEACHING

- Teach about the effects of opioid use on the bowel, as indicated.
- Teach the purpose of the nasogastric tube.
- Reinforce teaching about planned surgical procedures and what to expect postoperatively.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.



RN Recap: Bowel Obstruction

View a brief YouTube video overview of bowel obstruction[47]:

47. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 –*

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3319#oembed-1

Bowel obstruction [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/UA4d1b2182M?si=QHTinv7_87MF1IEj

11.14 Hernia

A **hernia** is when internal organs or tissues bulge through an inappropriate opening. Common types of hernias are inguinal hernias, hiatal hernias, and ventral hernias[1,2,3,4,5]:

- **Inguinal hernias** occur in the inguinal canal. The **inguinal canal** is a passageway that contains the spermatic cord and blood vessels in men and the round ligaments in women. See Figure 11.36[6] for an image of the small bowel herniating through the inguinal canal of a male.
- **Hiatal hernias** are when part of the stomach bulges through the diaphragmatic opening. This opening of the diaphragm is also known as the **esophageal hiatus** as the esophagus passes through this opening on its way to the stomach. See Figure 11.37[7] for an illustration of a hiatal hernia.

1. Curran, A. (2022). *Hernia nursing diagnosis and nursing care plan*. https://nursestudy.net/hernia-nursing-diagnosis/?expand_article=1

2. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

3. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia.* StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

4. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

5. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

6. "Inguinalhernia.gif" by National Institutes of Health is in the Public Domain

7. "Hiatal_Hernia.png" by BruceBlaus is licensed under CC BY-SA 4.0

- **Ventral hernias** are hernias that occur in the wall of the abdomen and are neither inguinal nor hiatal in origin. See Figure 11.38[8] for an illustration of a ventral hernia in a child.

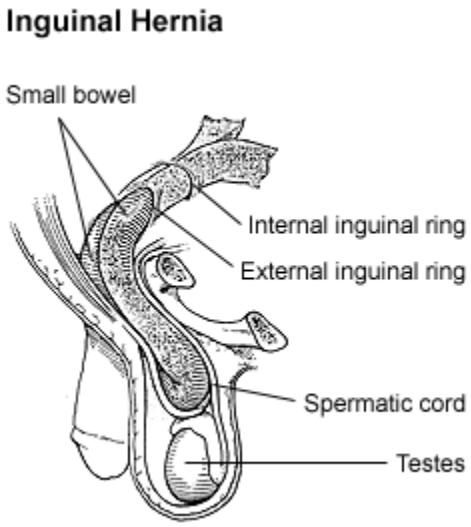


Figure 11.36 Inguinal Hernia

8. "Ventral_hernia_Wellcome_L0061630.jpg" by unknown author for Welcomimages.org is licensed under CC BY 4.0

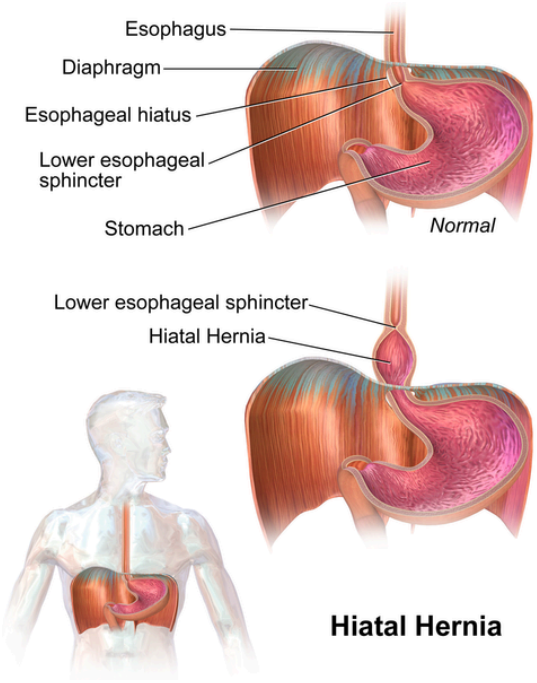


Figure 11.37 Hiatal Hernia

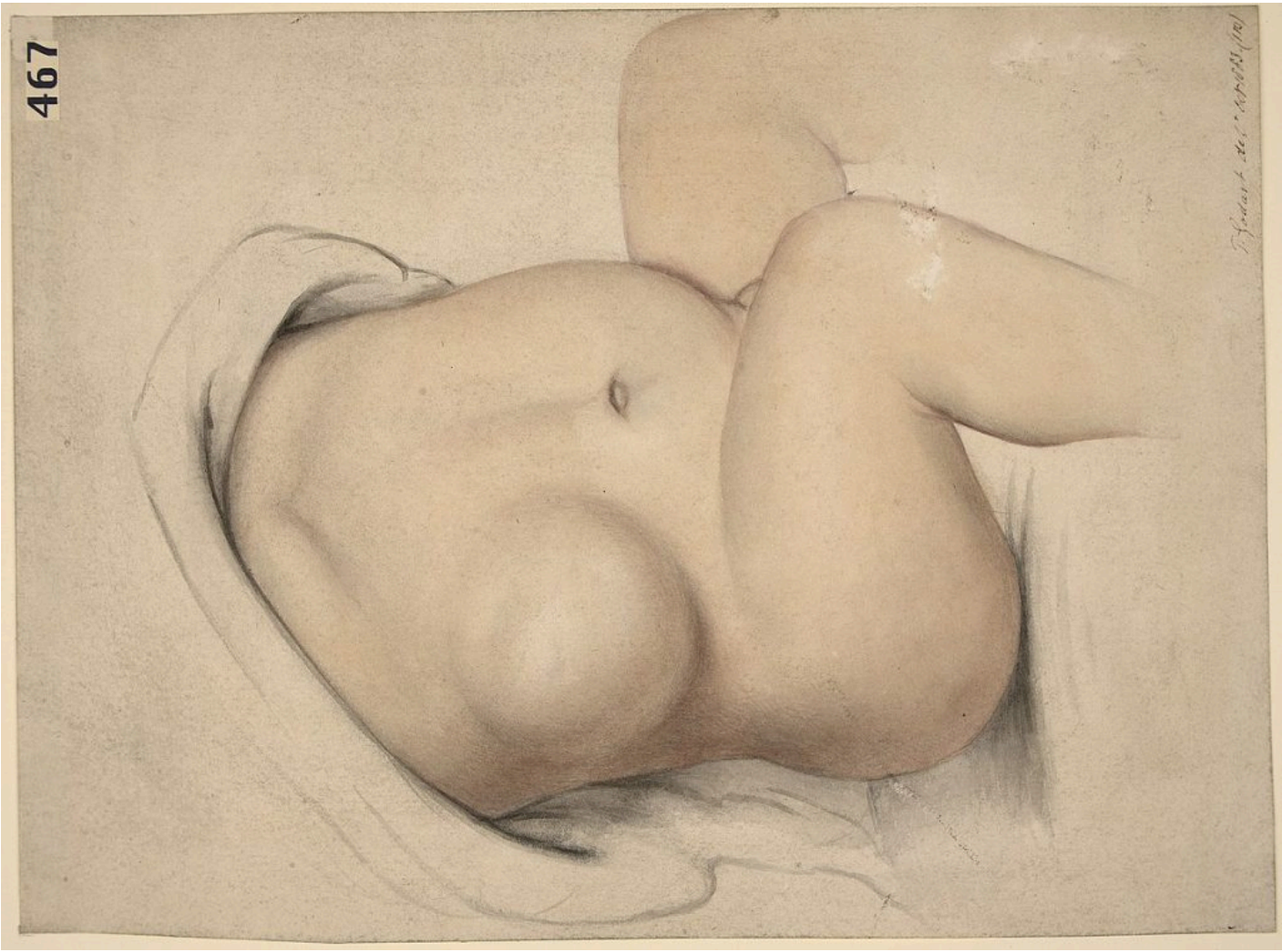


Figure 11.38 Ventral Hernia in a Child

All types of hernias can be present at birth (i.e., congenital) or acquired over time, but they are most likely to be acquired. Risk factors for hernias depend

on the specific type of hernia. See Table 11. 14 for a comparison of risk factors for inguinal, hiatal, and ventral hernias.[9,10,11,12,13]

Table 11.14. Hernia Risk Factors

Inguinal Hernia	Ventral Hernia	Hiatal Hernia
Family history	Previous surgical procedures (leads to an **incisional hernia** or a hernia at the site of an incision)	Previous surgery
History of connective tissue disorders such as Ehlers-Danlos or Marfan syndrome	Trauma to abdominal wall	Trauma to abdominal wall
Increased intra-abdominal pressure (obesity, coughing, lifting of heavy objects, staining with bowel movements)	Stress to abdominal wall (obesity or frequent weight loss and gain)	Increased intra-abdominal pressure (obesity, pregnancy, straining with bowel movements, COPD)
Not linked to age, but much more common in males	Not linked to age	Older age
No genetic link	No genetic link	Genetic link

Hernias can be further described as reducible or incarcerated. A **reducible hernia** means that the hernia and its contents can be pushed back into their normal anatomical space. An **incarcerated hernia** means that the hernia cannot be reduced. This can lead to a **strangulated hernia**, or when the hernia undergoes a reduction in oxygen supply due to reduced blood flow.

9. Curran, A. (2022). *Hernia nursing diagnosis and nursing care plan*. https://nursestudy.net/hernia-nursing-diagnosis/?expand_article=1

10. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

11. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

12. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

13. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

This is considered a medical emergency that requires urgent surgical intervention.[14,15,16,17,18]

View a supplementary YouTube video[19] on hernias and hernia repair: Repairing a hernia with surgery.

Pathophysiology

Hernias usually occur when there is a combination of increased pressure, as

14. Curran, A. (2022). *Hernia nursing diagnosis and nursing care plan*. https://nursestudy.net/hernia-nursing-diagnosis/?expand_article=1

15. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

16. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

17. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

18. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

19. Johns Hopkins Medicine. (2015, March 10). *Repairing a hernia with surgery* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=pLw3AjZx3NQ

well as an area of weakened tissue or musculature. The increase in pressure causes the organ or tissue to push through the weakened area.[20,21,22,23,24]

An inguinal hernia occurs when there is a weakened area in the oblique or transversalis muscles and abdominal organs protrude through the opening. These clients are also more likely to have increased levels of Type III collagen as opposed to Type I collagen, which is stronger. There is also a link between a patent processus vaginalis and the formation of an inguinal hernia. The **processus vaginalis** forms in fetal development. In males, it aids in the descent of the testicles through the inguinal canal. In females, it plays a role in the development of the round ligament. When this process does not occur in

20. Curran, A. (2022). *Hernia nursing diagnosis and nursing care plan*. https://nursestudy.net/hernia-nursing-diagnosis/?expand_article=1

21. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

22. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

23. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

24. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

a normal fashion and the processus vaginalis does not close appropriately, the client is at greater risk for an inguinal hernia.[25,26,27,28,29]

In clients with a ventral hernia, recurrent stress to the abdominal wall leads to the development of small tears in the abdominal tissue. With time, the abdominal tissue has reduced strength and increased intra-abdominal pressure, which can lead to abdominal organs protruding through the weakened area.[30]

With a hiatal hernia, the stomach is pushed through the esophageal hiatus into the chest by one of the causative factors mentioned above. This compromises the integrity of the lower esophageal sphincter and is a leading cause of gastroesophageal reflux disease.[31]

25. Curran, A. (2022). *Hernia nursing diagnosis and nursing care plan*. https://nursestudy.net/hernia-nursing-diagnosis/?expand_article=1

26. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

27. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

28. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

29. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

30. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

31. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

Assessment

Physical Exam

Presenting signs and symptoms of a hernia will depend on the specific type and location of the hernia. Common signs and symptoms of inguinal and ventral hernias are as follows[32,33]:

- Visible bulge in the area of the hernia
- Pain in the location of the hernia
- Increase in pain or size of bulge with activity, changes in position, or increases in intra-abdominal pressure

In addition to assessing for the aforementioned signs and symptoms, a physical exam can also aid in the diagnosis of inguinal and ventral hernias. With an inguinal hernia, the client is asked to stand so the health care provider can visualize the inguinal area for the presence of a bulge. The client will then be instructed to cough or bear down while the provider palpates the inguinal area. If there is a bulge that moves in and out with the increase in intra-abdominal pressure, an inguinal hernia is likely present. A ventral hernia can usually also be seen upon visualization of the abdomen. However, this should be done with the client in various positions as the appearance of the hernia can change based on the position of the client. Additionally, if the

32. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927

33. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

client is obese, a physical exam may have limited success in the diagnosis of a ventral hernia.[34,35]

Common signs and symptoms of hiatal hernias are as follows[36]:

- Heartburn or other GERD symptoms
- Chronic coughing or asthma
- Regurgitation of stomach contents
- Difficulty or painful swallowing

If a hernia of any type becomes strangulated, the client may exhibit the following signs and symptoms[37]:

- Signs of a bowel obstruction such as nausea, vomiting, and absence of feces and flatus
- Severe pain
- Signs of sepsis (decreased blood pressure and elevated heart rate)
- Reddened or dusky skin over the hernia site (inguinal and ventral hernias only)

Common Laboratory and Diagnostic Tests

Although the presence of an inguinal or ventral hernia can often be detected

34. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

35. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

36. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

37. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

via physical exam, imaging is often used to help confirm a diagnosis. Common imaging modalities used are ultrasound, CT scan, and MRI. An ultrasound is the least invasive modality, but not as sensitive and specific as an MRI. However, MRIs are expensive to perform, so a CT scan may be a better option in cases of unclear ultrasound results.[38,39]

In those with a suspected hiatal hernia, there are a number of potential diagnostic tests. A barium swallow can show the presence of a hiatal hernia, as well as its size and specific location. A barium swallow can also show areas of narrowing that may have occurred due to chronic GERD. An EGD may be performed to diagnose a hiatal hernia. Esophageal manometry, a test that measures esophageal motility, can also be used to diagnose hiatal hernia, as well as rule out other conditions with similar symptoms. Lastly, although a CT scan is not a first-line tool to diagnose a hiatal hernia, it may be used if additional information is needed regarding the location and type of hiatal hernia.[40]

Lab tests are not used in the diagnosis of hernias, but they will be used when strangulation of a hernia is suspected. In the case of strangulation, a complete blood count may show elevated white blood cells, and lactic acid levels may be elevated if the client is septic.[41]

38. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

39. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

40. Sfara, A., & Dumitrascu, D. L. (2019). The management of hiatal hernia: an update on diagnosis and treatment. *Medicine and pharmacy reports*, 92(4), 321–325. https://doi.org/10.15386/mpr-1323

41. Pastorino, A., & Alshuqayfi, A. A. (2022). *Strangulated Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK555972/

Nursing Diagnosis

Nursing priorities for those suffering from a hernia include managing symptoms, preventing complications, and client education.

Nursing diagnoses for clients with a hernia are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Common nursing diagnoses for those with a hernia are as follows[42,43]:

- Acute Pain
- Risk for Injury
- Risk for Infection
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes include the following:

- *The client will rate their pain at 3 or less on a scale of 0 to 10.*
- *The client will remain free from signs and symptoms of a strangulated*

42. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

43. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023 (12th ed.)*. Thieme.

hernia (nausea, vomiting, absence of feces and flatus).

- *The client will verbalize three methods to reduce their risk of contracting a surgical site infection after the teaching session.*
- *The client will describe common causes and treatment of hernias after the teaching session.*

Interventions

Medical Interventions

Specific medical interventions depend on the type and severity of the hernia present. The medical treatment approach for each hernia type covered in this textbook will be described below.

HIATAL HERNIAS

In those with hiatal hernias, symptoms of GERD may be managed with proton pump inhibitors and lifestyle modifications such as losing weight, elevating the head of the bed, and avoiding eating before bed. If PPIs are able to manage symptoms in those with a hiatal hernia, surgical management may not be needed.[44]

Surgical management should be considered when the client's symptoms are not managed with PPIs, when severe damage to the esophagus has occurred due to GERD, or when the hernia is large in size. Although there are a variety of options for surgical repair, a common procedure is the Nissen fundoplication. See the "Gastroesophageal Reflux Disease" section for more information on this procedure. Surgical management may be required for

44. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

complications such as a gastric volvulus. A **gastric volvulus** is a type of obstruction in which the stomach twists upon itself.[45,46]

INGUINAL HERNIAS

If the inguinal hernia is asymptomatic, the provider typically recommends watchful waiting. Watchful waiting consists of monitoring the hernia for worsening symptoms. Surgical management is advised for symptomatic cases. Open and laparoscopic surgical methods have similar percentages for hernia recurrence. Although some approaches only repair the damaged tissue that allowed the hernia to occur, other approaches place a surgical mesh at the hernia site to support healing and prevent hernia recurrence.[47]

VENTRAL HERNIAS

As with inguinal hernias, those with asymptomatic ventral hernias may also undergo watchful waiting. Ventral hernias that present with incarceration but without strangulation should have the hernia repaired surgically, but it is not emergent. Clients who have a strangulated ventral hernia require emergency surgery. Ventral hernias can be repaired in an open or laparoscopic manner or even with the assistance of robotic technology. Those who undergo laparoscopic repair tend to have fewer complications and a shorter hospital stay than those who undergo an open procedure. As with inguinal hernia repair, there are a variety of surgical techniques that can be used, and the

45. Smith, R. E., Sharma, S., & Shahjehan, R. D. (2024). *Hiatal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK562200/

46. Sfara, A., & Dumitrascu, D. L. (2019). The management of hiatal hernia: an update on diagnosis and treatment. *Medicine and pharmacy reports*, 92(4), 321–325. https://doi.org/10.15386/mpr-1323

47. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

approach varies from repairing the damaged tissue to implanting a surgical mesh.[48]

Nursing Interventions

When providing nursing care for a client with a hernia, nursing interventions can be divided into nursing assessments, nursing actions, and client teaching.[49,50]

NURSING ASSESSMENTS

- Assess for increased tenderness, decreased appetite, and altered bowel movements, as this could indicate intestinal blockage due to incarceration or strangulation.
- Assess the client's pain on a scale of 0-10. Pain is common after surgical repair of hernias and should be treated adequately. Changes in pain preoperatively could also indicate a complication such as a strangulated hernia.
- Assess the client's surgical site after hernia repair for edema, erythema, and bleeding.

NURSING ACTIONS

- Administer pain medications per provider order to manage the client's pain.

48. Smith, J., & Parmely, J. D. (2023). *Ventral Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK499927/

49. Curran, A. (2022). *Hernia nursing diagnosis and nursing care plan*. https://nursestudy.net/hernia-nursing-diagnosis/?expand_article=1

50. Hammoud, M., & Gerken, J. (2023). *Inguinal Hernia*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK513332/

- Administer stool softeners to prevent straining during bowel movements per provider order.
- Apply ice to the surgical site to reduce swelling and help reduce pain.
- Offer a scrotal support for male clients undergoing surgical repair of an inguinal hernia, as this can reduce swelling and optimize comfort levels.

CLIENT TEACHING

- Reinforce education given by the provider on the methods of surgical repair of hernias and ensure the client's questions are answered.
- Encourage hernia prevention/recurrence by teaching the importance of maintaining a healthy weight, preventing constipation by eating high-fiber foods, avoiding lifting heavy loads, following postoperative activity restrictions, and seeking treatment for persistent coughing.
- Educate the client about the need to increase fluids and protein in the diet to promote healing and good nutrition.
- Educate the client on any wound care needs they will have after discharge, as well as how to monitor the surgical site for signs of infection.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.



RN Recap: Hernia

View a brief YouTube video overview of hernia[51]:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/healthalts/?p=3325#oembed-1

51. Open RN Project. (2024, June 23). *Health Alterations – Chapter 11 – Hernia* [Video]. You Tube. CC BY-NC 4.0 https://youtu.be/n8tV3p0vg8Y?si=0OgLM1pdF93gVTp5

11.15 Hepatitis

The term **hepatitis** means inflammation of the liver. Hepatitis can be an acute or a chronic condition. When it lasts for six months or less, it is considered acute, and when it lasts over six months, it is considered chronic. The severity of hepatitis can range from mild to severe based on the source of the inflammation.[1]

Pathophysiology

Hepatitis is commonly caused by the viruses of hepatitis A, B, C, D, and E. Hepatitis A, B, and C are the most common viral causes. Hepatitis A is commonly transmitted via the fecal to oral route and is common in places where there is poor sanitation. Hepatitis B and C are transmitted via contact with infected body fluids via contaminated blood transfusions, sharing of needles, or other parenteral measures. Hepatitis B and C can also be transmitted sexually and via pregnancy/childbirth. The incubation period for viral hepatitis ranges from four to twelve weeks, depending on the specific virus. Hepatitis A is usually an acute condition, but hepatitis B and C can become chronic illnesses and can lead to liver cancer or other complications.[2]

Hepatitis D is inflammation of the liver that requires the presence of hepatitis B virus for viral replication. Hepatitis D infection cannot occur in the absence of hepatitis B virus, but it occurs concurrently or after being infected with Hepatitis B virus. Hepatitis E is transmitted mainly through contaminated drinking water and is common in low- and middle-income countries with limited access to essential water, sanitation, hygiene, and health services. The infection is usually self-limiting and resolves within two to

1. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/
2. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/

six weeks. Occasionally, serious complications such as acute liver failure develops, which can be fatal.[3, 4]

Hepatitis is also linked to a variety of autoimmune disorders. Autoimmune hepatitis is when the body develops antibodies that attack the liver that are triggered by exposure to certain drugs or viruses.[5]

Hepatitis can also be caused by the misuse of alcohol or drugs that can lead to death of liver cells, but the exact mechanism of action is unclear.[6]

Assessment

Regardless of the causes of hepatitis, the signs and symptoms are similar. Common early signs and symptoms of hepatitis are loss of appetite, nausea, vomiting, and fatigue. It can also be asymptomatic. As the disorder progresses, jaundice, pain in the right upper quadrant, an enlarged liver, light-colored stools, and dark-colored urine may occur. In severe cases of autoimmune and alcoholic hepatitis, clients may also have excessive fluid buildup in the abdomen referred to as **ascites** and mental status changes related to the buildup of toxins, such as ammonia, referred to as **hepatic encephalopathy**.[7]

3. World Health Organization. (2023). *Hepatitis D*. https://www.who.int/news-room/fact-sheets/detail/hepatitis-d

4. World Health Organization. (2023). *Hepatitis E*. https://www.who.int/news-room/fact-sheets/detail/hepatitis-e

5. Hepatitis by Mehta & Reddivari is licensed under CC BY-NC-ND 4.0

6. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/

7. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/

Common Laboratory and Diagnostic Tests

Lab values that may be altered in hepatitis are liver enzymes, bilirubin, coagulation labs, and ammonia levels. Coagulation labs such as prothrombin time (PT) and internalized normalized ratio (INR) may be increased due to the liver's role in blood clotting, resulting in increased risk for bleeding. Ammonia levels may be elevated in severe cases, causing hepatic encephalopathy.[8] To diagnose viral hepatitis, blood tests can detect the presence of antibodies to viruses. There are a variety of blood tests used to diagnose autoimmune hepatitis, but the gold standard is a liver biopsy.

Liver biopsies may be performed to establish a diagnosis of hepatitis and assess the extent of the disease.[9]

Nursing Diagnosis

Nursing diagnoses for clients with hepatitis are created based on the specific needs of the client, their signs and symptoms, and the etiology of the disorder. These nursing diagnoses guide the creation of client specific care plans that encompass client outcomes and nursing interventions, as well the evaluation of those outcomes. These individualized care plans then serve as a guide for client treatment.

Nursing priorities for clients with hepatitis include managing fatigue, promoting adequate nutrition, reducing the risk for bleeding, and providing health teaching. Common nursing diagnoses for clients with hepatitis are as follows[10]:

8. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/
9. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/
10. Herdman, T. H., Kamitsuru, S., & Lopes, C. T. (Eds.). (2020). *Nursing diagnoses: Definitions and classification, 2021-2023 (12th ed.)*. Thieme.

- Fatigue
- Imbalanced Nutrition: Less Than Body Requirements
- Risk for Bleeding
- Readiness for Enhanced Knowledge

Outcome Identification

Outcome identification encompasses the creation of short- and long-term goals for the client. These goals are used to create expected outcome statements that are based on the specific needs of the client. Expected outcomes should be specific, measurable, and realistic. These outcomes should be achievable within a set time frame based on the application of appropriate nursing interventions.

Sample expected outcomes for clients with hepatitis include the following[11]:

- *The client will maintain adequate fluid volume during hospitalization, as evidenced by stable vital signs, good skin turgor, capillary refill less than two seconds, strong peripheral pulses, and appropriate urinary output.*
- *The client will report an improved sense of energy and participate in desired activities within two weeks of treatment.*
- *After the teaching session, the client will verbalize understanding of the disease process, prognosis, and potential complications.*
- *After the teaching session, the client will verbalize understanding of the treatment regiment and initiate necessary lifestyle changes.*

Interventions

Medical Interventions

Medical treatment for acute viral hepatitis consists of supportive care such as

11. Nurseslabs. (2024). *6 hepatitis nursing care plans.* https://nurseslabs.com/hepatitis-nursing-care-plans/

rest, fluids, and a nutritious diet.[12] Chronic hepatitis may be treated with antiviral medications and medications that suppress the immune system, but these medications can have serious side effects that must be monitored.[13] Additionally, medications that adversely affect the liver are avoided, such as acetaminophen and paracetamol.[14]

Autoimmune hepatitis is typically managed with steroids or other medications that suppress the immune system. Liver transplantation may be performed for clients with severe hepatitis resulting in liver failure.[15]

Clients with alcoholic hepatitis should be referred to treatment for substance use disorders and abstain from the use of alcohol. Short-term steroid administration may be prescribed to reduce inflammation. In severe cases of liver failure, liver transplantation may be performed for clients who have abstained from alcohol or other drugs for six months or more.[16]

> Read more information about treatment for substance use

12. Centers for Disease Control and Prevention. (2024). *Clinical overview of viral hepatitis*. https://www.cdc.gov/hepatitis/hcp/clinical-overview/index.html
13. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/
14. World Health Organization. (2023). *Hepatitis A*. https://www.who.int/news-room/fact-sheets/detail/hepatitis-a
15. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/
16. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/

disorders in the "Substance Misuse" section of the "Maladaptive Coping" chapter of Open RN *Health Promotion*.

Vaccines are available to prevent the transmission of viral hepatitis A and B. Hepatitis A vaccines should be offered to those traveling to endemic areas or at high risk for contracting the disorder. Hepatitis B vaccine is included on the newborn vaccination schedule and should also be taken by those who did not receive the vaccine as an infant and are at risk for blood exposure, such as health care workers.[17]

Nursing Interventions

Nursing priorities for clients with hepatitis include managing symptoms, providing supportive care, preventing further liver damage, monitoring liver function and disease progression, and administering antiviral medications as prescribed. Nurses also teach clients about lifestyle modifications to promote liver health, the prevention of hepatitis transmission to others, and to promptly report symptoms of potential complications to the health care provider.[18]

NURSING ASSESSMENTS

Nurses monitor vital signs, 24-hour input and output, daily weight trends, and for signs of edema. They monitor for ascites by measuring abdominal girth. They assess peripheral pulses, capillary refill, skin turgor, and mucous membranes, as well as for signs of bleeding such as hematuria, melena,

17. Mehta, P., Grant, L. M., & Reddivari, A. K. R. (2024). *Viral Hepatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK554549/

18. Nurseslabs. (2024). *6 hepatitis nursing care plans*. https://nurseslabs.com/hepatitis-nursing-care-plans/

ecchymosis, and oozing from gums and IV sites. They monitor laboratory values such as serial liver enzymes, hemoglobin, hematocrit, albumin, and clotting times.[19]

NURSING ACTIONS

Nursing interventions include the following actions[20]:

- **Optimize nutrition:** Anorexia is a common symptom. A dietician is consulted to plan a diet according to the client's current nutritional needs. Medications are administered related to nutritional intake as prescribed such as antiemetics, antiulcer medications, vitamin B complex, vitamin C, and other nutritional supplements. Oral care is encouraged before meals to promote appetite.
- **Promote fluid balance:** Prescribed intravenous fluids and electrolytes are administered as indicated. Fluid restrictions are implemented if prescribed for fluid overload.
- **Prevent bleeding:** The client is encouraged to use an electric shaver and a soft-bristled toothbrush or sponge swabs and mouthwash to prevent bleeding. Additional bleeding precautions are described in the "Thrombocytopenia" section of the "Hematological Alterations" chapter.
- **Manage fatigue:** Bed rest is typically prescribed during acute illness. Nurses implement a quiet environment and limit visitors as needed. Nurses teach about energy-conserving techniques such as sitting when showering and scheduling rest periods. Additional energy management interventions are described in the "Iron Deficiency Anemia" section of the "Hematological Alterations" chapter.
- **Prevent skin breakdown and maintain skin integrity:** Skin is routinely

19. Nurseslabs. (2024). *6 hepatitis nursing care plans.* https://nurseslabs.com/hepatitis-nursing-care-plans/

20. Nurseslabs. (2024). *6 hepatitis nursing care plans.* https://nurseslabs.com/hepatitis-nursing-care-plans/

assessed for areas of redness and breakdown. Clients are encouraged and assisted to change position frequently. To manage the common symptom of itching, clients are encouraged to take cool showers or use baking soda baths. Alkaline soaps should be avoided. Diversional activities can be implemented to manage the discomfort of itching, and the use of knuckles instead of fingernails can be suggested if the desire to scratch is uncontrollable. Fingernails should be cut short, and gloves should be applied while sleeping to prevent skin damage from itching.

- **Provide emotional support:** Nurses perform active listening and encourage the client to verbalize their feelings and concerns. Nurses avoid making judgmental statements about lifestyle choices in cases of hepatitis due to substance misuse and instead focus on abstinence and efforts toward recovery. They teach about stress management techniques and positive coping strategies such as progressive relaxation, visualization, and guided imagery. Prescribed sedative medications are administered for anxiety as indicated, such as diazepam and lorazepam.
- **Make referrals:** Nurses refer clients to community resources, support groups, and drug/alcohol treatment programs as indicated.

Client Teaching

Nurses provide health teaching about several topics to clients with hepatitis[21]:

- The client's understanding of the disease process, prognosis, and treatment regimen is assessed, and additional information is provided as indicated.
- Information about preventing the transmission of hepatitis is provided. Close contacts may require administration of gamma-globulin to prevent disease. When liver enzymes are elevated, strict handwashing should be performed by the client and their household members, personal items

21. Nurseslabs. (2024). *6 hepatitis nursing care plans.* https://nurseslabs.com/hepatitis-nursing-care-plans/

should not be shared, and intimate contact such as kissing and sex should be avoided. Clothes, dishes, and toilet facilities should be sanitized.
- Resumption of activity as tolerated is planned, along with adequate periods of rest. Prescribed restrictions on heavy lifting, strenuous exercise, and contact sport are reinforced.
- Consumption of a healthy, balanced diet is encouraged to promote healing and tissue regeneration. Managing bowel function with adequate intake of fluids and fiber, and moderate activity is encouraged.
- Side effects of over-the-counter and prescribed medications that affect the liver, such as acetaminophen, aspirin, sulfonamides, and some anesthetics, are discussed. Notification of future health care providers about the diagnosis of hepatitis is strongly encouraged, especially if medications are prescribed, because some medications are toxic to the liver and others can cause cumulative toxic effects and chronic hepatitis.
- The importance of follow-up appointments and laboratory evaluation is emphasized, along with abstaining from alcohol and other drugs affecting the liver for a minimum of 6 to 12 months or longer.

Evaluation

Evaluation of client outcomes refers to the process of determining whether or not client outcomes were met by the indicated time frame. This is done by reevaluating the client as a whole and determining if their outcomes have been met, partially met, or not met. If the client outcomes were not met in their entirety, the care plan should be revised and reimplemented. Evaluation of outcomes should occur each time the nurse assesses the client, examines new laboratory or diagnostic data, or interacts with another member of the client's interdisciplinary team.

11.16 Other Gastrointestinal Disorders

Overviews of other common gastrointestinal disorders are discussed in this section.

Liver Cirrhosis

Liver cirrhosis occurs due to chronic liver damage and is characterized by the development of liver nodules and **liver fibrosis** (stiffening/scarring of the liver). This chronic liver damage can be related to viruses like hepatitis C, toxic substances like drugs or alcohol, or autoimmune conditions. There is also a hereditary link.[1,2]

When exposed to injurious substances, cells in the liver react by depositing excess collagen, which leads to fibrosis. Initially, this fibrosis does not result in loss of liver function. However, as the exposure is repeated over time, the majority of the liver will become fibrosed, and loss of function results. Ultimately, this leads to portal hypertension or elevated pressures in the blood vessels of the liver. Due to the elevated pressure, the body compensates by diverting blood to other veins. This increase in blood flow weakens these vessels and makes them prone to injury and bleeding.[3,4]

Clients with liver cirrhosis may be asymptomatic, and the disorder may only be discovered incidentally. Clinical manifestations of cirrhosis may include

1. Cleveland Clinic. (n.d.). *Portal hypertension*. https://my.clevelandclinic.org/health/diseases/4912-portal-hypertension
2. Sharma, B., & John, S. (2022). *Hepatic Cirrhosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482419/
3. Cleveland Clinic. (n.d.). *Portal hypertension*. https://my.clevelandclinic.org/health/diseases/4912-portal-hypertension
4. Sharma, B., & John, S. (2022). *Hepatic Cirrhosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482419/

nonspecific symptoms such as anorexia, weight loss, weakness, fatigue, or signs and symptoms of hepatic decompensation (jaundice, pruritus, signs of upper gastrointestinal bleeding, abdominal distension from ascites, and confusion due to hepatic encephalopathy). Physical examination findings may include jaundice, spider angiomas, gynecomastia, ascites, splenomegaly, palmar erythema, digital clubbing, and asterixis.[5] Clients with cirrhosis may experience bleeding from enlarged veins in the esophagus caused by portal hypertension called **varices**. As cirrhosis and portal hypertension continue to progress, the effects are widespread and affect multiple organs of the body. Clients with cirrhosis are also at an increased risk for liver cancer.[6,7]

Lab results typically indicate elevated liver enzymes and prothrombin time. Albumin levels are typically decreased because this protein is produced in the liver. Decreased red blood cells, white blood cells, and platelets may also occur. Diagnostic tests include an ultrasound, CT scan, or MRI, but the best diagnostic tool is a liver biopsy. Additional tests may be performed to evaluate for the specific cause of liver cirrhosis.[8,9]

5. Goldberg, E. & Chopra, S. (2023). Cirrhosis in adults: Etiologies, clinical manifestations, and diagnosis. *UpToDate*. https://www.uptodate.com

6. Cleveland Clinic. (n.d.). *Portal hypertension*. https://my.clevelandclinic.org/health/diseases/4912-portal-hypertension

7. Sharma, B., & John, S. (2022). *Hepatic Cirrhosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482419/

8. Cleveland Clinic. (n.d.). *Portal hypertension*. https://my.clevelandclinic.org/health/diseases/4912-portal-hypertension

9. Sharma, B., & John, S. (2022). *Hepatic Cirrhosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482419/

Cirrhosis can not be reversed, so treatment is focused on preventing further injury to the liver. Liver transplantation may be an option for some clients.[10,11]

Pancreatitis

Pancreatitis is inflammation of the pancreas, and it can be an acute or chronic condition. Although there are a variety of causes of acute pancreatitis, the most common causes are the presence of gallstones and excess alcohol use. Chronic pancreatitis is most commonly caused by alcohol abuse.[12]

In acute pancreatitis caused by gallstones, the pancreatic duct is obstructed and cannot release digestive enzymes. This leads to **autodigestion**, a process in which the enzymes of the pancreas digest pancreatic tissue, as well as inflammation. Alcohol use can lead to acute pancreatitis due to the toxic effect of alcohol on pancreatic tissues. Chronic pancreatitis occurs when the pancreas is repeatedly attacked, leading to scarring and pancreatic hypofunctioning.[13]

Common signs of acute pancreatitis are epigastric abdominal pain that spreads to the back, nausea, and vomiting. Jaundice may be present if the pancreatitis is caused by gallstones, and severe pancreatitis may lead to changes in mental status. Those with chronic pancreatitis may have nausea,

10. Cleveland Clinic. (n.d.). *Portal hypertension*. https://my.clevelandclinic.org/health/diseases/4912-portal-hypertension

11. Sharma, B., & John, S. (2022). *Hepatic Cirrhosis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK482419/

12. Mohy-ud-din, N., & Morrissey, S. (2023). *Pancreatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538337/

13. Mohy-ud-din, N., & Morrissey, S. (2023). *Pancreatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538337/

vomiting, abdominal pain, weight loss, and steatorrhea. There is also the potential for the development of diabetes due to pancreatic damage.[14]

Acute pancreatitis can be diagnosed by the presence of elevated serum amylase and lipase levels. These levels may be increased or normal in those with chronic pancreatitis. Imaging, such as a CT scan, MRI or MRCP, may also be done.[15]

Treatment of acute pancreatitis consists of IV fluids, analgesics, and diet modification. The client typically has an NPO diet order because this stops the activity of the pancreas, but their diet is progressed and they can take food by mouth when their pain is well managed.[16] In severe cases, parenteral nutrition may be required. If acute pancreatitis is caused by the presence of gallstones, an ERCP and/or a cholecystectomy may be performed. Clients with chronic pancreatitis will require pain management, a low-fat diet, and education on alcohol abstinence and potentially exogenous pancreatic enzymes.[17]

14. Mohy-ud-din, N., & Morrissey, S. (2023). *Pancreatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538337/

15. Mohy-ud-din, N., & Morrissey, S. (2023). *Pancreatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538337/

16. MedlinePlus [Internet]. (2023). *Acute Pancreatitis*. https://medlineplus.gov/ency/article/000287.htm

17. Mohy-ud-din, N., & Morrissey, S. (2023). *Pancreatitis*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK538337/

View a supplementary YouTube video[18] on pancreatitis: Acute pancreatitis.

Colon Cancer

Colon cancer is cancer of the colon or rectum and is one of the top causes of death in the United States. Risk factors for colon cancer are a family history, the presence of colon polyps, a history of inflammatory bowel disease, prior radiation to the abdomen, obesity, tobacco or alcohol use, and the intake of red or processed meat.[19,20]

Colon cancer forms after a number of genetic mutations result in cellular changes in the colon. Once colon cancer develops, it can be staged using the

18. Animated Pancreas Patient. (2013, September 6). *Acute pancreatitis* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=inRSjh3bHPg

19. Cleveland Clinic. (n.d.). *CEA test (carcinoembryonic antigen)*. https://my.clevelandclinic.org/health/diagnostics/22744-cea-test-carcinoembryonic-antigen

20. Menon, G., & Cagir, B. (2024). *Colon Cancer*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470380/

TNM system.[21,22] For more information on this system of staging, please visit the "Malignancy and Autoimmune Alterations" chapter of this textbook.

Sometimes colon cancer is found incidentally during a colonoscopy or at-home colon cancer screening. A popular at-home screening is Cologuard, which looks for abnormal DNA and blood in a stool sample. Others may have symptoms such as blood in the stool, abdominal pain, anemia, and changes in bowel movements that prompt them to seek medical care. Colon cancer commonly spreads to the liver, lungs, and/or lymph nodes. Clients with metastasis may have additional signs and symptoms.[23,24]

A definitive diagnosis of colon cancer requires a colonoscopy with a biopsy, but it could also be detected with a barium enema, CT scan, or MRI. A CEA test, a tumor marker blood test, may also be elevated with colon cancer. However, this test is used to monitor treatment response, not to diagnose.[25,26]

21. Cleveland Clinic. (n.d.). *CEA test (carcinoembryonic antigen).* https://my.clevelandclinic.org/health/diagnostics/22744-cea-test-carcinoembryonic-antigen

22. Menon, G., & Cagir, B. (2024). *Colon Cancer*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470380/

23. Cleveland Clinic. (n.d.). *CEA test (carcinoembryonic antigen).* https://my.clevelandclinic.org/health/diagnostics/22744-cea-test-carcinoembryonic-antigen

24. Menon, G., & Cagir, B. (2024). *Colon Cancer*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470380/

25. Cleveland Clinic. (n.d.). *CEA test (carcinoembryonic antigen).* https://my.clevelandclinic.org/health/diagnostics/22744-cea-test-carcinoembryonic-antigen

26. Menon, G., & Cagir, B. (2024). *Colon Cancer*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470380/

Colon cancer can be treated with surgical removal of the cancerous area and affected lymph nodes, chemotherapy, immunotherapy, or other biologic agents. If the entire colon must be removed, the client will end up with a colostomy.[27,28] For more information on nursing care of clients with cancer, please visit the "Malignancy and Autoimmune Alterations" chapter.

View a supplementary YouTube video[29] on Cologuard testing:
Cologuard video: Colon Cancer Screening with Cologuard – Easy At-Home Kit Explained.

27. Cleveland Clinic. (n.d.). *CEA test (carcinoembryonic antigen).* https://my.clevelandclinic.org/health/diagnostics/22744-cea-test-carcinoembryonic-antigen

28. Menon, G., & Cagir, B. (2024). *Colon Cancer*. StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK470380/

29. UC Davis Health. (2023, October 16). *Colon cancer screening with Cologuard – Easy at-home kit explained* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=ZcFGgFFY3Eo

11.17 Learning Activities

Learning Activities

GI Case Study 1[1]

(Case Study answers are located in the Answer Key at the end of the book.)

Mrs. G.B. is a 38-year-old female who presents to the emergency department with complaints of severe abdominal pain. G.B reports that she has had similar pain intermittently over the past week; however, tonight her pain has become constant and unbearable. She reports that the pain usually starts on the upper right side of her abdomen and radiates to her back. The pain often occurs at night after eating dinner, particularly after eating fatty foods. She reports nausea but no vomiting and explains that she has taken ibuprofen and antacids but neither have helped her symptoms.

Physical Exam

Upon exam, G.B.'s vitals are found to be as follows:

HR: 106, RR: 16, BP: 148/95, Temp: 100.6 F, Pulse ox: 98%

G.B. appears uncomfortable and is sweating. G.B. reports it feels better for her to lie in bed and not move. When G.B. is assessed, the right side of her abdomen below her rib cage is palpated during

1. "GI Case Study 1" by Open RN is licensed under CC BY-NC 4.0

inspiration. She reports increased pain to the point that she gently pushes the examiner's hands away.

Abnormal Laboratory Values

- WBC – 15.4 cells/mm3
- CRP – 18.3

Past Medical History

- Obesity, BMI of 31
- Mother of 2 children, ages 3 and 5 years
- Gestational diabetes with both pregnancies
- Hypertension, diagnosed 1 year ago, mild and not treated with medication at this time
- Cesarean section, age 35 and 33

Pertinent Family History

- Father alive and healthy age 71
- Mother with a history of obesity, hypertension, and gallstones, alive and age 70
- Brother with a history of obesity, alive and age 41
- Sister alive and healthy, age 36

Pertinent Social History

- Client works for a local hospital doing IT assistance, has worked there for ten years
- Client's hobbies include reading, knitting, and baking
- Client reports difficulty with attempts at weight loss, prefers to not go to the gym or be seen working out in public environment

After assessing the client, the health care provider states, "The client's pain could be caused by cholecystitis."

Critical Thinking Questions:

1. Symptoms of gallbladder disease often resemble those of other GI diseases. Which group of symptoms suggests cholecystitis?

   A) Pain in the right lower quadrant, leukocytosis, low-grade fever

   B) Pain in the right upper quadrant, low-grade fever, bloody stools

   C) Pain in the right upper quadrant that radiates to the right shoulder or back, positive Murphy's sign, bloody stools

   D) Pain in the right upper quadrant that radiates to the right shoulder or back, positive Murphy's sign, low-grade fever

2. What diagnostic tests can be used to confirm a diagnosis of cholecystitis?
3. Why are G.B.'s symptoms triggered by eating and/or eating fatty foods?
4. Which best describes the role of the gallbladder?

   A) Similar to the appendix, the gallbladder has little known physiologic function. Because of this, it can be removed without any consequence to the client.

   B) The gallbladder synthesizes bile. It also stores and secretes bile, a yellow-green substance needed to digest lipids.

   C) The gallbladder makes cholecystokinin (CCK). CCK stimulates the vagus nerve and facilitates movement of bile through the intestines.

   D) The gallbladder stores, concentrates, and secretes bile.

5. True or False: Family history is the ONLY risk factor for cholecystitis seen in G.B.'s case. If false, list the other risk factors.
6. What are some potential treatment options for G.B.?

7. The physician decides that the best course of action for G.B. is a laparoscopic cholecystectomy. What does this procedure entail? What kind of postoperative instructions will you give to G.B.?

GI Case Study 2[2]

(Case Study answers are located in the Answer Key at the end of the book.)

Samara Yang is a 33-year-old, second-generation Chinese American female who presents to the local hospital emergency department. She is unmarried and has no children. She works as an account executive in a corporate accounting firm. She states, "I am sorry to bother you, but I have been so sick. I had thought it must be the flu. Everyone at work has it. I am achy and tired. I keep vomiting and have not been able to keep anything down for the past three days—not even ginger tea. I am empty, and tonight, I vomited twice within three hours, and it was red like blood. I became frightened and came in." Current medications include Ortho Tri-Cyclen once a day and "Advil 3 or 4 times a day for headaches and body aches."

Vital signs: BP: 108/60; HR: 88, regular; R: 20; Temp 100.5 F (38 C)

Physical Examination: Skin is clammy and pale, appears physically fatigued, but able to ambulate independently. Denies pain but leaning forward slightly and holding abdomen.

Samara is admitted to the hospital for a probable upper GI bleed, and lab work and diagnostic testing have been ordered to further evaluate Samara's condition. Samara expresses concerns to the nurse regarding admission to the hospital. "I hope I will not be here for very long. I have been managing an important project for the

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past few months at my company. My boss is understanding, but there is an important deadline coming up next week. Being in the hospital for a long time could jeopardize the project and my future with the company."

Lab results:

- WBC: 11,800 cells/mm3
- RBC: 3.31 million/uL
- Hgb: 11 g/dL
- Hct: 34%
- Platelets: 150,000mm3
- K+: 3.6 mEq/L
- Na+: 138 mEq/L

Diagnostic Tests:

- EKG: Normal sinus rhythm.
- KUB Abdominal X-ray: Nonspecific gas pattern with moderate stool through the colon. No acute abnormality noted.
- EGD: Normal duodenum with no vascular anomalies. Gastric mucosa is inflamed. Small erosive changes noted, and one ulceration clearly visible.

Additional provider orders:

- Normal saline 100mL/hr
- Pantoprazole continuous IV drip
- Prochlorperazine 5 mg IV push q 3-4 hours prn for nausea and vomiting
- Strict I&O q 2 h
- Bedrest, up with assist
- VS q 2hrs
- Test every BM for occult blood
- Re-check CBC in six hours (@1400)

Critical Thinking Questions:

1. What are the signs and symptoms of peptic ulcer disease?
2. What risk factors does Samara present with?
3. What other MAJOR complications can occur with peptic ulcer disease?
4. What are the interventions if these major complications occur?
5. Should the nurse suggest to the health care provider that that the medications Ortho Tri-cyclen Lo and ibuprofen be added to her admission orders? Why or why not?
6. Which lab results are abnormal and what is the significance of the abnormal results?
7. What are the nursing responsibilities after Samara has the EGD?
8. After returning to the nursing unit from diagnostic testing, Samara asks to try some saltine crackers and ginger ale. How should the nurse respond to Samara's request?
9. Identify three nursing diagnoses appropriate on admission for Samara. Prioritize each nursing diagnosis and provide the rationales for each selected nursing diagnoses and its priority number.
10. Samara is diagnosed with a peptic ulcer. The plan of care is for Samara to be discharged tomorrow morning. Discharge medications and instructions include the following:

- Omeprazole 40mg one time per day every am for four to six weeks
- Calcium carbonate one to three tablets following meals as needed
- General diet as tolerated—minimize caffeine consumption
- Acetaminophen as needed for headache—do not take ibuprofen for four to six weeks
- Follow up with primary health care provider in three weeks

Develop a teaching plan for these medications and explain the rationales for diet and health care follow-up.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=3352#h5p-46

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An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=3352#h5p-60

"Case Study: GERD" by Open RN and Codaptive Labs is licensed under CC BY-NC 4.0

- Test your knowledge on appendicitis using sample NCLEX Next Generation case study provided by the NCSBN in their Sample Pack. Note that correct answers are not provided by the NCSBN but have been indicated by nursing faculty with associated rationale. This

sample is provided as an example to help students prepare for the NCLEX.[3]

- Test your knowledge on gastrointestinal conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[4]

- Test your knowledge on gastrointestinal conditions using this NCLEX Next Generation-style bowtie question. You may reset and resubmit your answers to this question an unlimited number of times.[5]

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4. "Gastrointestinal Bowtie" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

5. "Pediatric Gastrointestinal Bowtie" by Jennifer Hinz and OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on cholecystitis using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[6]



- Test your knowledge on gastrointestinal bleeding using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[7]



- Test your knowledge on bowel obstruction using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[8]



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7. "GI Bleed" by Angela Landry for OpenRN is licensed under CC BY-NC 4.0

8. "Bowel Obstruction" by Carrie Abrahamson for OpenRN is licensed under CC BY-NC 4.0

- Test your knowledge on diverticulitis using this NCLEX Next Generation-style case study. You may reset and resubmit your answers to this question an unlimited number of times.[9]

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XI Glossary

Amylase: An enzyme, produced chiefly in the pancreas and salivary glands, that breaks down carbohydrates. (Chapter 11.2)

Anal canal: A three-inch long section at the end of the gastrointestinal tract that opens to the exterior of the body at the anus. (Chapter 11.2)

Anus: The opening at the end of the digestive tract where feces leave the body. (Chapter 11.2)

Appendectomy: Surgical removal of the appendix. (Chapter 11.5)

Appendicitis: Inflammation of the appendix. (Chapter 11.2)

Appendix: A small pouch attached to the end of the cecum. (Chapter 11.2)

Ascending colon: The first part of the colon that travels upward on the right side of the abdomen. (Chapter 11.2)

Ascites: Excessive fluid build-up in the abdomen. (Chapter 11.15)

Aspiration pneumonia: A type of lung infection caused by material from the stomach or mouth inadvertently entering the lungs. (Chapter 11.3)

Autodigestion: A process in which the enzymes of the pancreas digest pancreatic tissue. (Chapter 11.15)

Barium enema: Also known as a lower GI series. (Chapter 11.3)

Barium swallow: Also known as an upper GI series. (Chapter 11.3)

Barrett's esophagus: Clients with chronic GERD whose esophagus is exposed to acidic stomach content and causes changes in the squamous epithelial cells that line the esophagus and transition into columnar epithelium. (Chapter 11.9)

Bile: A greenish-brown fluid that aids in digestion by breaking down lipids, secreted by the liver and stored in the gallbladder. (Chapter 11.2)

Bilirubin: A yellowish pigment formed in the liver by the breakdown of red blood cells. (Chapter 11.2)

Borborygmus: Hyperperistalsis; often referred to as "stomach growling." (Chapter 11.3)

Bowel obstruction: A blockage of the intestines caused by a mechanical or nonmechanical condition. (Chapter 11.13)

Cecum: The first section of the large intestine into which the ileum opens. (Chapter 11.2)

Chief cells: Cells in the glands of the stomach that secrete pepsinogen. (Chapter 11.2)

Cholecystectomy: Surgical removal of the gallbladder. (Chapter 11.6)

Cholecystitis: Inflammation of the gallbladder due to impaired bile flow. (Chapter 11.6)

Chyme: Partially digested food that passes from the stomach to the small intestine. (Chapter 11.2)

Colonoscopy: The insertion of a scope into the rectum to visualize the entire colon. (Chapter 11.3)

Descending colon: The part of the colon that travels downward on the left side of the abdomen. (Chapter 11.2)

Distention: An expansion of the abdomen caused by the accumulation of air or fluid. (Chapter 11.3)

Diverticulitis: Inflammation or infection of one or more diverticula in the digestive tract. (Chapter 11.8)

Diverticulosis: The condition of having diverticula in the colon. (Chapter 11.8)

Diverticulum: A small, bulging pouch that can form in the lining of the colon. (Chapter 11.8)

Duodenum: The first section of the small intestine, immediately beyond the stomach, leading to the jejunum. (Chapter 11.2)

Dysphagia: Difficulty or discomfort in swallowing. (Chapter 11.3)

Endocrine: Relating to glands that secrete hormones or other products directly into the blood. (Chapter 11.2)

Endoscopic retrograde cholangiopancreatography (ERCP): A procedure that uses a scope to diagnose and treat problems in the liver, gallbladder, bile ducts, and pancreas. (Chapter 11.3)

Esophageal hiatus: This opening of the diaphragm in which the esophagus passes through on its way to the stomach. (Chapter 11.14)

Esophagogastroduodenoscopy (EGD): A diagnostic test that uses a scope to examine the lining of the esophagus, stomach, and first part of the small intestine. (Chapter 11.3)

Esophagus: The muscular tube that conveys food and liquids from the throat to the stomach. (Chapter 11.2)

Exocrine: Pertaining to the secretion of a substance (such as digestive enzymes) out through a duct. (Chapter 11.2)

Extraintestinal manifestations: Signs and symptoms of inflammatory bowel disease that are not confined to the gastrointestinal tract such as inflammation of the joints/bones, bile ducts, mouth, eyes, and skin. (Chapter 11.11)

Fecalith: A mass of hardened feces. (Chapter 11.5)

Feces: Waste matter discharged from the bowels; also known as stool. (Chapter 11.2)

Fistula: An abnormal connection between two organs. (Chapter 11.8, Chapter 11.11)

Flatus: Gas in the gastrointestinal tract, expelled through the anus. (Chapter 11.2)

Gallbladder: A small organ where bile is stored and concentrated before it is released into the small intestine. (Chapter 11.2)

Gastric juice: A digestive fluid secreted by the stomach, containing hydrochloric acid, pepsin, water, mucus, and intrinsic factor. (Chapter 11.2)

Gastric volvulus: A type of obstruction in which the stomach twists upon itself. (Chapter 11.14)

Gastroenteritis: Inflammation of the stomach and intestines, typically resulting from bacterial toxins or viral infection. (Chapter 11.7)

Gastroesophageal reflux disease (GERD): Occurs when stomach contents flow backwards into the esophagus. (Chapter 11.9)

Haustra: Folds in the colon. (Chapter 11.11)

Heartburn: A retrosternal burning sensation or discomfort that may radiate into the neck and typically occurs after the ingestion of meals or when in a reclined position. (Chapter 11.9)

Hematemesis: Vomiting blood. (Chapter 11.2, Chapter 11.3)

Hematochezia: Passage of bloody stool. (Chapter 11.3)

Hepatic encephalopathy: Mental status changes due to buildup of toxins related to impaired liver function. (Chapter 11.15)

Hepatitis: Inflammation of the liver. (Chapter 11.15)

Hernia: When internal organs or tissues bulge through an inappropriate opening. (Chapter 11.14)

Hiatal hernia: A hernia in which part of the stomach bulges through the diaphragmatic opening. (Chapter 11.14)

Ileocecal valve: A sphincter muscle that separates the small intestine and the large intestine, controlling the passage of chyme. (Chapter 11.2)

Ileum: The third portion of the small intestine, between the jejunum and the cecum of the large intestine. (Chapter 11.2)

Incarcerated hernia: A hernia that cannot be reduced. (Chapter 11.14)

Incisional hernia: A hernia at the site of an incision. (Chapter 11.14)

Inflammatory bowel disease (IBD): A chronic disorder that is characterized by inflammation in the gastrointestinal tract. (Chapter 11.11)

Inguinal canal: A passageway that contains the spermatic cord and blood vessels in men and the round ligaments in women. (Chapter 11.14)

Inguinal hernia: A hernia that occurs in the inguinal canal. (Chapter 11.14)

Intrinsic factor: A substance secreted by the parietal cells of the stomach that is needed for the absorption of vitamin B12 in the small intestine. (Chapter 11.2)

Intussusception: A type of bowel obstruction where the intestine telescopes onto itself. (Chapter 11.13)

Involuntary guarding: The reflexive contraction of overlying abdominal muscles as the result of peritoneal inflammation. (Chapter 11.3)

Irritable bowel syndrome (IBS): A chronic gastrointestinal disorder in which there is abdominal discomfort, along with a change in bowel patterns. (Chapter 11.12)

Jejunum: The part of the small intestine between the duodenum and ileum. (Chapter 11.2)

Large intestine: The last part of the digestive system that runs from the cecum to the anus; absorbs water and electrolytes; forms, stores, and eliminates feces. (Chapter 11.2)

Lipase: An enzyme that breaks down lipids (fats). (Chapter 11.2)

Liver: A large lobed organ in the abdomen, involved in digestion, metabolism, blood clotting, protein creation, and cleansing the blood of toxins. (Chapter 11.2)

Liver cirrhosis: Chronic liver damage that is characterized by the development of liver nodules and liver fibrosis. (Chapter 11.15)

Liver fibrosis: Stiffening/scarring of the liver. (Chapter 11.5)

Lower esophageal sphincter (LES): A ring-shaped muscle just before the opening to the stomach that opens to let food pass into the stomach and closes to keep it there. (Chapter 11.2)

Magnetic resonance cholangiopancreatography (MRCP): The use of an MRI with contrast to see the bile ducts and assess disorders of the gallbladder, pancreas, or liver. (Chapter 11.3)

Magnetic resonance imaging (MRI): MRI is an imaging technique that uses a combination of strong magnets and radio waves to produce in-depth views of the body. (Chapter 11.3)

Mechanical blockage: When something is physically blocking the inside of the bowel and inhibiting the passage of bowel contents. (Chapter 11.13)

Melena: Dark, tarry stools. (Chapter 11.3)

NPO: An abbreviation for “nil per os”; the Latin phrase that means “nothing by mouth.” (Chapter 11.3)

Oral cavity: The mouth area, encompassing the lips, cheeks, palate, and floor of the mouth. (Chapter 11.2)

Pancreas: A large gland behind the stomach that secretes digestive enzymes into the duodenum and hormones into the blood. (Chapter 11.2)

Pancreatic juice: Digestive enzymes secreted by the pancreas and delivered to the duodenum. (Chapter 11.2)

Pancreatitis: Inflammation of the pancreas. (Chapter 11.15)

Parietal cells: Cells found in the glands of the stomach that produce and secrete hydrochloric acid and intrinsic factor. (Chapter 11.2)

Pepsin: A digestive enzyme that breaks down protein; formed when pepsinogen is exposed to acid. (Chapter 11.2)

Peptic ulcer disease: Characterized by erosions or ulcers in the gastrointestinal tract. (Chapter 11.10)

Peristalsis: The involuntary constriction and relaxation of the muscles in the gastrointestinal system, creating wave-like movements that push food forward. (Chapter 11.2)

Peritonitis: Inflammation of the peritoneum, the tissue that lines the inner wall of the abdomen and covers and supports most of the abdominal organs. (Chapter 11.5)

Pharynx: The muscular tube extending from the back of the nasal cavities and the mouth to the esophagus; known as the throat. (Chapter 11.2)

Processus vaginalis: Forms in fetal development. In males it aids in the descent of the testicles through the inguinal canal, and in females it plays a role in the development of the round ligament. (Chapter 11.14)

Protuberant: Convex or bulging appearance of the abdomen. (Chapter 11.3)

Pyloric sphincter: A ring of smooth muscle at the end of the stomach, regulating the flow of partially digested food into the small intestine. (Chapter 11.2)

Rebound tenderness: Pain when hand is withdrawn during palpation. (Chapter 11.3, Chapter 11.5)

Rectum: The final section of the large intestine, terminating at the anus. (Chapter 11.2)

Reducible hernia: When a hernia and its contents can be pushed back into their normal anatomical space. (Chapter 11.14)

Regurgitation: Refers to backwards flow of acidic gastric contents into the esophagus or mouth. (Chapter 11.9)

Rigidity: Involuntary contraction of the abdominal musculature in response to peritoneal inflammation. (Chapter 11.3)

Rome IV criteria: A set of diagnostic criteria utilized to help diagnose IBS. (Chapter 11.12)

Salivary glands: Small glands in the mucous membranes of the mouth and tongue that secrete saliva directly into the oral cavity or indirectly through salivary ducts. (Chapter 11.2)

Scaphoid: Sunken appearance. (Chapter 11.3)

Segmentation: The mechanical mixing of food with digestive juices. (Chapter 11.2)

Sigmoid colon: The last part of the colon that leads into the rectum; shaped like an “S.” (Chapter 11.2)

Skip lesions: Lesions that have normal areas of bowel between them; a hallmark symptom of Crohn’s disease. (Chapter 11.11)

Small intestine: The part of the intestine where most of the digestion and absorption of food occurs, extending between the stomach and large intestine. (Chapter 11.2)

Steatorrhea: The excretion of abnormal quantities of fat with the feces. (Chapter 11.2)

Stomach: A sac-like organ of the digestive system where food is mixed with gastric juice. (Chapter 11.2)

Strangulated hernia: When a hernia undergoes a reduction in oxygen supply due to reduced blood flow; considered a medical emergency. (Chapter 11.14)

Striae: White or silver markings from stretching of the skin; also known as stretch marks. (Chapter 11.3)

Strictures: Narrowing. (Chapter 11.11)

Tenesmus: The frequent urge to have a bowel movement or the sensation that the bowels are not empty. (Chapter 11.11)

Tongue: A muscular organ in the mouth, aiding in ingestion, digestion, sensation of food, swallowing, and speaking. (Chapter 11.2)

Total colectomy: Surgical removal of the entire colon. (Chapter 11.11)

Transverse colon: The middle part of the colon that travels across the abdomen. (Chapter 11.2)

Ultrasound: Uses sound waves to create images of the body. (Chapter 11.3)

Uvula: A fleshy extension at the back of the soft palate that hangs above the throat. (Chapter 11.2)

Varices: Enlarged veins in the esophagus that occur due to portal hypertension. (Chapter 11.15)

Ventral hernia: A hernia that occurs in the wall of the abdomen and is neither inguinal nor hiatal in origin. (Chapter 11.14)

Villi: Small, finger-like projections that protrude from the epithelial lining of the intestinal wall, increasing the surface area for absorption. (Chapter 11.2)

Voluntary guarding: Voluntary contraction of abdominal wall musculature; may be related to fear, anxiety, or presence of cold hands. (Chapter 11.3)

Volvulus: A type of bowel obstruction caused by twisting of the intestines. (Chapter 11.13)

PART XII

CHAPTER 12 TRANSITION TO PRACTICE

12.1 Transition to Practice Introduction

Learning Objectives

- Identify actions for obtaining a nursing credential

Preparing to enter the workforce as a licensed practical/vocational nurse (LPN/VN) can be a challenging but exciting time. Being aware of available resources will help navigate this process, decrease stress, and make the process more manageable. This chapter will discuss how to prepare for the NCLEX-PN examination, obtain an LPN/VN license, create a resume and portfolio, effectively participate in an interview, transition into the LPN role, and become a lifelong learner.

12.2 Preparing for the NCLEX-PN

The **National Council Licensure Examination for Practical Nurses (NCLEX-PN)** is the exam that nursing graduates must pass successfully to obtain their license and become a licensed practical/vocational nurse. The purpose of the NCLEX is to evaluate if a nursing graduate (i.e., candidate) is competent to provide safe, competent, entry-level nursing care. The NCLEX-PN is developed by the National Council of State Board of Nursing (NCSBN), an independent, nonprofit organization composed of the 50 state boards of nursing and other regulatory agencies.[1]

The NCLEX-PN is a pass/fail examination administered on a computer using computer adaptive testing (CAT). CAT means that every time a candidate answers a test item, the computer re-estimates their ability based on all their previous answers and the difficulty of those items. The computer then selects the next item based on an estimated 50% chance of the candidate answering it correctly. In this manner, the next item is not too easy nor too difficult, and a candidate's true ability level is determined. Each item is perceived by the candidate as challenging because it is targeted to their ability. With each item answered, the computer's estimate of the candidate's ability becomes more precise.

The computer stops providing items when it is 95% certain that the candidate's ability is clearly above or clearly below the passing standard, the candidate has received the maximum number of questions, or the candidate has run out of time without demonstrating a competence level to pass. Testing accommodations may be provided for eligible candidates with the authorization of the candidate's State Board of Nursing (SBON).[2]

1. NCSBN. https://www.ncsbn.org/nclex.htm
2. NCSBN. https://www.ncsbn.org/nclex.htm

See an image of a simulated graduate taking the NCLEX in Figure 12.1.[3]



Figure 12.1 Simulated Graduate Taking the NCLEX

- Read more about the NCLEX at NCSBN's Examinations web page.

Watch a video[4] from the NCSBN about how the NCLEX uses computer-assistive technology (CAT): NCLEX Using CAT.

3. "Woman_with_computer.jpg" by Cumminsr at English Wikipedia is licensed under CC BY-SA 3.0

4. NCSBN. (2012). *NCLEX using CAT* [Video]. All rights reserved. https://www.ncsbn.org/video/nclex-using-cat

Registering to Take the NCLEX

Before you can register to take the NCLEX, you will need an Authorization to Test (ATT). To receive an ATT, complete the following steps[5]:

- Apply for a nurse license from your State Board of Nursing (SBON) or other nursing regulatory body
- Register with Pearson VUE and pay the exam fee
- Wait to receive your ATT from Pearson Vue
- Schedule your exam with Pearson VUE

Be sure to start this process well in advance of your target date for taking the NCLEX.

Read specific instructions regarding registering and taking the NCLEX-PN by downloading the most current *NCLEX-Candidate Bulletin* from the NCSBN. The content includes the following:

- Registering for the exam
- Scheduling the exam
- Understanding test site rules and regulations
- Preparing for the day of the exam

> Download the most current *NCLEX-Candidate Bulletin* from NCSBN's Examinations web page.

Next Generation NCLEX

A new edition of NCLEX was released in 2023 with "Next Generation" questions.

5. NCSBN. https://www.ncsbn.org/nclex.htm

The Next Generation NCLEX (Next Gen) uses evolving case studies and new types of test questions based on a new NCSBN Clinical Judgment Measurement Model (NCJMM) that assesses how well the candidate can think critically and use clinical judgment when providing nursing care. The NCJMM assess the candidate's ability to recognize cues, analyze cues, prioritize hypotheses, generate solutions, take actions, and evaluate outcomes.[6]

Five new Next Generation test item types are called extended multiple response, extended drag and drop, cloze (drop-down), extended hot spot (highlighting), and matrix/grid:

- **Extended Multiple Response:** Extended Multiple Response items allow candidates to select one or more answer options at a time. This item type is similar to the current NCLEX multiple response item but has more options and uses partial credit scoring.[7]
- **Extended Drag and Drop:** Extended Drag and Drop items allow candidates to move or place response options into answer spaces. This item type is like the current NCLEX ordered response items but not all of the response options may be required to answer the item. In some items, there may be more response options than answer spaces.[8]
- **Cloze (Drop – Down):** Cloze (Drop – Down) items allow candidates to select one option from a drop-down list. There can be more than one drop-down list in a cloze item. These drop-down lists can be used as words or phrases within a sentence or within tables and charts.[9]
- **Enhanced Hot Spot (Highlighting):** Enhanced Hot Spot items allow candidates to select their answer by highlighting predefined words or

6. NCSBN. https://www.ncsbn.org/nclex.htm

7. NCSBN. https://www.ncsbn.org/nclex.htm

8. NCSBN. https://www.ncsbn.org/nclex.htm

9. NCSBN. https://www.ncsbn.org/nclex.htm

phrases. Candidates can select and deselect the highlighted parts by clicking on the words or phrases. These types of items allow an individual to read a portion of a client medical record (e.g., a nursing note, medical history, lab values, medication record, etc.), and then select the words or phrases that answer the item.[10]

- **Matrix/Grid:** Matrix/Grid items allow the candidate to select one or more answer options for each row and/or column. This item type can be useful in measuring multiple aspects of the clinical scenario with a single item.[11]

View a supplementary YouTube video[12] on Next Generation test items: The Right Decisions Come from the Right Questions.

Participate in an NCLEX tutorial at the Next Generation NCLEX's Prepare for Success web page.

Preparing for the Examination

Since the first day of nursing school, you have been working towards successfully passing the NCLEX. After you graduate, it is important to implement strategies for success for taking the NCLEX, such as reviewing the

10. NCSBN. https://www.ncsbn.org/nclex.htm
11. NCSBN. https://www.ncsbn.org/nclex.htm
12. NCSBN. (2019, December 17*). The right decisions come from the right questions* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=ZBXfkINIRF0

NCLEX Test Plan, setting up a dedicated review schedule based on your test date, and reviewing material you learned throughout nursing school.[13]

NCLEX Test Plan

The **NCLEX Test Plan** provides a concise summary of the content and scope of the exam and serves as an excellent guide for preparation. NCLEX test plans are updated every three years based on surveys of newly licensed registered nurses to ensure the NCLEX questions reflect fair, comprehensive, current, and entry-level nursing competency.[14]

The NCLEX Test Plan categorizes test questions based on categories and subcategories referred to as "Client Needs"[15]:

- Safe and Effective Care Environment
  - Management of Care
  - Safety and Infection Control
- Health Promotion and Maintenance
- Psychosocial Integrity
- Physiological Integrity
  - Basic Care and Comfort
  - Pharmacological and Parenteral Therapies
  - Reduction of Risk Potential
  - Physiological Adaptation

In addition, the following concepts are applied throughout the client needs categories[16]:

13. NCSBN. https://www.ncsbn.org/nclex.htm
14. NCSBN. https://www.ncsbn.org/nclex.htm
15. NCSBN. https://www.ncsbn.org/nclex.htm
16. NCSBN. https://www.ncsbn.org/nclex.htm

- Nursing Process
- Caring
- Communication and Documentation
- Teaching and Learning
- Culture and Spirituality

> Download the current NCLEX-PN Test Plan from Next Generation NCLEX's Test Plans web page.

Review Schedule

Many students find it helpful to create and follow a study calendar with topics to review based on the NCLEX-PN Test Plan.

Reviewing Material

Some graduates prefer to attend an NCLEX review course to prepare for the examination whereas others prefer to review their notes from nursing school on their own. Be sure to review the NCLEX Candidate Rules before the day of the examination.[17]

Day of the Examination

On the day of the examination, it is normal to experience some anxiety. However, it is important to use techniques to manage anxiety so it does not impact your ability to think through and answer the test questions. Use positive self-talk and remind yourself that you have been preparing for this

17. NCSBN. https://www.ncsbn.org/nclex.htm

examination since the first day of nursing school. Read additional tips for the day of the NCLEX and tips for testing in the following boxes.

Tips for the Day of the NCLEX[18]

- Locate the test center prior to the day of the exam, if possible.
- Get plenty of sleep the night before the exam.
- Eat prior to the examination.
- Dress comfortably.
- Bring your ID.
- Arrive early (30 minutes).
- All personal items must be placed in a sealable, plastic bag that is provided and placed in lockable storage. This includes electronic devices such as cell phones, tablets, smart watches, or other electronic devices.

Tips for Testing[19]

- Perform relaxation breathing to stay calm and focused (take a few deep breaths in and out and remind yourself you are ready).
- Set your pace as you proceed through the questions based on the time limit for the exam.
- There are two optional breaks during the exam (the first break occurs two hours into testing, and the second break occurs after 3.5 hours of testing).
- Take time to analyze each question carefully—once you submit an answer, you can't return to that question.
- The exam ends with a short, computerized survey. Afterwards, raise your hand and wait for the testing administrator to dismiss you. The sealed bag that was placed in locked storage will be inspected.

18. NCSBN. https://www.ncsbn.org/nclex.htm

19. NCSBN. https://www.ncsbn.org/nclex.htm

After the Examination

If your State Board of Nursing (SBON) or nursing regulatory body (NRB) participates in the "Quick Results Service," you can receive your "unofficial" results two business days after the exam if you pay for this service. Official results are sent to you approximately six weeks after the exam.[20]

If you didn't pass the exam, you'll receive an NCLEX Candidate Performance Report (CPR). The CPR is an individualized document that shows how a candidate performed in each of the test plan content areas. Graduates who fail the exam can use the CPR as a guide to prepare them to retake the exam.[21]

If you need to retake the exam, you will need to wait a minimum of 45 days before you can retake the NCLEX per NCSBN policy. This length of time is determined by your SBON (or NRB) and will be reflected in your new ATT's validity dates. Read the steps for retaking the NCLEX in the following box.

Steps for Retaking the NCLEX

- Contact your State Board of Nursing (SBON) or nursing regulatory body (NRB) and notify them that you plan to retake the exam.
- Determine what fees or materials you need to submit to the SBON or NRB.
- Reregister with Pearson VUE and pay the fee.
- Wait to receive your new ATT.
- Schedule your new exam.
- Review your CPR and set up a review plan.

20. NCSBN. https://www.ncsbn.org/nclex.htm
21. NCSBN. https://www.ncsbn.org/nclex.htm

12.3 Obtaining Your Nursing License

Licensure is the process by which a State Board of Nursing (SBON) grants permission to an individual to engage in nursing practice after verifying the applicant has attained the competency necessary to perform the scope of practice of a registered nurse (RN).[1] The SBON verifies these three components:

- Verification of graduation from an approved prelicensure practical nursing education program
- Verification of successful completion of NCLEX-PN examination
- A criminal background check (in some states)[2]

Requirements for licensure renewal vary from state to state. Some states require continued education credits (CEUs), along with the payment of fees. In Wisconsin the nursing license is renewed every two years. See Figure 12.2[3] for an image of a simulated nursing license.

1. NCSBN. https://www.ncsbn.org/nclex.htm
2. NCSBN. https://www.ncsbn.org/nclex.htm
3. "3277658479_86d3d7d61c_o.jpg" by Vernon Dutton is licensed under CC BY-NC-SA 2.0

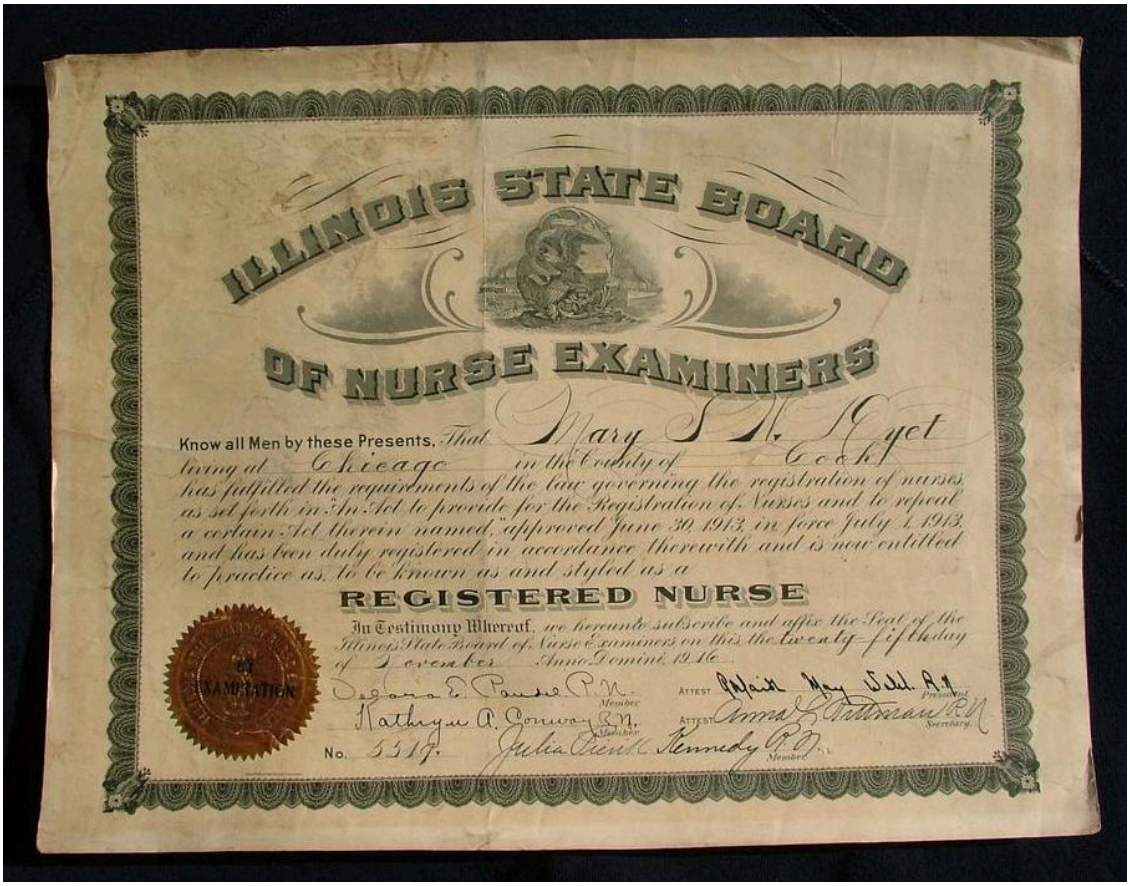


Figure 12.2 Simulated Nursing License

- Use this map for contact information for the State Boards of Nursing.
- Read more details on obtaining a Wisconsin LPN license at DSPS's Licensed Practical Nurse web page.

Nurse Licensure Compact

When applying for your nursing license from your State Board of Nursing (SBON), you may also be eligible to apply for a multistate license. The **Nurse Licensure Compact (NLC)** allows nurses to practice in other NLC states with their original state's practical nursing license without having to obtain additional licenses, contingent upon remaining a resident of that state.

Currently, 41 states have enacted the NLC. Read more information about the NLC using the information in the following box.

- View the current Nurse Licensure Compact Map.
- Read this algorithm on how to Navigate the Nurse Licensure Compact.

Watch a video[4] from the NCSBN for nursing students on the Nurse Licensure Compact: Guide to NLC for Nursing Students.

4. NCSBN. (2020). *Guide to NLC for nursing students* [Video]. All rights reserved. https://www.ncsbn.org/video/nclex-using-cat

12.4 Applying for a Nursing Position

Many students begin applying for their first nursing position before they graduate or take the NCLEX-PN. Read tips for employment in the following box.

Tips for Employment

- Reflect on previous clinical rotations and the experience. It is helpful to apply at agencies where you have had a positive learning experience.
- Obtain employment at a health care agency as a nursing assistant or intern prior to graduation. This allows you to experience the workplace culture. Intern and extern roles allow the nursing student to perform nursing skills under the supervision of an RN, often with a temporary permit obtained from their State Board of Nursing (SBON). After receiving your LPN license, it is often an easier transition into the practical nursing role. Working at the facility prior to graduation also increases familiarity with the environment, electronic health record, and health care team.

During your job-search process, it is helpful to begin by reviewing Medicare's quality ratings of health care agencies and providers. The "overall star rating" is based on how well the agency performs on various quality indicators and client satisfaction surveys.

Review Medicare ratings of hospitals, nursing homes, home health agencies, and providers at Medicare.gov's Find and Compare Provider web page.

When applying for a job position, a resume and/or portfolio is typically included as part of the application process.

Resume

A **resume** is a document that highlights one's background, education, skills, and accomplishments to potential employers. There are many types of resume formats, and some individuals elect to use online services to create a professional resume.

A resume typically includes the following components:

- Personal contact information
- Professional objective statement
- Education
- Work experience
- Awards and achievements
- Community service
- Languages, hobbies, volunteer experiences (optional)

When creating a resume, it is helpful to highlight skills and experience that separate you from the other candidates applying for the position. It is also helpful to tailor your resume to the skills and experience expressed in the job description.

- Read more details about what to put in a resume and nursing resumes and cover letters PDF.
- View a sample resume.
- View a sample Online Resume Service.

Portfolio

A **portfolio** is a compilation of materials showcasing examples of previous work demonstrating one's skills, qualifications, education, training, and

experience. They can be submitted in electronic or paper form. See Figure 12.3[1] for an image of a sample electronic portfolio.

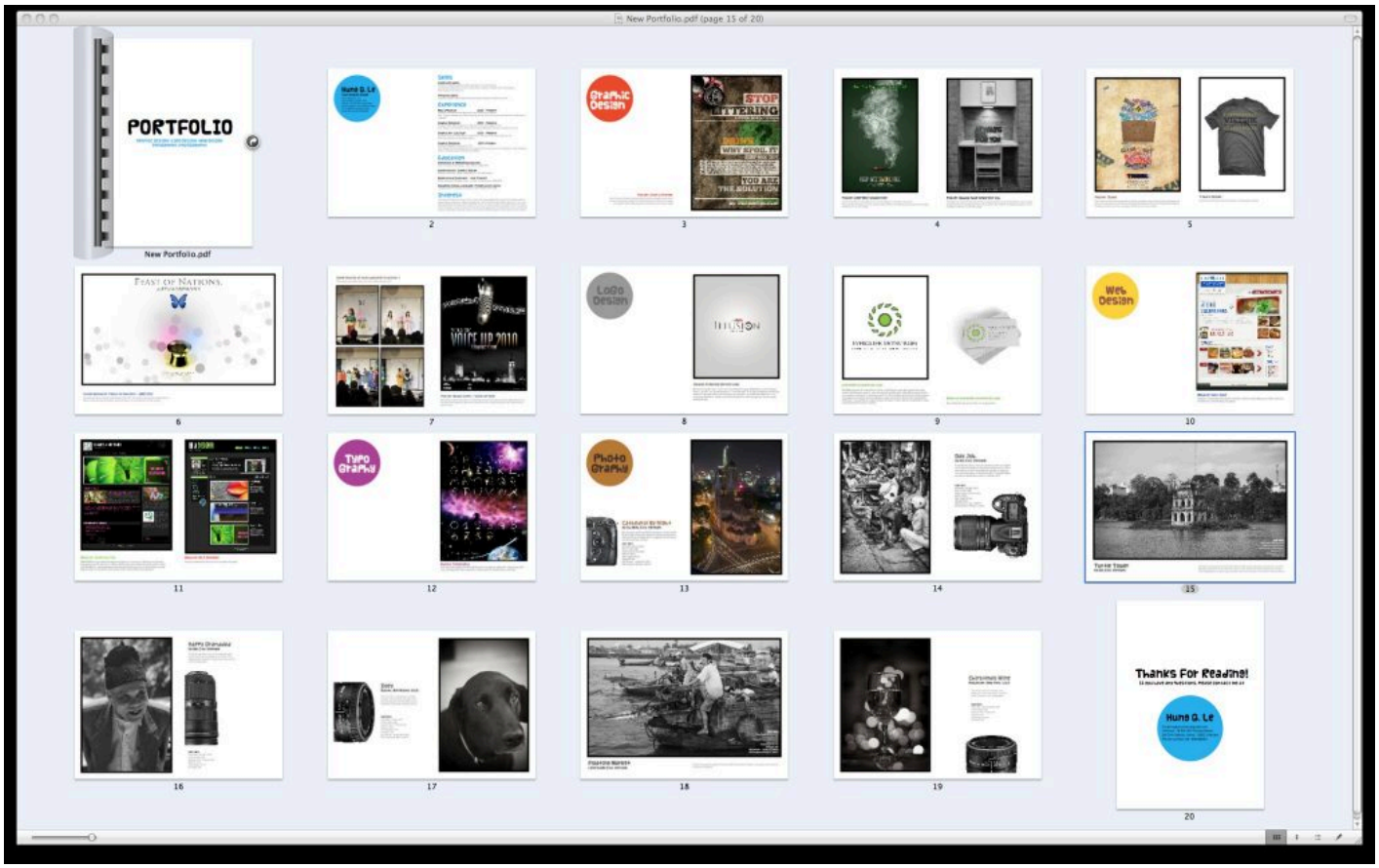


Figure 12.3 Sample Electronic Portfolio

Some schools of nursing require portfolios to be completed throughout the program. These portfolios are a representation of work demonstrating the student's accomplishments.

Portfolios typically include the following:

- Personal contact information
- Resume
- Professional goals
- Skilled work with examples (e.g., a nursing care plan, process recording, teaching plan, etc.)

1. "4805383850_7385e60b6c_k.jpg" by Hung Le is licensed under CC BY 2.0

- Accomplishments (e.g., dean's list)
- Degrees
- Certifications (e.g., CPR)
- Professional memberships (e.g., Student Nurse Association)
- Community service activities
- References (if requested)

- Read more about what to include in a portfolio.
- Visit an online portfolio service.

Interviewing

After applying for a position and submitting your resume and/or portfolio, you may be contacted to set up an interview. When you're interviewing for a position, you will be asked about your skills, experience, and your education. Some questions may be basic, such as, "Why did you become a nurse?" Other questions may be more difficult to answer, such as "Explain your strengths and weaknesses as a nurse." See Figure 12.4[2] for a simulated interview.

2. "24835247668_0828e986ad_k.jpg" by Amtec Photos is licensed under CC BY-SA 2.0



Figure 12.4 Simulated Interview

Interviewing for a new position can cause anxiety because you are required to answer questions and provide examples. A strategy to make the interview process easier and reduce anxiety is to prepare answers for commonly asked questions prior to the interview. Completing this task will help you prepare and increase your confidence. See common interview questions in the following box. It is helpful to tailor your answers to the skills and experience provided in the position description of the job you are seeking.

Common Questions During an Interview

- Tell me about yourself.
- Why did you become a nurse?
- What is your educational background?
- What are your future goals?
- What are your strengths?
- What are your weaknesses?
- Give an example of how you were a good team player.
- Tell me about a time you cared for a challenging client and how you handled the situation.

Prior to your interview, research the organization's website. Be aware of their mission and vision statements and any "current events" in the news. Interviewers are impressed when an applicant has taken the time to learn about the organization and demonstrates interest.

Interviews may take place face-to-face, virtually on a computer, or over the phone. If you are interviewing face-to-face or virtually, dress for success in professional attire. If interviewing virtually, be sure to decrease distractions at home by turning off your phone and conducting the interview in a quiet space. Establish good eye contact with the interviewer and speak in a confident manner. Remember, this is the time to "sell your nursing self," so highlight your achievements and what you are proud of accomplishing. See additional tips for interviews in the following box.

Tips for Interviews

- Dress in business casual attire.
- Arrive ten minutes early for the interview.
- Bring copies of your resume or portfolio.
- Silence your cell phone.
- Do not chew gum.
- Answer all questions honestly and thoroughly. Provide examples when feasible.
- Ask questions.
- At the end, thank the interviewer and ask when you will be notified if you are offered the position.

The interview process is also an opportunity for you to determine if this position and agency is a good fit for you. Remember that it is important to select an agency that has good ratings for providing safe client care and client satisfaction. It is not worth taking a position that may place your nursing license at risk. Research the mission and values of the health care facility and explain how you would make a good fit with those characteristics. Ask questions of the interviewer to clarify your understanding of the job position and expectations, agency policies, and workplace culture. Suggested interview questions are listed in the following box.

Questions for Interviewer
• How long is the orientation process? • How long will I have access to a mentor? • Do you have a nurse residency program? • What system do you use for the electronic health record? • What is the weekend rotation requirement? • What are the holiday requirements? • What are the staffing ratios? • What are your policies regarding “mandatory overtime” and “off with benefits”? • How long are the shifts? • What is your policy for tuition reimbursement? • What is the salary range? • How does this organization handle error reporting? • How has this organization adopted The Joint Commission’s Culture of Safety, such as the Just Culture model? • Do you have an ethics committee or other resources for nurses?

12.5 Transitioning to the PN Role

Reality Shock

As a new graduate transitions into the role of being a practical nurse, it is very common to experience something called “reality shock.” Although Kramer’s “Reality Shock” theory is several decades old, it continues to apply to new nurses transitioning to their new role through a process of learning and growing. Kramer’s Reality Shock theory characterizes four phases of transitioning into a new role referred to as the honeymoon, shock, recovery, and resolution phases[1]:

- **Honeymoon phase:** The first phase occurs when the newly graduated nurse is excited to join the nursing profession and it is everything they imagined. During this phase, the new nurse is typically paired up with a preceptor nurse to orient them to the new role.
- **Shock phase:** The second phase is when the new nurse is the most vulnerable. They are moved off orientation and independently perform tasks without the guidance of their preceptor. The nurse role is often more difficult than the new nurse previously imagined. The new nurse realizes their expectations associated with the nursing role may be inconsistent with the actual responsibilities. During this phase, negative feelings regarding their new profession may arise, and the new nurse is at greatest risk for leaving the unit or quitting.
- **Recovery phase:** The third phase is when new nurses begin to have positive feelings towards their profession again. During this phase, the new nurse is able to reflect on their experiences and develop a clear understanding of their responsibilities and role expectations. The novice nurse typically experiences decreased tension and anxiety and begins to assist other nurses as needed.
- **Resolution phase:** The fourth and final phase is usually at the end of the

1. Kramer, M. (1974). *Reality shock: Why nurses leave nursing*. C. V. Mosby Co.

first year of the new position. The new nurse can visualize how the role contributes to the profession, and work expectations are easily met.

Transitioning Into Practice

Over the years, the National Council of State Boards of Nursing (NCSBN) has researched the complex issue of retaining new nursing graduates and found the inability of new nurses to properly transition into practice can have grave consequences. New nurses care for sicker clients in increasingly complex health settings and feel increased stress levels. As a result, new nurses are involved in more client safety and practice errors than experienced nurses. It has been reported by the NCSBN that within the first year of employment, 25% of novice nurses leave their nursing positions.[2]

There are several potential strategies for helping new nurses transition into practice. The first step of the transition is being aware of "reality shock" and the phases of the transition process. A thorough orientation process with an experienced preceptor is a traditional strategy for transitioning into a new nursing position. A newer strategy being implemented in some agencies is a nurse residency program.

Orientation may last anywhere from one to four months, but can be longer depending on the specialty. Orientation is based on the new nurse's demonstration and completion of competencies. During this time, the novice nurse will work with a preceptor to experience all aspects of the role.

Preceptors are experienced and competent nurses who serve as a role model and a resource to a newly hired nurse. Preceptors have the knowledge, skills, and the ability to coach the new nurse into the nursing role and answer their questions. The preceptor also evaluates a new hire's performance and provides feedback for improvement.

Nurse residency programs provide additional professional development support for all newly licensed nurses. Nurse residency programs vary from institution to institution, but many start around the time the new graduate

2. NCSBN. (n.d.). *Transition to practice: Why transition to practice (TTP)?* http://www.ncsbn.org/transition-to-practice.htm

ends their orientation with a preceptor and continue to provide routine support throughout the year. Residency programs are structured to provide a variety of learning opportunities, including nursing skill development, peer networking, and mentorship. The goal of nurse residency programs is to provide organizational support for newly licensed nurses during the critical phase of transitioning from student to professional nurse.[3] See 12.5[4] for an image of new nurses participating in a nurse residency program.



Figure 12.5 Nurse Residency Program

Benner's Novice to Expert Theory

As a nursing graduate transitions into a new nursing role, a well-known theory called "**Benner's Novice to Expert Theory**" explains how new hires develop skills and a holistic understanding of client care over time, resulting

3. Ackerson, K., & Stiles, K. A. (2018). Value of nurse residency programs in retaining new graduate nurses and their potential effect on the nursing shortage. *The Journal of Continuing Education in Nursing, 49*(6). https://doi.org/10.3928/00220124-20180517-09

4. "1637163589.jpg" by Monkey Business Images is used under license from Shutterstock.com

from a combination of a strong educational foundation and thorough clinical experiences. See Figure 12.6[5] for an illustration of Benner's Novice to Expert Theory. Benner's theory identifies five levels of nursing experience: novice, advanced beginner, competent, proficient, and expert.[6]

- A **novice** is a beginner with no clinical experience. They are taught general rules to help perform tasks, and their rule-governed behavior is limited and inflexible. In other words, they are told what to do and simply follow instructions.
- An **advanced beginner** shows acceptable performance and has gained prior experience in actual nursing situations. This experience helps the nurse recognize recurring patterns of client symptoms and behaviors. An advanced beginner begins to formulate strategies, based on their previous experiences, to guide actions.
- A **competent nurse** generally has two or three years' experience on the job in the same type of position that has similar day-to-day situations. Competent nurses become aware of long-term goals and gain perspective from planning their own actions. This helps them achieve greater efficiency and organization.
- A **proficient nurse** perceives and understands situations as whole parts, so they have a holistic understanding of nursing that improves their decision-making. Proficient nurses have learned what to expect in various client situations and how to modify plans as needed.
- **Expert nurses** no longer rely on principles, rules, or guidelines to connect situations and determine actions. They have a deeper background of experience and an intuitive grasp of clinical situations. Their performances are fluid, flexible, and highly proficient.[7]

5. "Novice to Expert.png" by Meredith Pomietlo for Chippewa Valley Technical College is licensed under CC BY 4.0

6. Nursing Theory. (2020). *Dr. Patricia Benner novice to expert – nursing theorist.* https://nursing-theory.org/nursing-theorists/Patricia-Benner.php

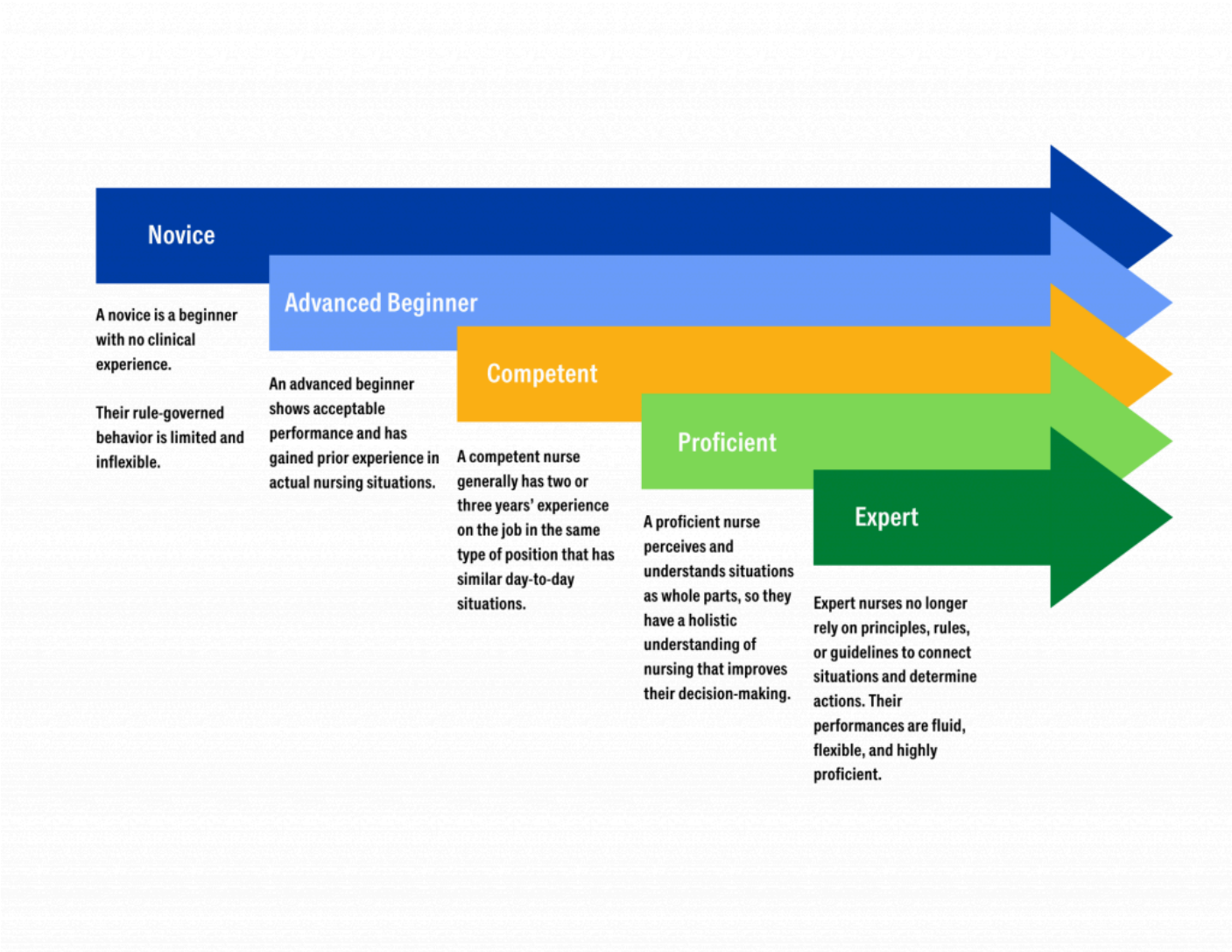


Figure 12.6 Novice to Expert Theory

7. Nursing Theory. (2020). *Dr. Patricia Benner novice to expert – nursing theorist.* https://nursing-theory.org/nursing-theorists/Patricia-Benner.php

12.6 Lifelong Learners

After graduating, passing the NCLEX-PN, and obtaining your first nursing position, your learning as a nurse has just begun. The first year of your nursing career is a continual process of transitional stages and experiential learning and is the beginning of lifelong learning as a nurse. Lifelong learning can be achieved through a variety of methods, such as obtaining additional nursing degrees, acquiring certifications, joining professional organizations, attending conferences and workshops, and staying up-to-date on current evidence-based practices by reading nursing literature and other research.

Advanced Nursing Degrees

After obtaining a nursing license, there are many opportunities to advance your education through accredited schools of nursing. Many health care organizations encourage nurses to obtain higher degrees and provide tuition reimbursement for a BSN and other advanced degrees.

Associate Degree in Nursing

Many practical nurses may choose to continue on in their educational programs and complete a second year of education to prepare them for registered nurse licensure.

Baccalaureate Degree in Nursing

Many hospitals hire nurses with an Associate's Degree in Nursing (ADN) on a condition they complete their Baccalaureate Degree in Nursing (BSN) within a specific time frame.

Master's Degree in Nursing

A Master of Science in Nursing Degree (MSN) requires additional credits and years of schooling beyond the BSN. There are a variety of degree options,

including, but not limited to, Nurse Educator, Advanced Practice Nurse (APRN), Informatics, Leadership, and Clinical Educators.

Doctoral Degrees in Nursing

Doctoral nursing degrees include the Doctor of Philosophy in Nursing (PhD) and the Doctor of Nursing Practice (DNP). PhD-prepared nurses complete doctoral work that is focused on research. They often teach in a university setting and/or conduct research. DNP-prepared nurses complete doctoral work that is focused on clinical nursing practice. They typically have work roles in advanced nursing practice, clinical leadership, or academic settings.

Advanced Practice Nurses

Advanced Practice Nurses (APRN) are defined by the NCSBN as an RN who has a graduate degree and advanced knowledge. There are four categories of Advanced Practice Nurses: certified nurse-midwife (CNM), clinical nurse specialist (CNS), certified nurse practitioner (CNP), and certified registered nurse anesthetist (CRNA). APRNs can diagnose illnesses and prescribe treatments and medications. Additional information about advanced nursing degrees and roles is provided in the box below.[1]

Nurse Practitioners: Nurse practitioners (NPs) work in a variety of settings and complete physical examinations, diagnose and treat common acute illness, manage chronic illnesses, order laboratory and diagnostic tests, prescribe medications and other therapies, provide health teaching and supportive counseling

1. Institute of Medicine. (2011). *The future of nursing: Leading change, advancing health.* National Academies Press. https://doi.org/10.17226/12956

with an emphasis on prevention of illness and health maintenance, and refer clients to other health professionals and specialists as needed. In many states, NPs can function independently and manage their own clinics, whereas in other states physician supervision is required. NP certifications include, but are not limited to, Family Practice, Adult-Gerontology Primary Care, Adult-Gerontology Acute Care, and Psychiatric/ Mental Health.

- To read more about NP certification, visit Nursing World's Our Certifications web page.

Clinical Nurse Specialists: Clinical Nurse Specialists (CNS) practice in a variety of health care environments and participate in mentoring other nurses, case management, research, designing and conducting quality improvement programs, and serving as educators and consultants. Specialty areas include, but are not limited to, Adult/Gerontology, Pediatrics, and Neonatal.

- To read more about CNS certification, visit NACNS's What is a CNS? web page.

Certified Registered Nurse Anesthetists: Certified Registered Nurse Anesthetists (CRNAs) administer anesthesia and related care before, during, and after surgical, therapeutic, diagnostic, and obstetrical procedures, as well as provide airway management during medical emergencies. CRNAs deliver more than 65 percent of all anesthetics to clients in the United States. Practice settings include operating rooms, dental offices, and outpatient surgical centers.

- To read more about CRNA certification, visit NBCRNA's website.

Certified Nurse Midwives: Certified Nurse Midwives (CNM) provide gynecological exams, family planning advice, prenatal

care, management of low-risk labor and delivery, and neonatal care. Practice settings include hospitals, birthing centers, community clinics, and client homes.

- To read more about CNM certification, visit AMCB Midwife's website.

Specialty Certifications

Acquiring nursing specialty certification is a way to demonstrate expertise. National certifications have various requirements, but most require continuing education credits and successful completion of a national examination. After successfully obtaining a specialty certification, additional credentials are displayed after "RN" in a nurse's signature. See Table 12.7 for a list of common specialty certifications and their associated credentials.

Table 12.6. Nursing Specialty Certification

Certification	Credentials
Critical Care Nursing	CCRN
Certified Nurse Educator	CNE
Oncology Certified Nurse	ONC
Stroke Certified Registered Nurse	SCRN
Trauma Certified Registered Nurse	TCRN
Surgical Nurse	CORN
Nursing Professional Development	NPD-BC

- Read more about specialty ANCC nursing certifications.

Professional Organizations

Joining a local, state or national nursing organization is a way to connect with other RNs and promote continued professional growth. The largest national

organization is the American Nurses Association (ANA). The ANA provides RN members with the following benefits:

- Advance your career with free development resources and webinars.
- Stay current with the most up-to-date nursing news.
- Save money with big discounts on continuing education (CE), certification, publications, and more.
- Network and connect with nurses for support and advice.
- Make your voice heard with opportunities to tell policymakers what you think.
- Receive state nurse association member benefits.

In addition to the ANA, each state has their own state nursing association.

> Read more about joining the American Nurses Association and your state Nursing Association on the ANA website.

Attending Conferences and Workshops

Regularly attending nursing conferences and workshops is an excellent way to maintain current, evidence-based knowledge and continue to provide safe, quality nursing care. Many opportunities exist for these types of experiences provided by local health care agencies, state nursing associations, or national conferences. Joining local, state, and national nursing organizations is the best way to be aware of upcoming conferences and workshops. See Figure 12.8[2] for an illustration of a lifelong learner and leader.

2. "EFP_2015_speaker_II.jpg" by Adrian Soldati is licensed under CC BY-SA 4.0

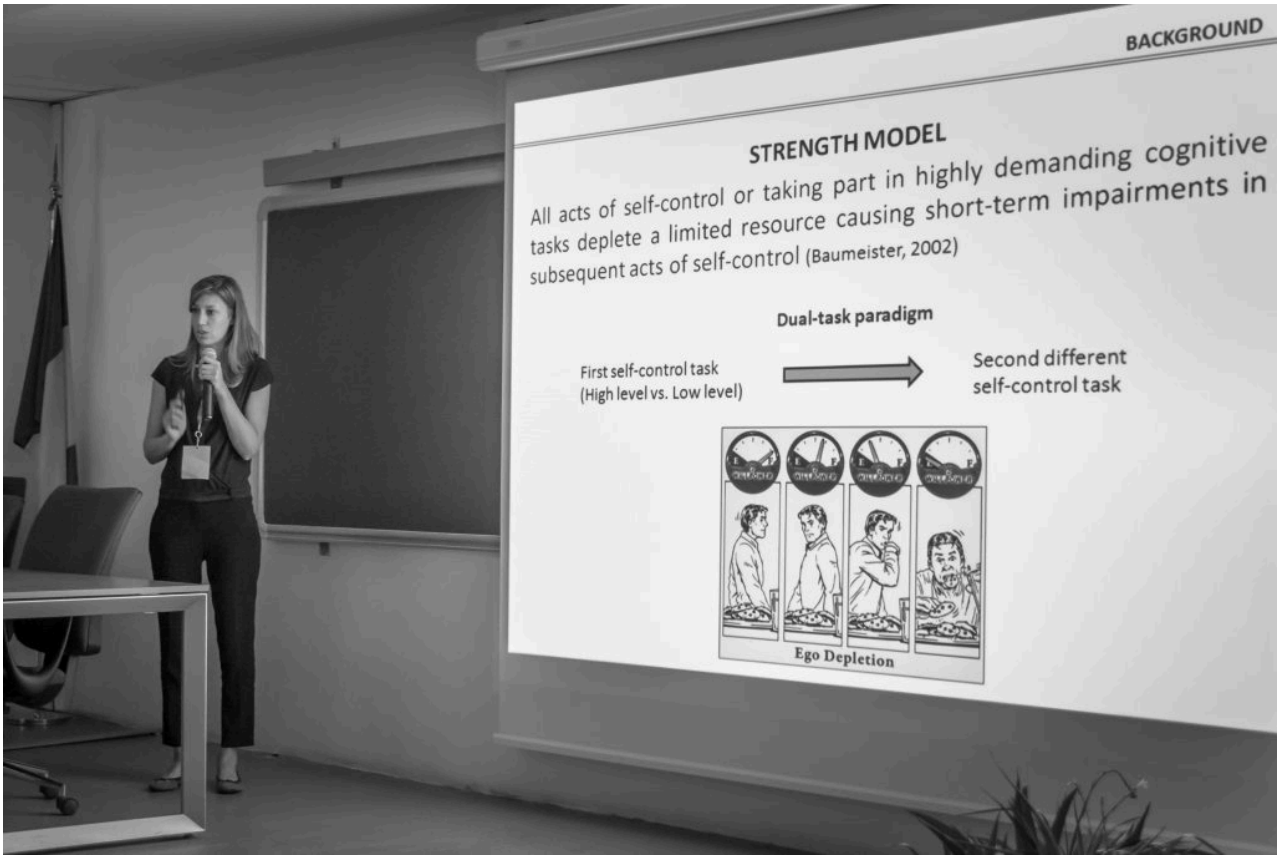


Figure 12.8 Lifelong Learner

Nursing Journals

There are many nursing journals that you can access electronically or have delivered to your home to read regularly.

> Read more about staying current on evidence-based practices in the "Quality and Evidence-Based Practice" chapter of the *Nursing Management and Professional Concepts* book.

12.7 Learning Activities

Learning Activities

Transitions to Practice Questions (Answers are located in the Answer Key at the end of the book.)[1]

1. Describe the characteristics and behaviors of a nurse in the novice stage of Benner's theory. How do novices typically approach client care?
2. What challenges might novice nurses face as they transition from the educational setting to clinical practice, according to Benner's framework?
3. Discuss the concept of "advanced beginner" in Benner's theory. What distinguishes an advanced beginner nurse from a novice, and what skills might they have developed at this stage?
4. How does Benner define competency in nursing practice? What skills and abilities does a competent nurse possess, and how do they differ from those of an advanced beginner?
5. Explain the proficient stage of nursing expertise according to Benner. What characterizes a proficient nurse, and how do they approach client care differently from nurses in earlier stages?

1. "Transition to Practice Questions" by Open RN are licensed under CC BY-NC CC BY-NC 4.0

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/healthalts/?p=5800#h5p-51

2

- Test your knowledge on transitions to practice using this NCLEX Next Generation-style Cloze question. You may reset and resubmit your answers to this question an unlimited number of times.[3]

2. "Transition to Practice Flashcards" by Open RN are licensed under CC BY-NC CC BY-NC 4.0

3. "Transitions Drop-Down Cloze" by Kellea Ewen and OpenRN is licensed under CC BY-NC 4.0

XII Glossary

Benner's Novice to Expert Theory: Explains how new hires develop skills and a holistic understanding of client care over time, resulting from a combination of a strong educational foundation and thorough clinical experiences. (Chapter 12.5)

Licensure: Process by which a State Board of Nursing (SBON) grants permission to an individual to engage in nursing practice, (Chapter 12.3)

National Council Licensure Examination for Practical Nurses (NCLEX-PN): The exam that nursing graduates must pass successfully to obtain their license and become a licensed practical nurse. (Chapter 12.2)

NCLEX-RN Test Plan: Provides a concise summary of the content and scope of the NCLEX exam and serves as an excellent guide for preparation. (Chapter 12.2)

Nurse Licensure Compact (NLC): Allows nurses to practice in other NLC states with their original state's practical nursing license without having to obtain additional licenses, contingent upon remaining a resident of that state. (Chapter 12.3)

Nurse residency programs: Provide additional professional development support for all newly licensed nurses but vary from institution to institution. Residency programs are structured to provide a variety of learning opportunities, including nursing skill development, peer networking, and mentorship. (Chapter 12.5)

Orientation: May last anywhere from one to four months but can be longer depending on the specialty. Orientation is based on the new nurse's demonstration and completion of competencies. During this time, the novice nurse will work with a preceptor. (Chapter 12.5)

Portfolio: A compilation of materials showcasing examples of previous work demonstrating one's skills, qualifications, education, training, and experience. They can be submitted in electronic or paper form. (Chapter 12.4)

Preceptors: Experienced and competent nurses who serve as a role model and a resource to a newly hired nurse. (Chapter 12.5)

Resume: A document that highlights one's background, education, skills, and accomplishments to potential employers. (Chapter 12.4)

PART XIII

ANSWER KEY

Chapter 1

Leadership Case Study Answers

1. What type of staffing model is being used in this scenario?

There is no acuity score noted, so it is ratio-based. It is also considered "team" nursing given that there are also a CNA and an LPN/LVN on the team with the RN.

2. Which tasks can be delegated to the LPN/VN?

Room 102–insulin and IV fluids; Room 107–oxygenation management and IV antibiotics; Room 103–IV antibiotics, coughing and deep breathing, and oxygenation management; Room 108–IV fluids, NG irrigation, oxygenation, and oximetry; Room 105–preop IV antibiotics and IM medication; Room 110–oxygenation, IV antibiotics, and transferring them up to the chair for 20 minutes

3. Which tasks cannot be delegated to the LPN/VN?

Room 102–postop assessment and peripheral vascular assessment; Room 107–IV change and ABGs and respiratory assessment; Room 103–GI assessment; Room 108–IV push pepcid and PCA morphine and assessment of surgical site and dressing; Room 105–surgical consent; Room 110–respiratory assessment

4. Which tasks can be safely delegated to the CNA?

Collection of vital signs, I and O for Rooms 102 and 107, turn every two hours for Room 102, and reminder to do IS every hour for Room 108

5. Identify the highest priority client to see first. What are your top three priority tasks? Provide your rationale.

Room 103 is the priority client. The nurse should first assess the client's current vital signs, as his blood pressure has been low, and his heart rate is high. The nurse should then evaluate the NG drainage as sanguinous is concerning because there is a risk that the client is bleeding internally. The nurse should also contact the provider to consider increasing IV fluids to support blood pressures and evaluate the concern for bleeding.

6. Plan your shift: Prioritize the remaining five clients in the order you will see first and your top three priority tasks for each.

Clients in the prioritized order you will see them and the rationale for doing so	Top 3 priority tasks for each client
Room 102–First day postop with a nonpalpable pulse on the operative limb	*Peripheral vascular assessment and pulse check with a Doppler* *Assess for swelling, tenderness, and changes in skin color to check for deep vein thrombosis* *Complete a pain assessment in operative leg*
Room 107–ABGs ordered and respiratory rate 24 with pulse ox 95%	*Complete a respiratory assessment, including vital signs* *Obtain ABGs* *Encourage client to be up to chair*
Room 110–Client is dyspneic with exertion	*Complete respiratory assessment* *Assess dyspnea and oxygenation status and ensure oxygen level is appropriate to client* *IV antibiotics as ordered*
Room 105–Surgery today and stay on time	*Review preop checklist and ensure consent is ready* *Assess client's anxiety regarding procedure and educate client as needed* *Ensure preop antibiotic and IM meds are completed*
Room 108–Stable postop	*GI assessment and check surgical dressing* *Assess placement and irrigate NG* *Administer IV pepcid and encourage IS use*

All of the answers to the interactive element are found within the element.

Chapter 2

Preoperative Case Study Answers

1. What information do you need to know or gather about this client before surgery occurs? Why?

- *Last time aspirin or Tylenol was taken (bleeding consideration).*
- *Consent needed to be explained again, by the surgeon, whether surgery is vaginal or abdominal (Client isn't clear about approach for surgery).*
- *Prior problems with surgery or anesthesia for client or family members (Assesses malignant hyperthermia risk).*
- *Support system of a friend or family members who can help during recovery and whether they are present (Second person to listen to postoperative instructions to later coach client/monitor and assist client in the first 24 hours after surgery).*
- *Full medication reconciliation to identify if any medications would interact with the anesthesia and if they were taken within a time frame of the surgery.*
- *Thorough health assessment to consider risk factors (Hypoventilation, renal excretion of medications, etc.).*
- *Client's normal blood pressure/pulse range (Monitor hemodynamic changes related to surgery).*
- *Height/weight (Anesthesia dosing).*
- *Allergies (Drug interactions).*
- *Preexisting infections, medical conditions, and H&P to identify any potential for increased surgical risk.*
- *Support system at home when discharged.*
- *Electrocardiogram for client over 40 years old (Identify cardiac risk) and preoperative labs such as CBC and BMP to examine bleeding risk, renal function, etc.*

2. Describe the client teaching needed. How would you prioritize teaching needs?

- *Priority consideration is clarifying the procedure for the client to ensure informed consent.*
    - *Need for surgeon to explain to the client the procedure; at this point the nurse has determined the consent hasn't been obtained as the client has questions and doesn't understand the type of surgery being performed.*
    - *To assess understanding, have the client reiterate the procedure to determine understanding using no leading language, "Ms. Smith, can you tell me why you are at the hospital today?"*

  Additional teaching related to the procedure may include the following:

    - *Teaching about pain management, expected blood loss, infection signs/risk, etc.*
    - *Teaching the importance of coughing and deep breathing after surgery, as well as early ambulation and leg exercises.*

- *Client also demonstrates sign of psychological discomfort related to the procedure. As a result, the preoperative nurse should take the following actions:*
    - *Anesthesiologist can provide additional teaching/reassurance regarding fear of "going under."*
    - *Anesthesiologist may order preoperative anxiety medication.*
    - *Nurse and members of surgical team should continue to reinforce what to expect before, during, and after the surgery (incisions, dressings, wound care, etc.).*

3. What lab tests and other diagnostic tests should be completed? Why?

- *RBC, hemoglobin, hematocrit, and platelet levels due to prior heavy bleeding.*
- *WBC to determine if WBCs are elevated, which may indicate underlying infection and potentially delayed surgery.*
- *Blood glucose (if diabetic) to know if client will need medications during*

or before surgery to keep blood sugar stable.
- *Blood type needed (in case the client needs blood transfusion with expected blood loss).*

4. Is there any information that should be shared with the surgeon or anesthesiologist?

- *Client has never had surgery (risk for malignant hyperthermia) and no known reaction to anesthesia.*
- *The client is unclear about aspects of her surgery and needs further explanation. She is anxious and afraid.*

5. What interventions can be used to reduce the client's anxiety?

- *Answer any questions*
- *Relaxation techniques*
- *Distraction*
- *Family present*
- *Medications (e.g., Midazolam [Versed], Lorazepam [Ativan])*
- *Explain what will happen after surgery*
- *Explain what she will likely be feeling*
- *Explain what she can do to decrease pain*

6. Based upon the information provided, what type of surgery is being described?

- *The surgery would be classified as curative to resolve health problems. It would be considered a major surgery with general anesthesia.*
- *Hysterectomy is a surgical operation to remove all or part of the uterus. The surgery can be identified as abdominal, vaginal, or laparoscopic.*

7. What medications might be given preoperatively to this client and why?

- *The medications that might be given preoperatively include Midazolam to assist with relaxation, Atropine (if anesthesiologist prefers) to help dry*

secretions, Famotidine to help with controlling potential acid reflux with surgery, and Ondansetron if client experiences nausea.

8. What if this client were 88 years old? How should preoperative care be modified to meet the needs of an older adult?

- *Making sure a family member is with the client.*
- *Identifying the client's decision-making capacity and identified/ activated power of attorney for health care.*
- *Understanding the different reactions to anesthesia and medications.*
- *Knowing that the elderly are at a higher risk for fluid imbalance, leading to confusion and postural hypotension.*
- *Understanding that weakened respiratory muscles can lead to collapsed lungs and impaired respiratory pattern.*

9. What risks are more likely with an older adult?

- *Delayed/ impaired healing*
- *Increased risk of infection*
- *Risk for falls*
- *Less able to adjust to the stress of surgery*
- *More prone to postural hypotension*
- *Potential complications with the lungs*
- *Difficulty maintaining blood pressure*
- *Need for more help with after-surgery medications*
- *Increased risk for aspiration*
- *Diminished hearing*
- *Forgetfulness -> impaired ability to retain information*
- *Decreased liver/kidney function -> may need reduced dosage of narcotics/sedatives*
- *Adverse drug responses -> fat soluble drugs have longer duration of action*
- *Hypoventilation due to decreased lung expansion and weakened respiratory muscles*
- *Skin breakdown due to decreased mobility*

All of the answers to the interactive element are found within the element.

Chapter 3

Chapter 3.3: Check Your Knowledge – Clinical Scenario Part A Answer

1. Based upon Sarah's case presentation, what physical assessment findings and clinical manifestations are consistent with the presence of a possible hematological alteration?

Pallor, petechiae, bruising, swollen lymph nodes, shortness of breath, enlarged spleen, fatigue, and tenderness in sternum are findings indicating a possible hematological alteration.

Chapter 3.3: Check Your Knowledge – Clinical Scenario Continued Part B Answer

1. What laboratory and diagnostic tests would be helpful in diagnosing Sarah? Why?

Complete Blood Count (CBC): Provides information about the number and types of blood cells in the client's bloodstream. It includes measurements of red blood cells (RBCs), white blood cells (WBCs), and platelets.

Peripheral Blood Smear: Assesses the size, type, and shape of the blood cells.

Coagulation Studies:

- *Prothrombin Time (PT)/International Normalized Ratio (INR): Allows for examination of extrinsic factors (Factor VII) in the clotting cascade.*
- *Partial Thromboplastin Time (PTT): Evaluates intrinsic pathway of clotting factors (Factors VIII, IX, XI, and XII).*

Bone Marrow Aspiration & Biopsy: Provide insight into the production and maturation of blood cells.

Iron Studies: Evaluate iron status within the blood.

Liver Function Tests: Examine any abnormalities in liver function that may impact the synthesis of clotting factors.

Hematological Case Study Answers

1. Which symptoms is Mia exhibiting that make you concerned about her hematological system?

The following symptoms would raise concern about Mia's hematological system: fatigue, pallor, shortness of breath, sore gums, difficulty concentrating, and lack of iron-rich foods.

2. Which assessments and diagnostic tests do you anticipate the health care provider would initially do for Mia?

The health care provider would most likely require a food diary, vital signs, and complete blood count (CBC), with a focus on hemoglobin and hematocrit.

3. What modifications to Mia's routine and lifestyle could assist her in symptom management?

The following modifications may help Mia with managing her symptoms: concentrate on iron-rich foods and supplement with over-the-counter iron recommended by her health care provider.

All of the answers to the interactive element are found within the element.

Chapter 4

Breast Cancer Case Study Answers

1. As a nurse caring for Sarah Smith, how would you approach providing emotional support and addressing her concerns related to her family history of breast cancer?

   As a nurse caring for Sarah Smith, providing emotional support and addressing her concerns related to her family history of breast cancer would involve empathetic listening, validation of her feelings, and education on risk factors and genetic predisposition. The nurse would offer counseling services, connect her with support groups, and facilitate discussions with her health care team to address her fears and anxieties. Additionally, the nurse would encourage open communication with her family members to foster a supportive environment and facilitate genetic counseling if indicated.

2. What nursing interventions would you prioritize to assist Sarah Smith in coping with the anxiety and uncertainty surrounding her breast cancer diagnosis and the upcoming diagnostic procedures?

   Nursing interventions prioritized to assist Sarah Smith in coping with the anxiety and uncertainty surrounding her breast cancer diagnosis and upcoming diagnostic procedures would include providing accurate information about the diagnostic process, offering reassurance and emotional support, and teaching relaxation techniques such as deep breathing or guided imagery. The nurse would encourage her to express her feelings and concerns, involve her in decision-making regarding her care, and collaborate with the interdisciplinary team to address any psychological distress. Referral to a counselor or support group may also be beneficial in providing ongoing support.

All of the answers to the interactive element are found within the element.

Chapter 5

Chest Pain Case Study Answers

1. What is the significance of elevated troponin levels in a client with suspected MI?

Elevated troponin levels in a client with suspected MI indicate myocardial damage or injury. Troponin is a highly sensitive and specific marker of cardiac muscle injury, and its elevation suggests necrosis of cardiomyocytes, which is characteristic of myocardial infarction. Troponin levels typically rise within four to six hours of the onset of chest pain, peak within 12-24 hours, and may remain elevated for several days, making it a valuable tool for diagnosing MI and assessing its severity.

2. How do elevated CK-MB levels contribute to the diagnosis of MI, and how do they differ from troponin levels in timing and specificity?

Elevated creatine kinase-MB (CK-MB) levels contribute to the diagnosis of MI by indicating myocardial damage, similar to troponin. However, CK-MB is less specific to cardiac tissue and can also be elevated in skeletal muscle injury. CK-MB levels typically rise within three to six hours of myocardial injury, peak within 12-24 hours, and return to baseline within 48-72 hours. Unlike troponin, CK-MB levels may be affected by skeletal muscle trauma or surgery, limiting its specificity compared to troponin.

3. Why is it important to monitor blood glucose levels in a client with acute MI, and what impact can elevated levels have on the client's prognosis?

Monitoring blood glucose levels in a client with acute MI is important because hyperglycemia is associated with worse outcomes and increased mortality in these clients. Elevated blood glucose levels during acute MI may exacerbate myocardial ischemia, promote inflammation and oxidative stress, and impair myocardial function. Tight glycemic control is, therefore, recommended to improve outcomes and reduce complications in clients with MI, including reducing the risk of arrhythmias, heart failure, and recurrent events.

4. Describe the role of total cholesterol levels in the assessment of cardiovascular risk and their relevance in the management of MI.

Total cholesterol levels play a role in assessing cardiovascular risk and

guiding treatment strategies in clients with MI. Elevated total cholesterol, particularly low-density lipoprotein cholesterol (LDL-C), is a major modifiable risk factor for atherosclerotic cardiovascular disease, including MI. High cholesterol levels contribute to the development and progression of atherosclerosis, leading to coronary artery disease and myocardial infarction. Lowering cholesterol levels through lifestyle modifications and pharmacotherapy, such as statins, is essential for reducing the risk of recurrent cardiovascular events and improving long-term outcomes in clients with MI.

All of the answers to the interactive element are found within the element.

Chapter 6

Asthma Case Study Answers

1. What is your hypothesis for Jeremy's current condition and what are two possible causes?

Hypothesis: Acute asthma exacerbation

Possible Causes:

- *Respiratory Infection: The recent "cold" affecting his family members suggests that Jeremy may have contracted a viral respiratory infection, a common trigger for asthma exacerbations.*
- *Physical Exertion: Playing basketball can be physically demanding and may have triggered his asthma symptoms, especially if he did not use a pre-exercise bronchodilator inhaler, if prescribed.*

2. How would you teach Jeremy and his parents about his salmeterol inhaler and why did it not offer relief?

- *Explain that Serevent is a long-acting beta-agonist (LABA) bronchodilator, which is primarily used for maintenance therapy, not for immediate relief during an asthma attack.*
- *Emphasize the importance of using a short-acting beta-agonist (e.g., albuterol) for quick relief during acute symptoms.*
- *Teach Jeremy and his parents to differentiate between their maintenance and rescue inhalers and when to use each.*

3. Evaluate Jeremy's peak flow reading. What zone is he in? What will you teach Jeremy and his parents regarding his asthma management using peak flow meter readings and the asthma action plan?

Jeremy's peak flow reading is 180, significantly below his personal best of 425.

Jeremy is in the "Red Zone," indicating a severe asthma exacerbation.

Teaching will include the following: regularly monitor peak flow measurements because peak flow readings help monitor lung function and

assess asthma control and reinforce the three zones (Green, Yellow, Red) in his asthma action plan and actions to take.

- *Green Zone (Good Control): No symptoms and peak flow reading 80% or higher compared to his personal best.*

- *Yellow Zone (Caution): Worsening symptoms. Peak flow reading between 50% and 79%. Follow the asthma action plan in self-administering prescribed medications and contacting the health care provider.*

- *Red Zone (Medical Alert): Immediate action is required. Administer quick-relief medication and contact the health care provider. Obtain emergency medical care as described.*

COPD Case Study Answers

1. Based upon the information above, what signs and symptoms suggest the client may have COPD?

Maria reports chronic cough with sputum production and exertional dyspnea. She has an increased respiratory rate, diminished breath sounds, wheezing, chronic cough with thick yellow/green sputum, barrel chest, and cyanosis in the nail beds. She has assumed a "tripod" position.

2. What are potential contributing factors to Maria's COPD diagnosis?

Maria's long-term smoking history is the most likely cause of her COPD. Cigarette smoke is a well-established risk factor for developing the disease. In addition to smoking, occupational or environmental exposures to lung irritants (e.g., dust, chemicals, pollutants) may have contributed to her condition, especially if she had a history of such exposures in her workplace or living environment.

3. The health care provider prescribes daily fluticasone inhaler use with albuterol inhaler for rapid treatment of dyspnea. What will you teach Maria about these medications?

Fluticasone is an inhaled corticosteroid that will reduce inflammation in the lungs. It should be used daily, and Maria should rinse out her mouth after use. Albuterol is a quick-relief medication that Maria should use when she feels short of breath.

4. The health care provider recommends Maria to participate in pulmonary rehabilitation. Maria states, “Why should I drive into town to go to pulmonary rehab?” How should the nurse respond to Maria?

Pulmonary rehabilitation is a supervised program that will help to improve her endurance to physical activity to its optimal level. The staff will also provide teaching on breathing techniques to use when she is feeling short of breath and ways to conserve her energy and manage her fatigue when doing daily activities.

Tuberculosis Case Study Answers

1. What are the key findings in Mrs. Xiong’s physical examination that suggest a diagnosis of pulmonary tuberculosis (TB)?

Mrs. Xiong’s key findings on physical examination include fatigue, night sweats, anorexia, weight loss, a persistent dry cough, and reduced breath sounds in the right upper lobe with occasional crackles. These symptoms, along with a chest X-ray showing cavitary lesions in her right upper lung lobe and a positive sputum AFB test, strongly suggest a diagnosis of pulmonary tuberculosis (TB).

2. What is the first-line therapy for treating active pulmonary TB, and what are the possible side effects of these medications?

The first-line therapy for treating active pulmonary TB consists of a combination of medications, including isoniazid (INH), rifampin (RIF), pyrazinamide (PZA), and ethambutol (EMB) taken for a minimum of six months. Possible side effects include hepatotoxicity, peripheral neuropathy, flu-like symptoms, and visual disturbances, respectively.

3. What nursing interventions are essential to prevent the spread of TB infection in the hospital setting and ensure Mrs. Xiong’s safety and well-being?

Essential nursing interventions include placing Mrs. Xiong in a negative pressure isolation room, wearing appropriate personal protective equipment (PPE), educating Mrs. Xiong on respiratory hygiene, administering and monitoring her medications, ensuring good nutrition and rest, providing emotional support, and communicating with the multidisciplinary team for coordinated care.

4. What should Mrs. Xiong be educated about regarding her condition,

including the importance of medication adherence, infection control measures, and follow-up care?

Mrs. Xiong should be educated about the importance of adhering to her prescribed medications to ensure successful treatment and prevent drug resistance. She should also be taught respiratory hygiene practices to minimize the spread of TB infection to others, including coughing or sneezing into a tissue or elbow, disposing of tissues properly, and wearing a mask if leaving her room. Additionally, she should understand the importance of follow-up appointments to monitor her progress and ensure continued care.

All of the answers to the interactive element are found within the element.

Chapter 7

Diabetes Case Study Answers

1. What cultural considerations should be taken into account when developing Daisy's care plan?

- *Consider the importance of family in Daisy's cultural context and involve them in discussions and decisions about her care.*
- *Utilize language-appropriate educational materials and ensure there is a translator available if needed.*
- *Recognize potential cultural barriers to adherence to treatment, such as traditional medicine beliefs or dietary preferences.*
- *Understand the importance of maintaining personal dignity and autonomy in care.*

2. How would you assess Daisy's understanding of her diagnosis and treatment plan given her primary language is Spanish?

- *Utilize an interpreter proficient in medical terminology to ensure accurate communication.*
- *Use visual aids and written materials in Spanish to enhance comprehension.*
- *Encourage Daisy to ask questions and repeat information in her own words to confirm understanding.*
- *Assess Daisy's level of health literacy and adjust education materials accordingly.*

3. What lifestyle modifications would you suggest to Daisy, considering her socioeconomic background?

- *Discuss low-cost dietary options, such as buying in-season fruits and vegetables or using frozen or canned options when fresh produce is expensive.*
- *Recommend physical activities that require little to no cost, like walking*

or gardening.
- *Encourage portion control and balanced meals to maximize nutritional value.*
- *Advise on low-cost ways to monitor blood glucose levels, such as using a basic glucose meter.*

4. What community resources could be utilized to support Daisy's long-term management of diabetes?

- *Identify local clinics that offer free or low-cost diabetes care and medication assistance programs.*
- *Connect Daisy with community-based diabetes support groups where she can receive guidance, education, and emotional support.*
- *Explore local food banks or government programs that provide nutritional assistance.*

5. How might Daisy's social and financial status impact her ability to access care and medications regularly?

- *Recognize potential challenges in accessing care, such as transportation limitations or work schedule conflicts.*
- *Collaborate with Daisy to find solutions that accommodate her circumstances, such as flexible appointment times or telehealth options.*
- *Assist Daisy in identifying and applying for available financial aid programs or sliding scale clinics.*

6. How would you involve Daisy's family in her care plan to support her management of diabetes?

- *Encourage family members to attend educational sessions and appointments to learn about diabetes management.*
- *Promote open communication within the family to address any concerns or misconceptions about Daisy's condition and treatment.*
- *Explore the family's support network and involve individuals who can provide practical or emotional support to Daisy.*

Hyperthyroidism vs. Hypothyroidism Case Study Answers

1. When the thyroid stimulating hormone (TSH) is released, what two thyroid hormones are released by the thyroid? What element is needed for the body to use these hormones?

- *The two thyroid hormones released by the thyroid are T3 and T4.*
- *Iodine is the needed element for T3 and T4.*

2. The most common cause of hyperthyroidism is Graves' disease.

3. Name two autoimmune diseases that affect thyroid function?

- *Two autoimmune diseases that affect thyroid function are Graves' disease (hyperthyroid) and Hashimoto's (hypothyroid) disease.*

4. Describe signs/symptoms of a thyroid storm (thyrotoxicosis)? What causes a thyroid storm?

- *Signs and symptoms of a thyroid storm (thyrotoxicosis) are a high temperature (>105,), agitation, confusion (early sign), restlessness, and hypertension.*
- *A thyroid storm is caused by too much thyroid hormone.*

5. The nurse is getting a new client with an admitting diagnosis of possible ("rule-out") myxedema coma.

- What equipment should they anticipate needing and why?
  - *The following equipment would be needed because respiratory failure, low blood pressure, and low heart rate could occur: endotracheal intubation, trach kit, warm blankets (for cold intolerance), and a heart monitor.*
- What are two risk factors for myxedema coma?
  - *Two risk factors for myxedema coma are a thyroidectomy or abrupt stop of levothyroxine.*

6. What are the signs/symptoms of hypothyroidism? What content should be included when teaching a client with hypothyroidism about diet and activity?

- *The signs and symptoms of hypothyroidism are the following:*
  - *Low energy and weakness*
  - *Low metabolism (weight gain and edema)*
  - *Constipation*
  - *Losing hair (baldness)*
  - *Forgetfulness (low mood)*
  - *Low libido (sex drive)*
  - *Dry skin*
  - *No menstrual cycle (or missed) (amenorrhea)*
- *Client teaching about hypothyroidism should include encouraging the client to take frequent rest periods and engage in a diet low in calories and low in cholesterol and saturated fats.*

7. Levothyroxine

- What is the onset of action?
  - *The onset of action for levothyroxine is typically about three to four weeks.*
- When should levothyroxine be administered?
  - *Levothyroxine should be taken on an empty stomach and 30-60 minutes before breakfast, once daily, and at the same time every day.*

8. (True or False) Levothyroxine should not be taken during pregnancy.

- *FALSE*

Thyroid Case Study 1

9. What could be contributing to her symptoms?

- *The levothyroxine dose may be too high for her and needs adjusting.*

10. What is the action of PTU (propylthiouracil)? What two side effects should be reported?

- *Propylthiouracil (PTU) stops thyroid from making thyroid hormones (T3 & T4). A fever and/or a sore throat should be reported.*

11. How does SSKI (potassium iodide) affect the thyroid?

- *S – Shrinks the thyroid (before removal)*
- *S – Stains the teeth (drink through straw and mix with some juice)*
- *K – Keep one hour apart from other thyroid medications (don't mix with other thyroid medications)*

Thyroid Case Study 2

12. Describe health teaching required following the ingestion of this medication.

- *Avoid contacts with others for one to three days because of the radioactivity.*
- *Avoid crowds and individuals who are pregnant or trying to become pregnant.*
- *Do not share eating utensils.*
- *Flush the toilet three times after voiding or having a bowel movement (radioactivity is excreted in waste products).*
- *Separate laundry.*

13. Describe nursing care following a thyroidectomy and identify two specific rationales for these nursing interventions.

- *Because of surgical manipulation, a load of thyroid hormones (T3 & T4) may be released into circulation, causing thyroid storm signs and symptoms.*
- *Airway is at risk because surgery is in the neck (monitor for edema following surgery, stridor, and hoarseness)*

- *Keep airway supplies at bedside (a "Trach set")*
- *Breathing: Keep head of bed up (semi-Fowler's or higher) and keep neck aligned*
- *Circulation (see above)*
- *Calcium—monitor calcium.*
    - *Observe for numbness and tingling around mouth (circumoral) paresthesia) and in the fingers*
    - *Trousseau's sign: If BP cuff inflated x 3 minutes, there is an involuntary contraction of the hand and wrist*
    - *Chvostek's sign: Face twitches if tapped on the cheek in front of the ear*

All of the answers to the interactive element are found within the element.

Chapter 8

Renal Case Study Answers

1. What are the likely differential diagnoses based on Jacob's symptoms?

Differential diagnoses based on Jacob's symptoms include kidney stones, urinary tract infection (UTI), appendicitis, cholecystitis, diverticulitis, and pyelonephritis.

2. Describe the pathophysiology of kidney stones formation.

Kidney stones form when certain substances in urine, such as calcium and oxalate, become concentrated enough to form crystals. Over time, these crystals can accumulate and form stones.

3. What are the key clinical manifestations of kidney stones?

Key clinical manifestations of kidney stones include sudden onset of severe pain in the flank, hematuria, nausea, vomiting, and urinary frequency or urgency.

4. What laboratory tests would you order for Jacob? Explain the rationale for each.

Laboratory tests for Jacob would include urinalysis, complete blood count (CBC), blood urea nitrogen (BUN), creatinine, electrolytes, and calcium levels. These tests help to diagnose kidney stones and assess for dehydration and electrolyte imbalances.

5. What radiological investigations would be indicated in this case?

Radiological investigations indicated in this case may include a plain abdominal X-ray, ultrasound, or CT scan of the abdomen and pelvis.

6. Discuss the role of a nurse in the management of a client with kidney stones.

The nurse plays a critical role in the management of a client with kidney stones by providing pain management, monitoring for complications, promoting fluid intake, and providing education on preventive measures.

7. Jacob has a history of recurrent kidney stones. What advice would you provide him regarding prevention of further stone formation?

To prevent further stone formation, Jacob should be advised to drink plenty of fluids, limit salt intake, eat a balanced diet, and avoid foods high in oxalate, such as spinach, nuts, and chocolate.

8. What pharmacological interventions are indicated for pain management in this case?

Pharmacological interventions for pain management in kidney stones include NSAIDs, opioids, and muscle relaxants.

9. Describe the process of lithotripsy. What are the nursing interventions associated with this procedure?

Lithotripsy is a noninvasive procedure that uses shock waves to break up kidney stones into smaller pieces, which can then pass more easily through the urinary tract. Nursing interventions include monitoring vital signs, pain management, and assisting with positioning for the procedure.

10. Jacob is scheduled for discharge. What key education points would you provide to him and his family before discharge?

Key education points for Jacob and his family before discharge include dietary modifications based upon the type of stone, the importance of maintaining hydration, signs and symptoms of complications, and when to seek medical attention.

All of the answers to the interactive element are found within the element.

Chapter 9

Stroke Case Study Answers

1. How does the Sandra's health history put her at risk for a stroke? How can the RN address the client's concerns and fears regarding the possibility of having another stroke?

- *Stroke is more common in women than men.*
- *Stoke is more common in American Indians.*
- *Hypertension and high cholesterol put her at risk.*
- *Has a history of what could have been a TIA.*
- *The RN can discuss lifestyle changes and teach the client the signs and symptoms of stroke for early recognition to help alleviate fears.*

2. What lifestyle modifications may Sandra have to make?

She will need to take her cholesterol and hypertension medications. She may need to change her diet to manage cholesterol.

3. Is Sandra a candidate to receive tPA? Why or why not? Provide the rationale for your response.

She is not a candidate because the requirement is that the client needs to receive the medication within 4.5 hours from when "last seen as normal." The time of her stroke was unknown.

4. What diagnostic tests and medications can you expect the client to receive?

The client will receive a CT scan upon arrival to the emergency room. They may also receive an MRI or MRA to determine extent of brain injury. They may also receive a carotid ultrasound, PT/INR to assess bleeding times, and a cardiac echocardiogram to look for clots and atrial fibrillation. ABCs are assessed and monitored, as are physical assessments and frequent neurological assessments by the nursing staff. They will also assess swallow function and start anticolagulant medications.

5. How will homonymous hemianopsia affect Sandra's hygiene, ability to drive, eat, and participate community activities?

She is missing some of her field of vision in each eye, affecting her ability to

see peripherally for driving and her ability to see for eating, performing hygiene, etc. She will need to move her head more to be sure she is seeing everything when eating, bathing, and doing community activities.

6. What additional assessments can the nurse make to develop interventions to help Sandra and her husband cope with this change in Sandra's health status?

The nurse will want to assess level of consciousness, physical strength/mobility, swallow ability, communication, and emotional status. Bowel and bladder function may be affected as well, so this will need to be evaluated.

All of the answers to the interactive element are found within the element.

Chapter 10

Osteoarthritis Case Study Answers

1. Based on Mary's symptoms, what are the potential differential diagnoses to consider besides osteoarthritis?

Potential differential diagnoses may include rheumatoid arthritis, gout, lupus, fibromyalgia, or other inflammatory joint diseases.

2. How would you assess Mary's pain level, and what pain assessment tools could be utilized?

Pain levels can be assessed using a numeric rating scale (0-10), visual analog scale (VAS), or verbal descriptor scale. Additionally, tools like the McGill Pain Questionnaire or Brief Pain Inventory may provide more comprehensive pain assessment.

3. What risk factors for osteoarthritis does Mary possess, and how do they contribute to her condition?

Mary's risk factors may include obesity, age, previous joint injury, and genetics. These factors contribute to the degeneration of cartilage and subsequent development of osteoarthritis.

4. What additional assessments would you conduct to further evaluate the extent of Mary's osteoarthritis?

Additional assessments may include imaging studies such as X-rays or MRI scans to evaluate joint damage, as well as blood tests to rule out other forms of arthritis.

5. How would you prioritize Mary's nursing diagnoses, and why?

The priority nursing diagnosis is impaired physical mobility because it addresses Mary's immediate problem of joint pain and stiffness, which significantly impact her ability to perform daily activities.

6. What education would you provide to Mary regarding her osteoarthritis diagnosis and management?

Education would include information about osteoarthritis, its causes, symptoms, and treatment options. Mary would also learn about joint protection techniques, medication management, exercise programs, and weight management strategies.

All of the answers to the interactive element are found within the element.

Chapter 11

GI Case Study 1 Answers

1. Symptoms of gallbladder disease often resemble those of other GI diseases. Which group of symptoms suggests cholecystitis?

Pain in the right upper quadrant that radiates to the right shoulder or back, positive Murphy's sign, and low-grade fever would suggest cholecystitis.

2. What diagnostic tests can be used to confirm a diagnosis of cholecystitis?

Diagnostic tests for cholecystitis include ultrasound, which can reveal gallstones or inflammation of the gallbladder, and a hepatobiliary iminodiacetic acid (HIDA) scan, which evaluates gallbladder function. Blood tests such as liver function tests and a complete blood count (CBC) may also be performed to assess for inflammation and infection.

3. Why are G.B.'s symptoms triggered by eating and/or eating fatty foods?

Symptoms are triggered by eating fatty foods because fatty foods stimulate the release of cholecystokinin (CCK), which causes the gallbladder to contract and release bile. In individuals with gallbladder disease, such as cholecystitis, the bile duct may become obstructed by gallstones, leading to inflammation and pain.

4. Which best describes the role of the gallbladder?

The gallbladder stores, concentrates, and secretes bile.

5. True or False: Family history is the ONLY risk factor for cholecystitis seen in G.B.'s case. If other risk factors are present, please list them.

False. Other risk factors for cholecystitis in G.B.'s case include obesity, previous gestational diabetes, and her symptoms worsening after consuming fatty foods.

6. What are some potential treatment options for G.B.?

Treatment options for cholecystitis may include pain management, antibiotics to treat infection, and dietary modifications. In severe cases or recurrent episodes, surgical removal of the gallbladder (cholecystectomy) may be necessary.

7. The physician decides that the best course of action for G.B. is a

laparoscopic cholecystectomy. What does this procedure entail? What kind of postoperative instructions will you give to G.B.?

Laparoscopic cholecystectomy is a minimally invasive surgical procedure to remove the gallbladder. It involves making small incisions in the abdomen and inserting a camera and specialized surgical instruments to visualize and remove the gallbladder. Postoperative instructions may include pain management, activity restrictions, dietary modifications (low-fat diet initially), and monitoring for signs of complications such as infection or bile duct injury.

GI Case Study 2 Answers

1. What are the signs and symptoms of peptic ulcer disease?

Signs and symptoms of peptic ulcer disease include abdominal pain, often described as burning or gnawing in nature, typically occurring between meals or during the night. Other symptoms may include nausea, vomiting (sometimes with blood), bloating, feeling full after small meals, and unintentional weight loss.

2. What risk factors does Samara present with?

Samara presents with risk factors for peptic ulcer disease such as frequent use of NSAIDs (ibuprofen), which can irritate the stomach lining, and symptoms suggestive of an upper GI bleed, such as vomiting blood (hematemesis).

3. What other MAJOR complications can occur with peptic ulcer disease?

Major complications of peptic ulcer disease include perforation, where the ulcer creates a hole through the wall of the stomach or duodenum, leading to leakage of stomach contents into the abdominal cavity; and gastric outlet obstruction, where swelling or scarring from the ulcer blocks the passage of food from the stomach into the small intestine.

4. What are the interventions if these major complications occur?

Immediate surgical intervention may be necessary if major complications such as perforation or gastric outlet obstruction occur. Perforation requires surgical repair of the hole in the stomach or duodenum, while gastric outlet obstruction may require procedures such as endoscopic dilation or surgical correction to relieve the blockage.

5. Should the nurse suggest to the health care provider that these two

home medications should be added to her admission orders? Why or why not?

The nurse should suggest discontinuing NSAIDs (ibuprofen) from Samara's admission orders, as NSAIDs can exacerbate peptic ulcer disease. However, Ortho Tri-Cyclen Lo can remain on her medication list as it is not associated with exacerbating peptic ulcers.

6. Which lab results are abnormal and what is the significance of the abnormal results?

Abnormal lab results include hemoglobin (Hgb) of 11g/dL and hematocrit (Hct) of 34%, indicating mild anemia likely due to chronic blood loss from the upper GI bleed. Additionally, the white blood cell count (WBC) of 11,800 cells/mm3 is elevated, suggesting an inflammatory response, possibly due to the ulceration and inflammation seen on EGD.

7. What are the nursing responsibilities after Samara has the EGD?

Nursing responsibilities after Samara's EGD include monitoring for signs of complications such as bleeding or perforation (e.g., abdominal pain, worsening hematemesis), providing comfort measures for any discomfort related to the procedure, and ensuring Samara remains on bedrest as ordered to minimize the risk of further bleeding.

8. After returning to the nursing unit from diagnostic testing, Samara asks to try some saltine crackers and ginger ale. How should the nurse respond to Samara's request?

Initially, the nurse should withhold solid foods and clear liquids until it is determined whether Samara's GI tract is actively bleeding or stable. However, if Samara's condition is stable and there are no contraindications, the nurse can offer small sips of clear fluids initially, such as water or ice chips, and gradually progress to bland foods like saltine crackers and ginger ale if tolerated.

9. Identify three nursing diagnoses appropriate on admission for Samara. Prioritize each nursing diagnosis and provide the rationales for each selected nursing diagnoses and its priority number.

Nursing diagnoses appropriate for Samara on admission include the following:

Acute Pain related to gastric ulceration and inflammation (Priority: 1) –

Priority is given to managing Samara's pain to ensure her comfort and promote rest, which aids in healing.

Risk for Deficient Fluid Volume related to vomiting and potential upper GI bleed (Priority: 2) – Priority is given to addressing fluid volume deficits to prevent complications such as hypovolemic shock.

Anxiety related to hospitalization, uncertainty about illness, and impact on work responsibilities (Priority: 3) – While important, addressing Samara's physical needs takes precedence over psychological support in this acute care setting.

10. Develop a teaching plan for these medications and explain to Samara rationales for diet and health care follow-up.

The teaching plan for Samara's discharge medications includes the following:

- *Omeprazole: Explanation of its role in reducing stomach acid production, which helps to heal and prevent ulcers.*
- *Calcium carbonate: Instruction on its use for relieving symptoms of indigestion or heartburn.*

All of the answers to the interactive element are found within the element.

Chapter 12

Transitions to Practice Answers

1. Describe the characteristics and behaviors of a nurse in the novice stage of Benner's theory. How do novices typically approach client care?

Novice nurses typically demonstrate limited clinical experience and rely heavily on theoretical knowledge gained from nursing school. They may approach client care cautiously and seek frequent guidance from more experienced colleagues. Novices may struggle with time management and prioritization of tasks as they adjust to the demands of clinical practice.

2. What challenges might novice nurses face as they transition from the educational setting to clinical practice, according to Benner's framework?

Novice nurses often face challenges in transitioning from the controlled environment of nursing school to the fast-paced, unpredictable setting of clinical practice. They may experience anxiety and self-doubt as they navigate unfamiliar tasks and responsibilities. Additionally, novices may find it challenging to apply theoretical knowledge to real-world client care situations and may require support and mentorship to develop confidence in their clinical skills.

3. Discuss the concept of "advanced beginner" in Benner's theory. What distinguishes an advanced beginner nurse from a novice, and what skills might they have developed at this stage?

Advanced beginner nurses have gained some familiarity with clinical routines and can perform basic nursing tasks with minimal supervision. They may start to recognize patterns in client care but still rely on rules and guidelines to guide their practice. Advanced beginners may exhibit increased confidence compared to novices but may struggle with more complex aspects of client care.

4. How does Benner define competency in nursing practice? What skills and abilities does a competent nurse possess, and how do they differ from those of an advanced beginner?

According to Benner, competency in nursing practice is characterized by the ability to manage client care independently and effectively. Competent nurses demonstrate proficiency in clinical skills and critical thinking. They

can anticipate client needs, prioritize tasks, and adapt their care plans based on client responses. Competent nurses also communicate effectively with the health care team and advocate for client well-being.

5. Explain the proficient stage of nursing expertise according to Benner. What characterizes a proficient nurse, and how do they approach client care differently from nurses in earlier stages?

Proficient nurses possess a deep understanding of client care that goes beyond routine tasks. They can recognize subtle cues and anticipate potential complications before they arise. Proficient nurses demonstrate strong critical thinking skills and can make complex clinical decisions autonomously. They also serve as mentors to less experienced colleagues and actively contribute to quality improvement initiatives.

All of the answers to the interactive element are found within the element.

Appendix A - Normal Reference Ranges

The following normal reference ranges are used for laboratory tests discussed throughout the book.[1]

Acid Base

pH	7.35 – 7.45
PaCO2	35 – 45 mmHg
HCO3-	18 – 22 mmol/L
PaO2	80 – 100 mmHg

Cardiac

CK	25 – 200 U/L
CKMB	0 – 4 ng/mL
Troponin	0 – 0.4 ng/mL

Cholesterol Panel

Total Cholesterol	3 – 5.5 mmol/L or < 200 mg/dL
HDL	40 – 80 mg/dL
LDL	85 – 125 mg/dL
Triglycerides	50 – 150 mg/dL

Coagulation Profile

Prothrombin Time	11 – 14 sec
International Normalized Ratio (INR)	0.9 – 1.2
aPTT (Activated Partial Thromboplastin Time)	20 – 40 sec

Complete Blood Count and Differential

1. Medscape. (2024). *Lab values, normal adult.* https://emedicine.medscape.com/article/2172316-overview?

RBC (Red Blood Cell Count)	Male: 4.50 – 5.90 million/mm^3 Female: 4.00 – 5.20 million/mm^3
RDW (Red Blood Cell Distribution Width)	11.5% – 14.5%
Mean Corpuscular Volume (MCV)	80 – 100 fL
Mean Corpuscular Hemoglobin (MCH)	0.4 – 0.5 fmol/cell
Mean Corpuscular Hemoglobin Concentration (MCHC)	30 – 35 g/dL
Hemoglobin	Male: 13 – 17 g/dL Female: 12 – 15 g/dL
Hematocrit	Male: 40% – 52% Female: 36% – 47%
White Blood Cells (WBC)	4000 – 10,000 mm^3
Neutrophils	46 – 78%
Lymphocytes	18 – 52%
Monocytes	3 – 10%
Eosinophils	0 – 6%
Basophils	0 – 3%
Platelet Count	150,000 – 400,000 mm^3

HbA1C (Hemoglobin A1C)

A1C	3.9 – 6.2%

Iron

Total serum iron	Male: 65 – 180 µg/dL (men) Female: 30 – 170 µg/dL (women)
Ferritin	Male: 12 – 300 ng/mL (men) Female: 12 – 150 ng/mL
Transferrin	200 – 350 mg/dL
Total Iron-Binding Capacity	45 – 85 µmol/L

Metabolic Panel

Sodium	135 – 145 mmol/L
Potassium	3.5 – 5 mmol/L
Chloride	95 – 105 mmol/L
Calcium	8.5 – 10.2 mg/dL
Magnesium	1.5 – 2 mEq/L
Phosphate	0.8 – 1.5 mmol/L
Glucose	65 – 110 mg/dL
Blood Urea Nitrogen (BUN)	8 – 21 mg/dL
Creatinine	0.8 – 1.3 mg/dL

Liver Function Tests

Alkaline Phosphatase (ALP)	50 – 100 U/L
Alanine Aminotransferase (ALT)	5 – 30 U/L
Aspartate Aminotransferase (AST)	5 – 30 U/L
Albumin	35 – 50 g/L
Total Protein	60 – 80 g/L
Total Bilirubin	2 – 20 µmol/L
Amylase	30 – 125 U/L

Thyroid Hormones

Thyroid Stimulating Hormone (TSH)	0.5 – 5 mIU/L
Total Thyroxine (T4)	4.9 – 11.7 mg/dL
Total Triiodothyronine (T3)	0.7 – 1.5 ng/dL

Urinalysis

Appearance	Clear
Color	Amber Yellow
Odor	Aromatic
pH	5-8
Protein	negative
Specific Gravity	1.002 – 1.030
Leukocyte Esterase	negative
Nitrites	negative
Ketones	negative
Bilirubin	negative
Crystals	negative
Casts	0 – 4 hyaline casts/lpf
Glucose	negative
WBCs	0 – 5/hpf
RBCs	0 – 5/hpf

Miscellaneous

Brain Natriuretic Peptide (BNP)	< 100 pg/mL
C-Reactive Protein (CRP)	< 5 mg/L
d-Dimer	< 500 ng/mL
Lactate Dehydrogenase (LDH)	50-150 U/L

Appendix B - Overall Glossary

15-15 Rule: Suggests consuming or administering 15 grams of a carbohydrate, followed by a 15-minute wait and then remeasurement of blood glucose level to assess if blood glucose has returned to normal levels. (Chapter 7.5)

A

Above-elbow (Transhumeral) amputation: Amputation above the elbow joint. (Chapter 10.5)

Above-knee (Transfemoral) amputation: Amputation above the knee joint, requiring more energy for mobility due to the absence of the knee joint and increased leverage requirements. (Chapter 10.5)

Acanthosis nigricans: Hyperpigmentation often found in the axilla, groin, and folds of the neck. (Chapter 7.5)

Accountability: Being answerable to oneself and others for one's own choices, decisions, and actions as measured against a standard. (Chapter 1.8)

Acetabulum: The large socket that holds the head of the femur. (Chapter 10.2)

Achilles tendon: Attaches the calf muscles to the heel bone. (Chapter 10.2)

Acquired immunity: Refers to immunity that develops with exposure to various antigens as an individual's immune system builds a defense. (Chapter 4.2)

Acromion: An extension from the scapula that forms the bony tip of the shoulder. (Chapter 10.2)

Actual versus potential nursing problems: A prioritization strategy that considers the type of nursing problem when prioritizing care. Actual problems refer to a clinical problem that is actively occurring with the client. A risk problem indicates the client may potentially experience a problem, but they do not have current signs or symptoms of the problem actively occurring. (Chapter 1.9)

Acuity: The level of client care that is required based on the severity of a client's illness or condition. For example, acuity may include characteristics such as unstable vital signs, oxygenation therapy, high-risk IV medications, multiple drainage devices, or uncontrolled pain. A "high-acuity" client requires several nursing interventions and frequent nursing assessments. (Chapter 1.9)

Acuity-rating staffing models: A strategy for making client assignments to equitably assign clients to nursing staff according to their acuity ratings. This means that when comparing client assignments across the nursing team on a unit, similar acuity team scores should be seen with the goal of achieving equitable and safe division of workload across the nursing team. (Chapter 1.9)

Acute compartment syndrome (ACS): Increased pressure within a muscle compartment, resulting in reduced blood flow to the tissues within that compartment. (Chapter 10.6)

Acute coronary syndrome: A group of conditions that involves a sudden compromise in blood flow to the myocardium. (Chapter 5.7)

Acute renal failure: The sudden loss of kidney function; also known as acute kidney injury. (Chapter 8.5)

Acute versus chronic conditions: A prioritization strategy that considers acute versus chronic medical conditions. Acute conditions have a sudden and severe onset. These conditions occur due to a sudden illness or injury, and the body often has a significant response as it attempts to adapt. Chronic conditions have a slow onset and may gradually worsen over time. (Chapter 1.9)

Adaptive immune response: Activated when the nonspecific, innate immune response is insufficient to control an infection; requires the body's exposure to a pathogen to recognize it as a threat in order for it to respond. (Chapter 4.2)

Adaptive immunity: The production of antibodies by B cells and targeted killing of infected cells by T cells. (Chapter 3.2)

Addisonian crisis: Life-threatening medical emergency that occurs when the body's need for the hormones cortisol and aldosterone exceeds the available supply. (Chapter 7.7)

Adenoiditis: Inflammation of the adenoids, a common medical condition in young children that can hinder speaking and breathing. (Chapter 6.2)

Adenoids: Lymphatic tissue between the back of the nasal cavity and the pharynx. (Chapter 6.2)

Adjuvant chemotherapy: Given after surgery or radiation therapy to kill any remaining cancer cells and lower the risk of recurrence. (Chapter 4.3)

Adrenal cortex: Responsible for producing a group of steroid hormones known as corticosteroids. (Chapter 7.2)

Adrenal glands: Small glands located at the top of each kidney. (Chapter 7.2)

Adrenal medulla: Responsible for producing epinephrine and norepinephrine. (Chapter 7.2)

Adrenocorticotropic hormone (ACTH): Regulates the release of glucocorticoid hormone (cortisol) by the adrenal gland. (Chapter 7.2)

Afterload: The force the ventricles must generate to pump blood against the resistance in the vessels. (Chapter 5.2)

Agranulocytosis: A severe reduction in WBCs. (Chapter 3.11)

Airway, breathing, and circulation (ABCs): A prioritization strategy, similar to Maslow's Hierarchy of Needs, that guides nursing decision-making based on the most critical needs for preserving human life. (Chapter 1.9)

Akinesia: The inability to voluntarily move muscles. (Chapter 9.6)

Aldosterone: A mineralocorticoid hormone produced by the adrenal gland that regulates the salt and water balance of the body in the kidneys by increasing the retention of sodium and water and excreting potassium. (Chapter 7.7)

Allergens: Substances that are generally harmless to most individuals but may induce an allergic response in some. Common allergens include pollen, dust mites, pet dander, certain foods, and insect venom. (Chapter 4.5)

Allergic responses: A specific form of hypersensitivity reactions that arise when the immune system reacts to allergens. (Chapter 4.5)

Allergy: An inflammatory response due to a hypersensitivity to a substance that most people's bodies perceive as harmless. (Chapter 4.2)

Allogeneic transplants: A procedure that involves obtaining stem cells from a matching donor, often a sibling or unrelated donor, and then transplanting them into the client after preparatory treatments. (Chapter 4.3)

Alpha cells: Secrete a hormone called glucagon. (Chapter 7.2)

Alveoli: Small, grape-like sacs responsible for gas exchange. (Chapter 6.2)

Alzheimer's disease (AD): The most common type of dementia, accounting for at least two thirds of cases of dementia in people aged 65 and older. (Chapter 9.5)

Amenorrhea: Absence of menstrual periods. (Chapter 7.6)

Amputation: Refers to the surgical removal of a body part. (Chapter 10.5)

Amylase: An enzyme, produced chiefly in the pancreas and salivary glands, that breaks down carbohydrates. (Chapter 11.2)

Amyotrophic lateral sclerosis (ALS): Also known as Lou Gehrig's disease; a neurological disorder that affects motor neurons and the control of voluntary muscle movement and breathing. (Chapter 9.12)

Anal canal: A three-inch long section at the end of the gastrointestinal tract that opens to the exterior of the body at the anus. (Chapter 11.2)

Anaphylaxis: A life-threatening Type I hypersensitivity reaction that occurs rapidly and systemically, and if not promptly treated, it can be fatal. (Chapter 4.5)

Anemia: A clinical sign characterized by a reduction in either the number of red blood cells, the amount of hemoglobin, or the hematocrit (percentage of red blood cells in the total blood volume). (Chapter 3.5)

Anesthesia: Medications used to reduce or temporarily eliminate sensory perception; commonly referred to as "negative sensation." (Chapter 2.2)

Aneurysm: An abnormal bulging or ballooning that develops in a weak spot of the arterial wall, which may become so thin that it ruptures. (Chapter 5.12, Chapter 9.9)

Angina: Chest pain or discomfort that is unpredictable and occurs at rest or with minimal exertion. (Chapter 3.6, Chapter 5.7)

Angioplasty: Use of a balloon to stretch open a blocked artery. (Chapter 5.3)

Ankle-brachial index (ABI): An assessment comparing the blood pressure in the arms (brachial artery) to that in the ankles (dorsalis pedis or posterior tibial arteries). (Chapter 5.9)

Ankle disarticulation: Amputation at the ankle joint, preserving the heel pad for weight-bearing and prosthetic fitting. (Chapter 10.5)

Antibodies: Proteins that destroy pathogens based on their antigens. (Chapter 4.2)

Antidiuretic hormone (ADH): Regulates blood osmolarity by targeting the kidneys to increase water reabsorption. (Chapter 7.2)

Antigens: Markers that tell the immune system whether something in the

body is harmful or not; found on viruses, bacteria, cancer cells, and even normal cells of the body. (Chapter 4.2)

Anuria: Absence of urine output, typically found during kidney failure, defined as less than 50 mL of urine over a 24-hour period. (Chapter 8.2)

Anus: The opening at the end of the digestive tract where feces leave the body. (Chapter 11.2)

Aplastic anemia: A relatively rare but serious medical condition characterized by a significant reduction or absence of all three major blood cell types: red blood cells (RBCs), white blood cells (WBCs), and platelets. (Chapter 3.12)

Apnea: Absence of breathing. (Chapter 6.2)

Appendectomy: Surgical removal of the appendix. (Chapter 11.5)

Appendicitis: Inflammation of the appendix. (Chapter 11.2)

Appendix: A small pouch attached to the end of the cecum. (Chapter 11.2)

Arachnoid: The meninge middle layer that is filled with fluid that cushions the brain. (Chapter 9.2)

Arteriosclerosis: The thickening and stiffening of arterial walls. (Chapter 5.6)

Arteriovenous graft: Similar to a fistula but uses a synthetic tube to create a conduit between the artery and vein. (Chapter 8.6)

Arteriovenous malformation: A tangle of blood vessels that irregularly connects arteries and veins that can rupture, causing bleeding in the brain and spinal cord. (Chapter 9.9)

Artery: A blood vessel that carries blood away from the heart. (Chapter 5.2)

Arthrocentesis: A surgical puncture to aspirate fluid from a joint, such as the knee, for lab analysis and symptom relief. (Chapter 10.3)

Arthroplasty: Refers to joint replacement surgery; an invasive procedure requiring extended recovery time. (Chapter 10.7)

Arthroscopy: A common procedure performed by orthopedic surgeons to view the inside of a joint to diagnose and/or to repair joint problems. (Chapter 10.3, Chapter 10.7)

Ascending colon: The first part of the colon that travels upward on the right side of the abdomen. (Chapter 11.2)

Ascites: Abnormal fluid accumulation in the abdomen. (Chapter 5.3, Chapter 5.8, Chapter 11.15)

Aspiration: Inhalation of food or fluids into the trachea and lower respiratory tract. (Chapter 6.2)

Aspiration pneumonia: Refers to when someone inhales food, drink, vomit, saliva, or medication into the lungs instead of swallowing it. (Chapter 6.7, Chapter 11.3)

Asterixis: Flapping tremor. (Chapter 8.5)

Asthma: A condition caused by chronic inflammation in the airways, resulting in narrowed air passages. Individuals also experience bronchoconstriction that tightens the smooth muscle surrounding the airways, further limiting airflow. (Chapter 6.5)

Ataxia: Refers to lack of muscle control in the arms and legs that causes poor balance and coordination, which can result in trouble walking. (Chapter 9.3, Chapter 9.10, Chapter 10.10)

Atelectasis: Collapse of alveoli and/or small passageways of the lungs. (Chapter 2.3, Chapter 6.2)

Atherosclerosis: Buildup of cholesterol, fatty deposits, and wastes within the lining of the arteries. (Chapter 5.6)

Atonic (akinetic): A sudden loss of muscle tone for a few seconds and followed by postictal (period after seizure) confusion. (Chapter 9.7)

Audible wheezing: Whistling or squeaky sound when breathing. (Chapter 6.6)

Aura: Unusual sensation occurs before the seizure and is often described as a “deja vu” feeling, a perceived offensive smell, or sudden onset of pain. (Chapter 9.7)

Aural phase: A sensory warning that is similar each time a seizure occurs. (Chapter 9.7)

Authentic leaders: Leaders who have an honest and direct approach with employees, demonstrating self-awareness, internalized moral perspective, and relationship transparency. They strive for trusting, symmetrical, and close leader–follower relationships; promote the open sharing of information; and consider others’ viewpoints. (Chapter 1.3)

Authoritarian leadership: The leader has full power. Authoritarian leaders tell team members what to do and expect team members to execute their plans. (Chapter 1.3)

Autodigestion: A process in which the enzymes of the pancreas digest pancreatic tissue. (Chapter 11.15)

Autoimmune disease: Caused by the body's inability to distinguish its own healthy cells from abnormal cells or pathogens, producing antibodies that attack its own tissues. (Chapter 4.2)

Autoimmune reactions: Actions within the body where one's own immune system accidentally initiates a response against the body's own healthy cells, tissues, or organs. (Chapter 4.1)

Autologous transplants: A procedure where the client's own stem cells are collected, purified, and then reinfused following intensive chemotherapy or radiation to destroy cancer cells. (Chapter 4.3)

Autonomic dysreflexia: A medical emergency that occurs in clients who have sustained a spinal cord injury above T6. (Chapter 9.12)

B

Barium enema: Also known as a lower GI series. (Chapter 11.3)

Barium swallow: Also known as an upper GI series. (Chapter 11.3)

Barrett's esophagus: Clients with chronic GERD whose esophagus is exposed to acidic stomach content and causes changes in the squamous epithelial cells that line the esophagus and transition into columnar epithelium. (Chapter 11.9)

Basic nursing care: Care that can be performed following a defined nursing procedure with minimal modification in which the responses of the patient to the nursing care are predictable. (Chapter 1.7)

Basic patient situation: A situation determined by an RN, physician, podiatrist, dentist, or optometrist that meets the following three conditions:

- The patient's clinical condition is predictable.
- Medical or nursing orders are not changing frequently and do not contain complex modifications.
- The patient's clinical condition requires only basic nursing care. (Chapter 1.7)

B cells: Cells that produce antibodies that are used to attack invading bacteria, viruses, and toxins. (Chapter 4.2)

Bedside Handoff Report Checklist: Similar to an ISBARR report but

contains additional information to ensure continuity of care across nursing shifts. (Chapter 1.2)

Below-elbow (Transradial) amputation: Amputation below the elbow joint. (Chapter 10.5)

Below-knee (Transtibial) amputation: Amputation below the knee joint, providing a longer residual limb for better prosthetic control and energy-efficient walking. (Chapter 10.5)

Benign: Cells that grow and divide in a more controlled manner, remaining localized to a certain area. (Chapter 4.3)

Benign prostatic hyperplasia (BPH): Enlargement of the prostate that is not cancerous. (Chapter 8.12)

Benner's Novice to Expert Theory: Explains how new hires develop skills and a holistic understanding of client care over time, resulting from a combination of a strong educational foundation and thorough clinical experiences. (Chapter 12.5)

Beta cells: Secrete insulin that facilitates the uptake of glucose by cells from the bloodstream. (Chapter 7.2)

Beta endorphin: Possesses morphine-like effects and plays a role in pain management and natural reward circuits such as feeding, drinking, sex, and maternal behavior. (Chapter 7.2)

Biceps brachialis: Muscle located in the arm that flexes the elbow joint and rotates the forearm. (Chapter 10.2)

Biceps brachii: Muscle on the anterior upper arm. (Chapter 10.2)

Bile: A greenish-brown fluid that aids in digestion by breaking down lipids, secreted by the liver and stored in the gallbladder. (Chapter 11.2)

Bilirubin: A yellowish pigment formed in the liver by the breakdown of red blood cells. (Chapter 11.2)

Bladder: Hollow muscular organ that serves as a reservoir to collect urine. (Chapter 8.2)

Blood osmolarity: Concentration of solutes in the blood plasma. (Chapter 7.2)

Blood pressure: The force exerted by blood on the walls of the blood vessels. (Chapter 5.2)

Board of Nursing (BON): A state-specific licensing and regulatory body that

sets standards for safe nursing care and issues nursing licenses to qualified candidates. (Chapter 1.7)

Body: References the middle portion of the sternum. (Chapter 10.2)

Bone density scans (Dual-energy X-ray absorptiometry – DEXA or DXA): Specialized X-ray tests that measure bone mineral density. (Chapter 10.3)

Bone marrow aspiration: The extraction of a small sample of liquid bone marrow from the center of a bone. (Chapter 3.3)

Bone marrow biopsy: A procedure that involves obtaining a small core of bone and marrow tissue from the bone marrow space. (Chapter 3.3)

Bone marrow transplantation: The replacement of damaged or diseased bone marrow with healthy stem cells to restore the body's ability to produce essential blood cells. (Chapter 4.3)

Borborygmus: Hyperperistalsis; often referred to as "stomach growling." (Chapter 11.3)

Boutonniere deformities: Firm, observable lumps underneath the skin on or near the base of the joint. (Chapter 10.9)

Bowel obstruction: A blockage of the intestines caused by a mechanical or nonmechanical condition. (Chapter 11.13)

Brachytherapy: A procedure where radioactive materials are placed directly inside or very close to the tumor. (Chapter 4.3)

Bradycardia: The condition in which resting rate drops below 60 bpm. (Chapter 5.2, Chapter 5.3)

Bradykinesia: Slow, shuffling gait. (Chapter 9.6)

Bradypnea: Slow breathing. (Chapter 6.2)

Brain stem: Connects the spinal cord to the brain. (Chapter 9.2)

Bronchi: Main air passageways of the lungs. (Chapter 6.2)

Bronchial responsiveness testing: Measures the responsiveness of the airway after it has been exposed to an allergen or bronchoconstrictive substance. (Chapter 6.3)

Bronchial thermoplasty: Procedure is performed during a bronchoscopy and delivers heat to the muscles surrounding the airways to reduce smooth muscle mass and prevent them from narrowing. (Chapter 6.5)

Bronchioles: Small branches of the bronchi that lead to the alveolar sacs. (Chapter 6.2)

Bronchitis: Inflammation of the bronchi. (Chapter 6.2)

Bronchoscopy: Procedure in which a tube is inserted by a health care provider to visually examine the bronchi. (Chapter 6.3)

Bronchospasm: Symptom of many respiratory conditions; sudden constriction of the muscles in the walls of the bronchioles. (Chapter 6.2)

Brudzinski sign: When neck flexion causes the individual to automatically flex their hips and knees. (Chapter 9.8)

Bruit: Whooshing sound. (Chapter 8.6)

Buck's traction: Skin traction that involves the application of weights over the end of the bed as a pulling force. (Chapter 10.6)

Bullectomy: One or more very large bullae are removed from the lungs. (Chapter 6.6)

C

Calcaneus: Heel bone. (Chapter 10.2)

Capillary: A microscopic channel that supplies blood to the tissue cells where nutrients and wastes are exchanged at the cellular level. (Chapter 5.2)

Capillary refill test: Test performed on the nail beds to monitor perfusion. (Chapter 5.3)

Capnography: A sensor that measures the concentration of carbon dioxide exhaled, translated into a waveform and numerical value. (Chapter 6.3)

Carbohydrate counting: Diabetic meal planning strategy in which individuals keep track of the total grams of carbohydrates they consume in a meal, regardless of the food source. (Chapter 7.5)

Carcinogen: Any substance capable of causing cancer. (Chapter 4.3)

Carcinogenesis: The process of cancer development in the body. (Chapter 4.3)

Carcinoma in situ: Also known as Stage 0; cancerous or abnormal cells are present, but they are localized to the initial layer of cells where they were first discovered. (Chapter 4.3)

Cardiac catheterization: A diagnostic procedure used to visualize the coronary arteries, heart chambers, and great vessels; also known as coronary angiography or angiogram. (Chapter 5.3)

Cardiac muscle: Specialized muscle located in the heart. (Chapter 10.2)

Cardiac output (CO): Measurement of the amount of blood pumped by each ventricle in one minute. (Chapter 5.2)

Cardiac stress test: A diagnostic procedure used to evaluate the performance and function of the heart during physical activity; also known as an exercise stress test or treadmill test. (Chapter 5.3)

Cardiovascular disease (CVD): Disease that affects the heart and blood vessels. (Chapter 5.1)

Cardiovascular surgery: Surgery involving the heart and blood vessels; often performed to treat heart conditions or improve blood flow. (Chapter 2.2)

Carina: A raised structure that contains specialized nervous system tissue that induces violent coughing if a foreign body, such as food, is present. (Chapter 6.2)

Carpals: Wrist bones. (Chapter 10.2)

Carpal tunnel syndrome: A common neurological and musculoskeletal disorder that occurs when the median nerve, which runs from the forearm into the palm of the hand, becomes pressed or squeezed at the wrist. (Chapter 9.12)

Cartilaginous joints: When two bones are connected by cartilage; a tough but flexible type of connective tissue. (Chapter 10.2)

Cecum: The first section of the large intestine into which the ileum opens. (Chapter 11.2)

Central nervous system (CNS): Includes the brain and the spinal cord. (Chapter 9.2)

Cerebellar function: Tested by assessing gait, balance, and coordination. (Chapter 9.3)

Cerebellum: The posterior part of the brain that controls fine motor skills. (Chapter 9.2)

Cerebral palsy (CP): A group of disorders that affects the ability to move and maintain balance and posture. (Chapter 10.10)

Cerebrovascular accident (CVA): Commonly referred to as a stroke; a sudden interruption of blood flow to the brain that requires immediate emergency care. (Chapter 9.9)

Cervical: The first seven vertebrae in the neck region, C1 to C7. (Chapter 10.2)

Charcot joint: Chronic joint damage as the result of neuropathy. (Chapter 7.5)

Chemical carcinogenesis: Occurs due to exposure to various chemicals, drugs, and products encountered in everyday life. (Chapter 4.3)

Chemotherapy: The use of medications to destroy or slow the growth of cancer cells. (Chapter 4.3)

Chest physiotherapy techniques: Techniques such as postural drainage and percussion, which may be used to assist in clearing mucus and secretions from the airways. (Chapter 6.7)

Chief cells: Cells in the glands of the stomach that secrete pepsinogen. (Chapter 11.2)

Child life specialists: Members of the health care team who work with children and their families to provide education and preparation during hospitalization. (Chapter 2.3)

Cholecystectomy: Surgical removal of the gallbladder. (Chapter 11.6)

Cholecystitis: Inflammation of the gallbladder due to impaired bile flow. (Chapter 11.6)

Cholinergic crisis: Respiratory failure resulting from a high dose of cholinesterase inhibitors. (Chapter 9.11)

Chronic kidney disease (CKD): The gradual, progressive loss of kidney function over time. (Chapter 8.6)

Chronic obstructive pulmonary disease (COPD): A chronic, progressive, and incurable respiratory condition that causes breathing difficulties and reduced lung function. (Chapter 6.6)

Chronic traumatic encephalopathy: Occurs in people with extraordinary exposure to multiple blows to the head, such as boxers and football players. (Chapter 9.12)

Chvostek's sign: A classic sign of acute hypocalcemia and is an involuntary twitching of facial muscles when the facial nerve is tapped. (Chapter 7.8)

Chyle: Lipids and fat-soluble vitamins absorbed in the small intestine. (Chapter 4.2)

Chyme: Partially digested food that passes from the stomach to the small intestine. (Chapter 11.2)

Clavicle: Connects the sternum to the scapula; also known as the collarbone. (Chapter 10.2)

Clipping: A surgical procedure involving the placement of a small metal clip at the base of the aneurysm to block blood flow into it and prevent rupture. (Chapter 5.12)

Clock drawing test: A neurological test in which the client is provided with a piece of paper with a pre drawn circle approximately 10 cm in diameter and told that the circle represents the face of a clock. The person is asked to write numbers within the circle so that it looks like a clock and then add arms to the clock to show a desired time. (Chapter 9.5)

Clonic: Muscle contractions and relaxation last several minutes. (Chapter 9.7)

Closed-loop communication: A communication strategy used to ensure that information conveyed by the sender is heard by the receiver and completed. Closed-loop communication is especially important during emergency situations when verbal orders are being provided as treatments are immediately implemented. (Chapter 1.2)

Closed or simple fracture: The broken bone does not penetrate the skin, remaining within the body. (Chapter 10.6)

Closed reduction: Involves a nonsurgical procedure where the provider manipulates the fractured bones back into their proper position without making an incision. (Chapter 10.6)

Clubfoot: A congenital condition that causes the foot and lower leg to turn inward and downward. (Chapter 10.10)

Coagulation cascade: A complex series of reactions involving a variety of coagulation factors that eventually leads to the formation of a fibrin clot. (Chapter 3.2)

Coccyx: The tailbone; formed by the fusion of four very small coccygeal vertebrae. (Chapter 10.2)

Cognitive reserve: Refers to the brain's ability to make flexible and efficient use of networks of neuron-to-neuron connections that enable a person to continue to carry out cognitive tasks despite degenerative brain changes. (Chapter 9.5)

Coiling: A minimally invasive procedure involving the insertion of tiny coils

into the aneurysm through a catheter to promote clotting within the aneurysm and prevent blood flow into it. (Chapter 5.12)

Colonoscopy: The insertion of a scope into the rectum to visualize the entire colon. (Chapter 11.3)

Comminuted fracture: A bone is crushed into pieces. (Chapter 10.6)

Community-acquired pneumonia (CAP): Refers to pneumonia that began in the community (not in a hospital). (Chapter 6.7)

Complete fracture: The bone breaks entirely into two or more separate pieces. (Chapter 10.6)

Complete injury: No nerve communication below the injury site so muscle control, feeling, and function below the injury are lost. (Chapter 9.12)

Complex partial seizures: These seizures often occur in the temporal lobe and may be called psychomotor seizures due to the function of this part of the brain. (Chapter 9.7)

Complex patient situation: An act determined by an RN, physician, podiatrist, dentist, or optometrist where one or more of the following conditions exist in a given situation:

- The patient's clinical condition is not predictable.
- Medical or nursing orders are likely to involve frequent changes or complex modifications.
- The patient's clinical condition indicates care that is likely to require modification of nursing procedures in which the responses of the patient to the nursing care are not predictable. (Chapter 1.7)

Compliance: The ability of any compartment to expand to accommodate increased content. (Chapter 5.2)

Compression fracture: Typically occurs in vertebrae and involves the bone being crushed or collapsing; often seen in conditions like osteoporosis. (Chapter 10.6)

Computed tomography (CT): Detailed, cross-sectional, three-dimensional images of bones, joints, and soft tissues. (Chapter 10.3)

Concussion: A temporary, mild TBI that may take several months to heal. (Chapter 9.12)

Conflict resolution: Respectful dialogue and active listening to address

conflicts promptly and constructively. Through mediation and negotiation, a nurse leader can help team members find common ground, reach compromises, and maintain harmonious working relationships. (Chapter 1.5)

Conscious sedation: A state where the client remains conscious but deeply relaxed and pain-free; also known as "moderate sedation" or "twilight anesthesia." (Chapter 2.2)

Constructive feedback: Providing feedback to team members in a manner that focuses on their behavior or performance rather than criticism of the individual. The purpose of constructive feedback is to help the team member identify areas for improvement and offer suggestions for development. By providing specific and actionable feedback, team members can gain valuable insights into their strengths and weaknesses, reflect on their actions, create personal goals, and plan strategies for personal and professional growth. (Chapter 1.6)

Continuous ambulatory peritoneal dialysis (CAPD): Peritoneal dialysis involving manual exchanges multiple times a day. (Chapter 8.5)

Continuous cycling peritoneal dialysis (CCPD): Peritoneal dialysis using a machine for automated exchanges during the night. (Chapter 8.5)

Continuous glucose sensor (CGS): A medical device designed to monitor and track blood glucose levels in the interstitial fluid. (Chapter 7.5)

Continuous renal replacement therapy (CRRT): A slow and continuous form of dialysis that occurs 24 hours a day, emulating the continuous filtration process of the kidney. (Chapter 8.5)

Contractility: The force or strength of the contraction itself. (Chapter 5.2)

Contracture: A condition of shortening and hardening of muscles, tendons, or other tissue, often leading to deformity and rigidity of joints. (Chapter 10.10)

Coronary angiogram: A procedure that uses a special dye (contrast material) and X-rays to see how blood flows through the arteries in the heart. (Chapter 5.3)

Coronary artery disease (CAD): Plaque buildup that causes the inside of the coronary arteries to narrow over time, which can partially or totally block the blood flow to the muscle tissue of the heart. (Chapter 5.7)

Cor pulmonale: Right-sided heart failure. (Chapter 6.6)

Corticosteroids: Group of steroid hormones produced by the adrenal cortex;

examples include mineralocorticoids, glucocorticoids, and androgens. (Chapter 7.2)

Cortisol: The most important glucocorticoid because it plays a crucial role in metabolism, immune response, and the body's response to stress. (Chapter 7.2, Chapter 7.7)

Cosmetic surgery: Surgery performed primarily to enhance or alter a person's appearance. (Chapter 2.2)

Costovertebral angle tenderness: Tenderness to palpation over the kidneys. (Chapter 8.8)

Coughing and deep breathing: A breathing technique similar to incentive spirometry but no device is required. (Chapter 6.3)

COVID-19: Caused by the novel coronavirus SARS-CoV-2; emerged as a global pandemic in late 2019, causing a wide spectrum of symptoms ranging from mild respiratory distress to severe pneumonia and organ failure. (Chapter 6.10)

C-peptide: Generally found in amounts in the blood equal to the amount of insulin. (Chapter 7.5)

Cranial nerves: Directly connected from the brain to the periphery. (Chapter 9.2)

Cranium: The bones that form the head, including the skull and facial bones. (Chapter 10.2)

C-reactive protein: High levels of C-reactive protein in blood samples indicate a serious infection or other medical condition is causing inflammation. (Chapter 4.2)

Crepitus: Popping, clicking, or crackling sound when moving a joint. (Chapter 10.7)

Culture of safety: An organizational culture that embraces error reporting by employees with the goal of identifying systemic causes of problems that can be addressed to improve client safety. According to The Joint Commission, a culture of safety includes the following components:

- **Just Culture:** A culture where people feel safe raising questions and concerns and report safety events in an environment that emphasizes a nonpunitive response to errors and near misses. Clear lines are drawn by

managers between human error, at-risk, and reckless employee behaviors.

- **Reporting Culture:** People realize errors are inevitable and are encouraged to speak up for client safety by reporting errors and near misses. For example, nurses complete an "incident report" according to agency policy when a medication error occurs, or a client falls. Error reporting helps the agency manage risk and reduce potential liability.
- **Learning Culture:** People regularly collect information and learn from errors and successes while openly sharing data and information and applying best evidence to improve work processes and client outcomes. (Chapter 1.2)

Curative surgery: Surgery performed to remove or treat the cause of a disease, providing a cure or permanent resolution. (Chapter 2.2, Chapter 4.3)

CURE hierarchy: An acronym for a prioritization strategy based on identifying the differences among Critical needs, Urgent needs, Routine needs, and Extras. (Chapter 1.9)

Cushing's disease: Typically caused by a benign tumor in the adrenal gland that causes excess hormone production. (Chapter 7.7)

Cushing's syndrome: Caused by excess glucocorticoid blood levels caused by medication therapy for another medical problem, such as COPD or immunosuppressive therapy after an organ transplant. (Chapter 7.7)

Cyanosis: Bluish skin discoloration. (Chapter 2.5, Chapter 6.3)

Cystitis: A condition characterized by the inflammation of the bladder. (Chapter 8.7)

Cytokines: Proteins secreted by cells that act as chemical messengers in immune responses. (Chapter 4.2)

Cytokine storm: A severe immune reaction in which the body releases too many cytokines into the blood too quickly; can occur as a result of an infection, autoimmune condition, or other disease. Signs and symptoms include high fever, inflammation, severe fatigue, and nausea. (Chapter 4.2)

Cytotoxic: Effects within the body that impact cells that are rapidly dividing. (Chapter 4.3)

D

Data cues: Pieces of significant clinical information that direct the nurse toward a potential clinical concern or a change in condition. (Chapter 1.9)

D-dimer: A blood test that is a marker for the presence of blood clots, specifically the breakdown products of fibrin that result from the dissolution of a blood clot. (Chapter 5.11)

Deamination: The process by which amino acids are converted into ammonia, urea, and uric acid. (Chapter 8.2)

Deep vein thrombosis (DVT): The formation of a blood clot (thrombus) in a deep vein, usually in the legs. (Chapter 2.3, Chapter 5.11)

Dehiscence: The separation of surgical wound edges, exposing underlying tissues. (Chapter 2.5)

Delegatee: An RN, LPN/VN, or AP who is delegated a nursing responsibility by either an advanced practice registered nurse (APRN), RN, or LPN/VN, is competent to perform the task, and verbally accepts the responsibility. (Chapter 1.8)

Delegation: States have different laws and rules/regulations regarding delegation. Delegation is generally defined as allowing a delegatee to perform a specific nursing activity, skill, or procedure that is beyond the delegatee's traditional role and not routinely performed, but the individual has obtained additional training and validated their competence to perform the delegated responsibility. However, the licensed nurse still maintains accountability for overall client care.

In Wisconsin, the NPA states, "In the supervision and direction of delegated acts, an RN shall do all of the following:

- Delegate tasks commensurate with educational preparation and demonstrated abilities of the person supervised.
- Provide direction and assistance to those supervised.
- Observe and monitor the activities of those supervised.
- Evaluate the effectiveness of acts performed under supervision." (Chapter 1.8)

Delta cells: Secrete somatostatin. (Chapter 7.2)

Deltoid: A large triangular muscle covering the shoulder joint. (Chapter 10.2)

Dementia: A general term that refers to a decline in cognitive ability severe

enough to interfere with a person's ability to complete their activities of daily living. (Chapter 9.5)

Democratic leadership: The leader balances decision-making responsibility between team members and the leader. Democratic leaders actively participate in discussions, but also make sure to listen to the views of others. (Chapter 1.3)

Demyelination: Refers to the loss or destruction of the myelin sheath. (Chapter 9.10)

Descending colon: The part of the colon that travels downward on the left side of the abdomen. (Chapter 11.2)

DEXA scans: The gold standard test for diagnosing osteoporosis comparing an individual's bone density to that of a young healthy adult reflecting the risk of fracture. (Chapter 10.8)

Diabetes insipidus (DI): Rare medical condition characterized by excessive thirst and the excretion of large amounts of very dilute urine. (Chapter 7.2)

Diabetes mellitus (DM): A chronic medical condition marked by persistently elevated blood glucose levels. (Chapter 7.5)

Diabetes nephropathy: Kidney disease as the result of ongoing diabetes. (Chapter 7.5)

Diabetic ketoacidosis (DKA): Occurs during severe hyperglycemia episodes if the client's pancreas is no longer producing insulin. (Chapter 7.5)

Diagnostic surgery: Surgery performed to obtain a definitive diagnosis or to assess the extent of a disease or condition. (Chapter 2.2)

Dialysis: A procedure to artificially perform the functions of the kidneys when they are unable to effectively filter waste products and excess fluids from the blood. (Chapter 8.5)

Diaphragmatic breathing: Also called abdominal breathing; encourages them to consciously use their diaphragm to take deep breaths. (Chapter 6.3)

Diastole: Period of relaxation that occurs as the chambers fill with blood. (Chapter 5.2)

Diffusion capacity testing: Measures the lung's ability to transfer gases from alveoli into the bloodstream. (Chapter 6.3)

Diplopia: Double vision. (Chapter 9.11)

Direct supervision: Immediate availability to continually coordinate, direct, and inspect at first hand the practice of another. (Chapter 1.7)

Discoid rash: Raised red patches with scaling and scarring. (Chapter 4.6)

Dislocation: Displacement of a bone from its normal position in a joint. (Chapter 10.2, Chapter 10.10)

Distended: Stretched out. (Chapter 8.2)

Distention: An expansion of the abdomen caused by the accumulation of air or fluid. (Chapter 11.3)

Diuresis: Increased production of urine. (Chapter 8.2)

Diuretic: A substance that increases urine production. (Chapter 8.2)

Diverticulitis: Inflammation or infection of one or more diverticula in the digestive tract. (Chapter 11.8)

Diverticulosis: The condition of having diverticula in the colon. (Chapter 11.8)

Diverticulum: A small, bulging pouch that can form in the lining of the colon. (Chapter 11.8)

Duodenum: The first section of the small intestine, immediately beyond the stomach, leading to the jejunum. (Chapter 11.2)

Duplex ultrasonography: An imaging test that uses sound waves to look at the flow of blood in the veins. (Chapter 5.11)

Dura mater: The tough outermost membrane enveloping the brain and spinal cord. (Chapter 9.2)

Dysarthria: Unclear articulation of speech. (Chapter 9.7, Chapter 9.10, Chapter 9.11)

Dyskinesia: Uncontrollable movements. (Chapter 9.6, Chapter 10.10)

Dysmetria: Inability to direct or limit movement. (Chapter 9.10)

Dysphagia: Difficulty or discomfort in swallowing. (Chapter 9.11, Chapter 11.3)

Dysphonia: Voice impairment. (Chapter 9.11)

Dyspnea: Shortness of breath. (Chapter 2.5, Chapter 3.6, Chapter 3.9, Chapter 5.3, Chapter 5.8, Chapter 6.1, Chapter 6.2)

Dysuria: Painful or burning sensation during urination. (Chapter 8.2)

E

Echocardiography: A noninvasive diagnostic test that uses sound waves (ultrasound) to create real-time images of the heart's structure and function. (Chapter 5.3)

Edema: Excess fluid around the cells. (Chapter 5.2, Chapter 8.2)

Elective amputation: Amputation is planned and performed due to medical conditions such as severe infection, tumors, or vascular diseases that compromise blood flow to the affected limb. (Chapter 10.5)

Electrocardiogram (EKG or ECG): A recording of the electrical activity of the heart that allows health care professionals to assess the heart's rhythm and identify various cardiac conditions. (Chapter 5.3)

Electromyogram (EMG): A diagnostic procedure that assesses the function of nerve cells that control muscles. (Chapter 10.3)

Embolism: A blockage in a blood vessel caused by a dislodged clot or foreign material, often in the lungs (pulmonary embolism). (Chapter 2.5)

Embolus: A portion of a thrombus that breaks free from the vessel wall and enters the circulation. (Chapter 5.6)

Emergency department surgical setting: Urgent or emergency surgeries that are necessary to address critical conditions or life-threatening situations. (Chapter 2.2)

Endarterectomy: Surgical removal of plaque from the arteries. (Chapter 5.6)

Endocrine: Relating to glands that secrete hormones or other products directly into the blood. (Chapter 11.2)

Endocrine role: Refers to the production of glucagon and insulin by clusters of cells called islet cells to regulate blood glucose levels and keep them within a healthy range. (Chapter 7.2)

Endoscopic retrograde cholangiopancreatography (ERCP): A procedure that uses a scope to diagnose and treat problems in the liver, gallbladder, bile ducts, and pancreas. (Chapter 11.3)

Endovascular aneurysm repair (EVAR): A minimally invasive procedure where a stent graft is inserted into the aneurysm through small incisions in the groin or other access points. (Chapter 5.12)

Enuresis: Involuntary urination, especially by children. (Chapter 8.2)

Epicardial pacemakers: Pacemakers inserted through an incision in the chest, and the leads are attached to the heart. (Chapter 5.3)

Epidural blocks: A procedure involving injection of an anesthetic agent into the epidural space; often used for vaginal, perineal, hip, and lower extremity surgeries. (Chapter 2.2)

Epidural space: The potential space between the dura mater and vertebrae (spine). (Chapter 9.2)

Epiglottis: A flap of tissue that covers the trachea during swallowing to prevent aspiration. (Chapter 6.2)

Epilepsy: A chronic disorder that is defined by at least two unprovoked seizures occurring at least 24 hours apart and in which groups of nerve cells, or neurons, in the brain sometimes send the wrong signals and cause recurrent, unpredictable, and unprovoked seizures. (Chapter 9.7)

Epinephrine: A catecholamine produced by the adrenal medulla. (Chapter 7.7)

Epistaxis: Bleeding from the nose. (Chapter 6.2, Chapter 6.11)

Erythrocytes: Red blood cells (RBCs). (Chapter 3.2)

Erythromelalgia: Flushed or reddened skin, especially in the face or hands, due to engorged blood vessels. (Chapter 3.9)

Erythropoietin: An enzyme produced by the kidneys in response to hypoxia and essential for RBC production. (Chapter 3.2)

Esophageal hiatus: The opening of the diaphragm in which the esophagus passes through on its way to the stomach. (Chapter 11.14)

Esophagogastroduodenoscopy (EGD): A diagnostic test that uses a scope to examine the lining of the esophagus, stomach, and first part of the small intestine. (Chapter 11.3)

Esophagus: The muscular tube that conveys food and liquids from the throat to the stomach. (Chapter 11.2)

Estrogen: Hormone that promotes the development of breasts and the maturation of the uterus. (Chapter 7.2)

Ethmoid: Part of the nose and base of the skull. (Chapter 10.2)

Evisceration: The protrusion of internal organs through a dehisced surgical incision site. (Chapter 2.5)

Exchange system: A meal planning method that categorizes foods into three main groups: carbohydrates (CHO), meat and meat substitutes, and fats, assigning specific portion sizes to each food group while allowing for the substitution of foods within the same group without significantly affecting blood glucose levels. (Chapter 7.5)

Exhalation: Act of breathing out. (Chapter 6.2)

Exocrine: Pertaining to the secretion of a substance (such as digestive enzymes) out through a duct. (Chapter 11.2)

Exocrine role: Refers to the release of digestive enzymes called amylase and lipase that help to digest food. (Chapter 7.2)

Exophthalmos: Bulging eyes. (Chapter 7.6)

Expected outcomes: Statements of measurable action for the client within a specific time frame that are responsive to nursing interventions. (Chapter 2.5)

Exploratory surgery: Surgery performed to visualize and inspect internal organs and structures to diagnose or assess health conditions. (Chapter 2.2)

External fixation: A surgical procedure where metal pins or screws are inserted into the bone above and below the fracture site and connected to an external frame to stabilize the fracture. (Chapter 10.6)

Extraintestinal manifestations: Signs and symptoms of inflammatory bowel disease that are not confined to the gastrointestinal tract such as inflammation of the joints/bones, bile ducts, mouth, eyes, and skin. (Chapter 11.11)

Extravasation: A process by which cancer cells cross into surrounding tissues by squeezing through vessel walls. (Chapter 4.3)

F

False ribs: Ribs 8, 9, and 10 that are attached to the cartilage that joins the sternum. (Chapter 10.2)

Fasciotomy: A surgical procedure to relieve pressure within the compartment by making incisions through the fascia (connective tissue surrounding the compartment) to release the built-up pressure. (Chapter 10.6)

Fasting blood glucose (FBG): Assesses an individual's blood glucose level when they have had no caloric intake for at least eight hours (although water intake is permitted). (Chapter 7.5)

Fat embolism syndrome: Can arise from certain fractures, particularly long-bone fractures or bone with large amounts of marrow, such as the ribs, pelvis, and femur. (Chapter 10.7)

Fecalith: A mass of hardened feces. (Chapter 11.5)

Feces: Waste matter discharged from the bowels; also known as stool. (Chapter 11.2)

Femur: Thigh bone. (Chapter 10.2)

FEV1/FVC ratio: Ratio used to assess airflow obstruction. (Chapter 6.3)

Fibrin clot formation: The final step in the clotting process. (Chapter 3.2)

Fibrinolysis: The process in which a clot is degraded in a healing vessel. (Chapter 3.2)

Fibromyalgia: A condition that causes widespread pain, sleep problems, fatigue, and often emotional and mental distress. (Chapter 10.10)

Fibrous joints: Nonmoveable joints where two bones are attached by fibrous connective tissue. (Chapter 10.2)

Fibula: The smaller, lateral bone of the lower leg. (Chapter 10.2)

Field blocks: A series of local anesthetic injections around the operative field. (Chapter 2.2)

Finger or partial hand amputation: Removal of fingers or part of the hand. (Chapter 10.5)

Fistula: An abnormal connection between two organs. (Chapter 11.8, Chapter 11.11)

Five rights of delegation: A method to ensure proper and appropriate delegation, including right task, right circumstance, right person, right directions and communication, and right supervision and evaluation. (Chapter 1.8)

Flaccid: The muscles atrophy (i.e., shrink) due to loss of function. (Chapter 10.10)

Flatus: Gas in the gastrointestinal tract, expelled through the anus. (Chapter 11.2)

Flexion contracture: Occurs when the residual limb remains in a flexed position for an extended period, leading to decreased range of motion and contracture of muscles and soft tissues. (Chapter 10.5)

Floating ribs: Ribs 11 and 12 that are not attached to the front of the sternum. (Chapter 10.2)

Fluoroscopy: An imaging technique that can assess the movement of the diaphragm and chest structures during respiration. (Chapter 6.3)

Follicle-stimulating hormone (FSH): Plays a role in sexual development and reproduction by affecting the function of the ovaries and testes. (Chapter 7.2)

Foot drop: The inability to raise the front part of the foot due to weakness or paralysis of the muscles that lift the foot. (Chapter 10.10)

Forced expiratory volume in one second (FEV1): The volume of air exhaled in the first second of forced expiration. (Chapter 6.3)

Forced vital capacity (FVC): The maximum amount of air that can be exhaled after a deep inhalation. (Chapter 6.3)

Fracture: A break or disruption in the integrity of a bone. (Chapter 10.6)

FRAX tool: A fracture risk calculator that estimates a client's ten-year probability of a hip fracture or other major fracture. (Chapter 10.8)

Frequency: The need to urinate several times during the day or night in normal or less-than-normal volumes. (Chapter 8.2)

Frontal: Bone covering the forehead area of the skull. (Chapter 10.2)

Functional incontinence: Normal bladder control but difficulties getting to the toilet because of arthritis or other disorders that make it hard to move quickly or manipulate zippers or buttons. (Chapter 8.10)

G

Gallbladder: A small organ where bile is stored and concentrated before it is released into the small intestine. (Chapter 11.2)

Gas exchange: Main function of the respiratory system, providing a supply of oxygen to the body and removing carbon dioxide. (Chapter 6.2)

Gastric juice: A digestive fluid secreted by the stomach, containing hydrochloric acid, pepsin, water, mucus, and intrinsic factor. (Chapter 11.2)

Gastric volvulus: A type of obstruction in which the stomach twists upon itself. (Chapter 11.14)

Gastrocnemius: The chief muscle of the calf of the leg. (Chapter 10.2)

Gastroenteritis: Inflammation of the stomach and intestines, typically resulting from bacterial toxins or viral infection. (Chapter 11.7)

Gastroesophageal reflux disease (GERD): Occurs when stomach contents flow backwards into the esophagus. (Chapter 11.9)

Gastroparesis: Delayed stomach emptying, nausea, and vomiting. (Chapter 7.5)

General anesthesia: The use of medications to induce a state of unconsciousness and loss of sensation throughout the entire body. (Chapter 2.2)

Generalized seizures: Involve abnormal electrical activity in both cerebral hemispheres of the brain. (Chapter 9.7)

Gestational diabetes: Elevated blood glucose occurs during pregnancy and typically resolves after the baby is born. (Chapter 7.5)

Gingival hyperplasia: Gum enlargement. (Chapter 9.7)

Glasgow Coma Scale: A standardized tool used to objectively assess and continually monitor a client's level of consciousness when damage has occurred, such as after a head injury or a cerebrovascular accident (stroke). (Chapter 9.3)

Glomerular filtration: The first step in urine production. (Chapter 8.2)

Glomerular filtration rate (GFR): The volume of filtrate formed by both kidneys per minute. (Chapter 8.2)

Glomeruli: Structures within the kidneys responsible for filtering waste and excess fluids from the blood to produce urine. (Chapter 8.9)

Glomerulonephritis: An inflammatory disease that specifically affects the kidney glomeruli. (Chapter 8.9)

Glomerulus: Cluster of high-pressure capillaries. (Chapter 8.2)

Glossitis: Inflammation of the tongue. (Chapter 3.6)

Glucagon: Hormone released in response to low blood glucose levels in order to raise blood glucose. (Chapter 7.2)

Gluconeogenesis: Stimulates the conversion of amino acids into glucose. (Chapter 7.2)

Gluteus maximus: The largest and outermost of the three gluteal muscles in the buttocks. (Chapter 10.2)

Glycogen: Glucose that is not immediately used by cells is stored in the liver and muscles. (Chapter 7.2)

Glycogenolysis: The conversion of glycogen stored in the liver into glucose and its release into the bloodstream. (Chapter 7.2)

Glycolysis: The first step in the breakdown of glucose to extract energy for cellular metabolism. (Chapter 7.2)

Goiter: A swelling or nodularity of the thyroid and a sign of both hypothyroidism and hyperthyroidism. (Chapter 7.6)

Gout: A type of inflammatory arthritis that causes pain and swelling in the

joints, usually as flares that last for one or two weeks and then resolves. (Chapter 10.10)

Graves' disease: A typically long-lasting or permanent condition resulting from autoimmune destruction of the thyroid gland. (Chapter 7.6)

Greenstick fracture: Bone is partially broken; a common fracture in children that occurs rarely in adults. (Chapter 10.6)

Growth hormone (GH): Promotes growth in children, helps maintain normal body structure in adults, and plays a role in metabolism in both children and adults. (Chapter 7.2)

Guillain-Barré syndrome (GBS): A rare autoimmune disease that causes muscle weakness and sometimes paralysis. (Chapter 9.12)

H

Hallux: The great toe. (Chapter 10.2)

Hamstring: Five tendons at the back of a person's knee that connect a group of three hamstring muscles to bones in the pelvis, knee, and lower leg. (Chapter 10.2)

Handoff report: A transfer and acceptance of client care responsibility achieved through effective communication. It is a real-time process of passing client specific information from one caregiver to another, or from one team of caregivers to another, for the purpose of ensuring the continuity and safety of the client's care. (Chapter 1.2)

Hashimoto's thyroiditis: An autoimmune disease in which the immune system mistakenly attacks the thyroid gland, resulting in inflammation and damage. (Chapter 7.6)

Haustra: Folds in the colon. (Chapter 11.11)

Heartburn: A retrosternal burning sensation or discomfort that may radiate into the neck and typically occurs after the ingestion of meals or when in a reclined position. (Chapter 11.9)

Heart failure (HF): Occurs when the heart loses its effectiveness in pumping blood and is referred to as decreased cardiac output. (Chapter 5.8)

Heart rate (HR): The number of times the heart beats per minute. (Chapter 5.2)

Helper T cells: Use chemical messengers to activate the adaptive immune

response by stimulating B cells to make antibodies and help develop killer T cells. (Chapter 4.2)

Hemarthrosis: Bleeding into joints. (Chapter 3.10)

Hematemesis: Vomiting of blood. (Chapter 5.12, Chapter 11.2, Chapter 11.3)

Hematochezia: Passage of bloody stool. (Chapter 11.3)

Hematoma: Bleeding in and around the brain caused by a ruptured blood vessel. (Chapter 9.12)

Hematuria: Blood in the urine. (Chapter 3.3, Chapter 3.9, Chapter 4.6, Chapter 8.2)

Hemodialysis: A type of dialysis using a machine called a dialyzer or artificial kidney. (Chapter 8.5)

Hemoglobin A1C (HbA1C): Assesses an individual's average blood glucose levels over the preceding two to three months. (Chapter 7.5)

Hemoglobin electrophoresis: A blood test that allows for the detection of abnormal types of hemoglobin and often used when diagnosing sickle cell disease. (Chapter 3.8)

Hemoptysis: Coughing up blood. (Chapter 2.5, Chapter 3.10, Chapter 5.11)

Hemorrhage: Excessive bleeding at the surgical site due to blood vessel damage or clotting abnormalities. (Chapter 2.5, Chapter 10.5)

Hemorrhagic stroke: A type of stroke in which the stability of a blood vessel in the brain is compromised, leading to rupture and bleeding. (Chapter 9.9)

Hemostasis: The process by which the body seals a ruptured blood vessel and prevents further loss of blood. (Chapter 3.2)

Hepatic encephalopathy: Mental status changes due to buildup of toxins related to impaired liver function. (Chapter 11.15)

Hepatitis: Inflammation of the liver. (Chapter 11.15)

Hepatomegaly: Enlarged liver. (Chapter 3.8)

Hernia: When internal organs or tissues bulge through an inappropriate opening. (Chapter 11.14)

Herniated disk: A condition in which a disk protrudes beyond the normal confines of the vertebrae. (Chapter 10.2)

Hiatal hernia: A hernia in which part of the stomach bulges through the diaphragmatic opening. (Chapter 11.14)

Hilum: The area that connects the lungs to the supporting structures and where the pulmonary vessels enter and exit the lungs. (Chapter 6.2)

Hip fracture: Commonly referred to as a "broken hip." (Chapter 10.6)

Hirsutism: Abnormal hair growth. (Chapter 7.7, Chapter 9.7)

Histamine: Released during the immune response and a primary cause of allergies and anaphylactic shock. (Chapter 4.2)

Holter monitor: A portable device designed to continuously record a client's heart rhythm and electrical activity over an extended period, typically 24 to 48 hours. (Chapter 5.3)

Homeostasis: The ability to maintain a stable state. (Chapter 7.2)

Hormone: A regulatory chemical substance produced by specialized cells or glands in the endocrine system that helps to regulate physiological processes. (Chapter 7.2)

Hospital-acquired pneumonia (HAP): Refers to pneumonia that began during or immediately following a stay in a health care setting. (Chapter 6.7)

Huffing technique: A technique in which an individual inhales with a medium-sized breath and then makes a sound like "Ha" to push the air out quickly with the mouth slightly open. (Chapter 6.3)

Humerus: Upper arm. (Chapter 10.2)

Humoral immunity: Refers to the function of B cells and their production of antibodies to destroy pathogens in the interstitial spaces. (Chapter 4.2)

Hydrocephalus: Fluid accumulation in the brain. (Chapter 9.9)

Hydrostatic pressure: The pressure produced by a fluid against a surface. (Chapter 8.2)

Hyoid: An independent bone that does not contact any other bone and, thus, is not part of the skull. (Chapter 10.2)

Hypercalcemia: Increased calcium levels caused by tumor invasion into bone or increased production of parathyroid hormone or vitamin D3. (Chapter 4.3)

Hypercapnia: Elevated levels of carbon dioxide. (Chapter 6.2)

Hyperglycemia: Occurs when a fasting blood glucose level is above 126 milligrams per deciliter (mg/dL) or a random blood glucose level exceeds 200 mg/dL. (Chapter 7.5)

Hyperhidrosis: Excessive sweating. (Chapter 7.7)

Hyperkalemia: Elevated potassium. (Chapter 7.7)

Hypernatremia: Elevated sodium. (Chapter 7.7)

Hyperosmolar hyperglycemic state (HHS): A severe hyperglycemic emergency, primarily seen in individuals with type 2 diabetes; often in older adults. (Chapter 7.5)

Hyperparathyroidism: Overactivation of parathyroid glands causing excessive release of parathyroid hormone, resulting in hypercalcemia. (Chapter 7.8)

Hyperpigmentation: Darkening of the skin, especially in sun-exposed areas. (Chapter 7.7)

Hypersensitivities: A range of exaggerated immune responses triggered by exposure to specific antigens. (Chapter 4.5)

Hypertension: Chronically elevated blood pressure greater than 120/80 mm Hg. (Chapter 5.5)

Hypertonia: Spasticity. (Chapter 9.3)

Hyperventilation: Rapid and deep breathing. (Chapter 6.2)

Hypervolemia: Excessive fluid volume. (Chapter 5.2)

Hypoesthesias: Numbness. (Chapter 9.10)

Hypoglycemia: An abnormally low blood glucose level typically below 70 mg/dL. (Chapter 7.5)

Hypokalemia: Decreased potassium. (Chapter 7.7)

Hyponatremia: Low sodium. (Chapter 7.7)

Hypothalamus: Area of the brain that serves as the body's control center regulating temperature, heart rate, hunger, and mood. (Chapter 7.2, Chapter 9.2)

Hypothalamus–pituitary complex: Coordinates the messages of the endocrine and nervous systems. (Chapter 7.2)

Hypothyroidism: A medical condition characterized by an underactive thyroid gland that causes reduced production of thyroid hormones. (Chapter 7.6)

Hypotonia: Flaccidity. (Chapter 9.3)

Hypoventilation: Slow and shallow breathing. (Chapter 6.2)

Hypovolemia: Low blood volume. (Chapter 5.2)

Hypovolemic shock: Type of shock caused by extensive blood loss and

characterized by a rapid heart rate, low blood pressure, and altered consciousness. (Chapter 10.6)

Hypoxemia: A decreased amount of dissolved oxygen in the blood. (Chapter 6.2)

Hypoxia: Low levels of oxygen in the tissues. (Chapter 6.2)

Hypoxic drive: Instead of relying on PaCO2 levels to initiate breathing, the brain primarily relies on dissolved oxygen levels in the bloodstream to initiate respiratory effort. (Chapter 6.6)

I

Ictal phase: The phase from the first symptoms to the end of seizure activity. (Chapter 9.7)

Ileocecal valve: A sphincter muscle that separates the small intestine and the large intestine, controlling the passage of chyme. (Chapter 11.2)

Ileum: The third portion of the small intestine, between the jejunum and the cecum of the large intestine. (Chapter 11.2)

Ilium: The superior region that forms the largest part of the hip bone. (Chapter 10.2)

Immobilization: Involves using casts, splints, or braces to restrict movement of the affected limb or body part, allowing the bones to heal properly. (Chapter 10.6)

Immune evasion: Strategies developed by cancer cells to evade immune recognition. (Chapter 4.3)

Immune system: The complex collection of cells and organs that destroys or neutralizes pathogens that would otherwise cause infection, disease, or death. (Chapter 4.2)

Immunization: A method to trigger an individual's acquired immune response and prevent future disease. (Chapter 4.2)

Immunodeficiency: Results from a failure or absence of lymphocytes, phagocytes, and the complement system; can be caused by either primary or secondary reasons. (Chapter 4.2)

Immunoglobulins: Specific types of antibodies that provide immediate protection against an antigen, but do not provide long-lasting protection. (Chapter 4.2)

Immunological memory: Refers to the ability of the adaptive immune

response to mount a stronger and faster immune response upon reexposure to a pathogen. (Chapter 4.2)

Immunosurveillance: The immune process involving T cells, natural killer cells, and cytokines to target and destroy cancer cells. (Chapter 4.3)

Immunotherapy: Therapies that enable one's own immune system to target and destroy cancer cells. (Chapter 4.3)

Impacted fracture: One fragment of the bone is driven into the other, usually as a result of compression. (Chapter 10.6)

Impaired fasting glucose: Identified in levels that range between 100 to 125 mg/dL. (Chapter 7.5)

Incarcerated hernia: A hernia that cannot be reduced. (Chapter 11.14)

Incentive spirometer: A medical device commonly prescribed after surgery to expand the lungs, reduce the buildup of fluid in the lungs, and prevent pneumonia. (Chapter 6.3)

Incisional hernia: A hernia at the site of an incision. (Chapter 11.14)

Incomplete fracture: Bone cracks but doesn't break completely into separate pieces. This could be a hairline fracture or a partial break. (Chapter 10.6)

Incomplete injury: The spinal cord is still able to send some messages to or from the brain. (Chapter 9.12)

Incontinence: Loss of bladder control. (Chapter 8.2)

Infarct: The most significant area of damage during an MI. (Chapter 5.7)

Infectious cystitis: The most common type of urinary tract infection (UTI), resulting from a bacterial, viral, or parasitic infection. (Chapter 8.7)

Infective endocarditis: A potentially life-threatening infection of the inner lining of the heart chambers and valves. (Chapter 5.13)

Inferior conchae: Lower lateral walls of the nasal cavity. (Chapter 10.2)

Inflammation: Characterized by heat, redness, pain, and swelling but is an important process that recruits immune defenses to eliminate pathogens, remove damaged and dead cells, and initiate repair mechanisms. (Chapter 4.2)

Inflammatory bowel disease (IBD): A chronic disorder that is characterized by inflammation in the gastrointestinal tract. (Chapter 11.11)

Influenza: Commonly known as the flu; caused by influenza viruses that

primarily infect the respiratory tract, leading to symptoms such as fever, cough, sore throat, body aches, and fatigue. (Chapter 6.10)

Informed consent: An active, shared decision-making process between the health care provider and the recipient of care, empowering clients to participate in decisions about their treatment and surgical procedures. (Chapter 2.2)

Inguinal canal: A passageway that contains the spermatic cord and blood vessels in men and the round ligaments in women. (Chapter 11.14)

Inguinal hernia: A hernia that occurs in the inguinal canal. (Chapter 11.14)

Inhalation: Act of breathing in. (Chapter 6.2)

Injured: Tissues located next to ischemic area that can remain viable as long as oxygen is delivered to the tissue by pathways that circumvent the blockage. (Chapter 5.7)

Innate immune response: Defends the body against pathogens through physical defenses and internal defenses; present from the moment we are born. (Chapter 4.2)

Inpatient setting: Surgery requiring the client to be admitted to the hospital either the day before the surgery or on the same day of the procedure. (Chapter 2.2)

Insulin: Facilitates the uptake of glucose by cells from the bloodstream, thus reducing blood glucose levels. (Chapter 7.2)

Insulin pumps: Small, programmable devices that deliver a continuous supply of insulin into the body, mimicking the function of a healthy pancreas. (Chapter 7.5)

Intensity: The time needed to complete nursing care and interventions such as providing assistance with activities of daily living (ADLs), performing wound care, or administering several medication passes. For example, a “high intensity” client generally requires frequent or long periods of psychosocial, educational, or hygiene care from nursing staff members. High-intensity clients may also have increased needs for safety monitoring, familial support, or other needs. (Chapter 1.9)

Intercostal: Area between the ribs. (Chapter 10.2)

Intermittent claudication: Muscle pain, cramping, or fatigue during

physical activity (e.g., walking) that resolves with rest and recurs with activity. (Chapter 5.9)

International Normalized Ratio (INR): A blood test that measures how long it takes for the blood to clot compared to a standardized value. (Chapter 3.2)

Interstitial cystitis: An inflammatory disease characterized by chronic bladder inflammation that lacks a known cause. (Chapter 8.7)

Interstitial space: The space between individual cells in the tissues. (Chapter 4.2)

Intervertebral disks: Cartilage that acts as shock absorbers and allows for flexibility in the spine. (Chapter 10.2)

Intraoperative period: The time from when the client is wheeled into the operating room until they are transferred to the Post-Anesthesia Care Unit (PACU), Same-Day Surgery Suite, or Intensive Care Unit (ICU) following the surgical procedure. (Chapter 2.4)

Intrinsic factor: A protein produced by the parietal cells of the stomach that allows vitamin B12 to be absorbed by the intestines. (Chapter 3.7, Chapter 11.2)

Intussusception: A type of bowel obstruction where the intestine telescopes onto itself. (Chapter 11.13)

Involuntary guarding: The reflexive contraction of overlying abdominal muscles as the result of peritoneal inflammation. (Chapter 11.3)

I-PASS: A mnemonic used to provide structured communication among interprofessional team members. I-PASS stands for **I**llness severity, **P**atient summary, **A**ction list, **S**ituation awareness and contingency plans, and **S**ynthesis by receiver. (Chapter 1.2)

Iron-deficiency anemia (IDA): A type of anemia characterized by a lack of sufficient iron in the body, leading to a decrease in the production of hemoglobin and red blood cells. (Chapter 3.6)

Irritable bowel syndrome (IBS): A chronic gastrointestinal disorder in which there is abdominal discomfort, along with a change in bowel patterns. (Chapter 11.12)

ISBARR: A common format used by health care team members to exchange client information; the mnemonic stands for **I**ntroduction, **S**ituation, **B**ackground, **A**ssessment, **R**equest/Recommendation, and **R**epeat back. (Chapter 1.2)

Ischemia: Condition in which oxygenated blood flow to tissue is reduced. (Chapter 5.7)

Ischemic stroke: Stroke caused by a blockage or occlusion of a cerebral or carotid artery. (Chapter 9.9)

Ischium: Forms the posteroinferior region of each hip bone and supports the body when sitting. (Chapter 10.2)

J

Janeway lesions: Nontender, red, or hemorrhagic macules often found on the palms of the hands or soles of the feet. (Chapter 5.13)

Jaundice: A yellow discoloration in the skin, mucus membranes, and eyes due to the body's inability to adequately metabolize bilirubin. (Chapter 3.2)

Jejunum: The part of the small intestine between the duodenum and ileum. (Chapter 11.2)

Joints: Places where two bones or bone and cartilage come together and form a connection. (Chapter 10.2)

Jugular venous distention (JVD): Distended jugular vein when client is positioned at 45 degrees. (Chapter 5.3)

K

Kernig sign: Refers to pain that is elicited on passive extension of the client's knees. (Chapter 9.8)

Ketones: Metabolic byproducts of fatty acid metabolism, typically produced in the liver. (Chapter 7.5)

Kidney: An organ that filters waste from the blood and produces urine. (Chapter 8.2)

Killer T cells: Directly kill cells that have been invaded by a virus or are otherwise abnormal; also known as cytotoxic cells. (Chapter 4.2)

Koilonychia: Thin, brittle, or spoon-shaped nails often resulting from iron-deficiency anemia. (Chapter 3.6)

Kyphosis: A curving of the spine that causes a bowing or rounding of the back, often referred to as a "buffalo hump" that can lead to a hunchback or slouching posture. (Chapter 10.10)

L

Labored breathing: Additional muscle contractions during inspiration. (Chapter 6.2)

Lacrimal: Walls of the inner orbit (i.e., eye socket). (Chapter 10.2)

Laissez-faire leadership: The leader gives team members total freedom to perform as they please. Laissez-faire leaders do not participate in decision-making processes and rarely offer opinions. (Chapter 1.3)

Large intestine: The last part of the digestive system that runs from the cecum to the anus; absorbs water and electrolytes; forms, stores, and eliminates feces. (Chapter 11.2)

Laryngitis: Inflammation of the larynx, typically resulting in huskiness or loss of one's voice and a cough. (Chapter 6.2)

Larynx: Formed by several pieces of cartilage, it contains the vocal cords that allow for speech. (Chapter 6.2)

Latent autoimmune diabetes in adults (LADA): A type of diabetes that starts in adulthood and slowly gets worse over time. (Chapter 7.5)

Lateral malleolus: The bony protrusion on the lateral side of the ankle. (Chapter 10.2)

Latissimus dorsi: A large muscle in the back. (Chapter 10.2)

Length of stay: A clinical metric that measures the time elapsed between a client's admission and discharge. (Chapter 2.1)

Leukocytes: White blood cells (WBCs). (Chapter 3.2)

Leukopenia: An abnormally low number of circulating white blood cells (WBC). (Chapter 3.11)

Licensed practical/vocational nurse (LPN/VN): A nurse who has completed a state-approved practical nursing program, successfully passed the NCLEX-PN, and received an LPN or LVN license. LPN/VNs perform basic nursing care for stable clients under the supervision of an RN. (Chapter 1.1, Chapter 1.7)

Licensure: Process by which a State Board of Nursing (SBON) grants permission to an individual to engage in nursing practice, (Chapter 12.3)

Ligaments: Narrow bands of fibrous connective tissue that connect a bone to a bone. (Chapter 10.2)

Lipase: An enzyme that breaks down lipids (fats). (Chapter 11.2)

Lipogenesis: A process in which excess glucose is synthesized into triglycerides. (Chapter 7.2)

Lipolysis: A process in which stored triglycerides are broken down into free fatty acids and glycerol. (Chapter 7.2)

Lithotomy position: A position used during surgical procedures to enhance access of the pelvic organs. The client is placed on their back with their buttocks at the edge of the table and their legs abducted 30 to 45 degrees from the midline. The patient's knees and hips are flexed to about 90 degrees and supported with stirrups or padded leg holders. (Chapter 2.4)

Liver: A large lobed organ in the abdomen, involved in digestion, metabolism, blood clotting, protein creation, and cleansing the blood of toxins. (Chapter 11.2)

Liver cirrhosis: Chronic liver damage that is characterized by the development of liver nodules and liver fibrosis. (Chapter 11.15)

Liver fibrosis: Stiffening/scarring of the liver. (Chapter 11.5)

Lobectomy: Surgical removal of a lobe of the lung. (Chapter 6.2)

Lobes: Smaller units within the lungs. (Chapter 6.2)

Local anesthesia: Medications used to numb a specific area of the body, typically near the surgical site. (Chapter 2.2)

Long-term oxygen therapy (LTOT): Prescribed for clients with chronic obstructive pulmonary disease (COPD) when oxygen saturation levels are 88% or less when at rest and in a stable clinical condition. (Chapter 6.6)

Lordosis: The inward curve of the lumbar spine just above the buttocks. (Chapter 10.10)

Lumbar: The five vertebrae that form the inner curvature of spine, L1 to L5. (Chapter 10.2)

Lungs: Organ of the respiratory system responsible for gas exchange. (Chapter 6.2)

Luteinizing hormone (LH): Plays a role in sexual development in children and in women and triggers ovulation (the release of an egg from the ovary) during the menstrual cycle. (Chapter 7.2)

Lymph: A fluid that transports immune cells and waste products. (Chapter 4.2)

Lymphatic system: The system of vessels, cells, and organs that transports fluid called lymph to the bloodstream and also filters pathogens from the blood. (Chapter 4.2)

Lymphedema: The accumulation of fluid in interstitial spaces. (Chapter 4.2)

Lymph node: Store immune system cells that help the body fight infection

and also filter the lymph fluid to remove foreign material such as bacteria and cancer cells. (Chapter 4.2)

Lymphocyte: A type of white blood cell that fights infection. (Chapter 4.2)

M

Macrophages: Created from monocytes, a type of white blood cell, and can destroy multiple pathogens. (Chapter 4.2)

Magnetic resonance cholangiopancreatography (MRCP): The use of an MRI with contrast to see the bile ducts and assess disorders of the gallbladder, pancreas, or liver. (Chapter 11.3)

Magnetic resonance imaging (MRI): Uses magnet and radio waves to generate detailed images of bones, joints, ligaments, tendons, and soft tissues. (Chapter 10.3, Chapter 11.3)

Malar rash: Butterfly-shaped rash across the cheeks and nose. (Chapter 4.6)

Malignant cells: Abnormal cells that have the ability to invade and harm tissues. (Chapter 4.1, Chapter 4.3)

Mandible: Lower jawbone and only movable bone of the skull. (Chapter 10.2)

Manubrium: The upper portion of the sternum. (Chapter 10.2)

Maslow's Hierarchy of Needs: A prioritization strategy based on foundational human needs with progressive steps moving towards higher levels of achievement. This hierarchy of needs is traditionally represented as a pyramid with the base of the pyramid serving as essential needs that must be addressed before one can progress to another area of need. (Chapter 1.9)

Maxillary: Upper jaw and hard palate. (Chapter 10.2)

Mechanical blockage: When something is physically blocking the inside of the bowel and inhibiting the passage of bowel contents. (Chapter 11.13)

Medial malleolus: The bony protrusion on the medial side of the ankle. (Chapter 10.2)

Megakaryocytes: Platelet-producing cells. (Chapter 3.10)

Melatonin: Hormone that affects reproductive development and daily circadian rhythms. (Chapter 7.2)

Melena: Dark, tarry stools. (Chapter 5.12, Chapter 11.3)

Meninges: Three membranes that protect the brain and spinal cord called the pia mater, arachnoid, and dura mater. (Chapter 9.2)

Meningitis: An infectious inflammatory process that involves the meninges, the protective membranes covering the brain and spinal cord. (Chapter 9.8)

Metabolic acidosis: A pH level below 7.35 and an HCO3 level below 22. (Chapter 8.2)

Metabolic alkalosis: A pH above 7.45 and an HCO3 level above 26. (Chapter 8.2)

Metabolic syndrome: A group of conditions that increase the risk of coronary heart disease, diabetes, and stroke. (Chapter 7.5)

Metacarpals: Wrist bones. (Chapter 10.2)

Metastasize: The spread of cancerous cells through the blood or lymphatic system to different areas of the body. (Chapter 4.3)

Metatarsals: Bones of the anterior half of the foot. (Chapter 10.2)

Migraine: A type of headache characterized by recurrent attacks of moderate to severe throbbing and pulsating pain on one side of the head. (Chapter 9.12)

Minimally invasive surgeries: Surgeries where smaller incisions are made, resulting in reduced trauma, faster recovery, and improved client outcomes. (Chapter 2.1)

Mini Mental State Exam (MMSE): A common neuropsychological test that assesses five major cognitive areas, including orientation, registration, attention and calculation, recall, and speech-language-reading. (Chapter 9.5)

Modifiable risk factors: Risk factors that an individual can control through their actions, behavior, or lifestyle choices. (Chapter 5.3)

Monitored anesthesia care (MAC): The administration of IV sedation and pain management for clients undergoing certain procedures. The anesthesia provider continuously monitors the client's vital signs and level of consciousness throughout the procedure. (Chapter 2.2)

Multiple sclerosis (MS): A chronic disease triggered by an immune-mediated response that leads to progressive demyelination in the CNS. (Chapter 9.10)

Murmurs: Abnormal heart sounds that may indicate valvular or structural heart abnormalities. (Chapter 5.3)

Muscle rigidity: Refers to resistance to passive limb movement. (Chapter 9.6)

Muscular dystrophy (MD): Refers to a group of diseases caused by abnormal muscle development due to gene mutations. (Chapter 10.10)

Myalgia: Muscle pain. (Chapter 10.10)

Myasthenia gravis (MG): A chronic, autoimmune, neuromuscular disease that causes weakness in voluntary muscles, including those required for breathing and swallowing. (Chapter 9.11, Chapter 10.10)

Myasthenic crisis: A medical emergency with respiratory failure due to respiratory muscle weakness. (Chapter 9.11)

Myelin sheath: Acts as insulation much like the plastic or rubber that is used to insulate electrical wires. (Chapter 9.2)

Myocardial infarction (MI): Commonly referred to as a "heart attack"; occurs when there is a sudden blockage within the coronary arteries. (Chapter 3.6, Chapter 5.7)

Myocardial ischemia: Also known as "heart attack." Myocardial ischemia occurs when there is decreased blood flow through the coronary arteries. (Chapter 5.3)

Myoclonic: A brief episode of jerking or stiffening of the extremities, either in muscle groups or isolated; contractions can be symmetrical or asymmetrical. (Chapter 9.7)

Myoclonus: Spasm of muscles. (Chapter 9.2)

Myopathy: Muscle weakness. (Chapter 7.5)

Myxedema coma: A severe, life-threatening emergency that represents the extreme end of the spectrum of hypothyroidism. (Chapter 7.6)

N

Nasal: Pair of bones that form the bridge of the nose. (Chapter 10.2)

Nasal septum: Separates the left and right sections of the nasal cavity. (Chapter 6.2)

National Council Licensure Examination for Practical Nurses (NCLEX-PN): The exam that nursing graduates must pass successfully to obtain their license and become a licensed practical nurse. (Chapter 12.2)

NCLEX-RN Test Plan: Provides a concise summary of the content and scope of the NCLEX exam and serves as an excellent guide for preparation. (Chapter 12.2)

Negative feedback loop: A regulatory mechanism that serves to maintain

stability and homeostasis by counteracting changes in a physiological or environmental parameter. (Chapter 7.2)

Negative inotropic factors: Factors that increase contractility. (Chapter 5.2)

Neoadjuvant chemotherapy: Medication administered before surgery or radiation to shrink tumors and make them more manageable for surgical removal or radiation treatment. (Chapter 4.3)

Nephrolithiasis: Kidney stones. (Chapter 8.11)

Nephron: Functional unit of the kidney and filters the blood, removes wastes, and balances fluid and electrolyte levels. (Chapter 8.2)

Nerve blocks: The injection of a local anesthetic into or around a single nerve or a group of nerves in the involved area. (Chapter 2.2)

Neurogenic pain: An intense burning or stinging sensation that may be constant or intermittent. (Chapter 9.12)

Neurons: Responsible for the communication that the nervous system provides. (Chapter 9.2)

Neuroreceptors: Receptors are specific for certain neurotransmitters, and the two fit together like a key and lock. (Chapter 9.2)

Neurosurgery: Surgery for the treatment of conditions affecting the nervous system, brain, and spinal cord. (Chapter 2.2)

Neurotransmitters: Cause an impulse to be transferred to a neuroreceptor on another neuron, muscle fiber, or other structure. (Chapter 9.2)

Neutropenia: An abnormally low level of neutrophils, which are important for fighting infections. (Chapter 3.11)

Neutrophils: The most abundant type of white blood cells. (Chapter 4.2)

Nocturia: Frequent urination at night. (Chapter 8.2)

Noninfectious cystitis: Cystitis from irritants such as certain chemicals (such as chemotherapy medications) or radiation exposure. (Chapter 8.7)

Nonmodifiable risk factors: Risk factors are those that cannot be changed. (Chapter 5.3)

Norepinephrine: A catecholamine produced by the adrenal medulla. (Chapter 7.7)

NPO: An abbreviation for “nil per os”; the Latin phrase that means “nothing by mouth.” (Chapter 11.3)

Nuclear medicine scans (Bone Scans): Bone scans involve injecting a

radioactive tracer into the bloodstream, which accumulates in areas of increased bone turnover or damage. (Chapter 10.3)

Nurse Licensure Compact (NLC): Allows nurses to practice in other NLC states with their original state's practical nursing license without having to obtain additional licenses, contingent upon remaining a resident of that state. (Chapter 12.3)

Nurse Practice Act (NPA): Nursing regulations established by each state's legislature that are enforced by the Board of Nursing. (Chapter 1.7)

Nurse residency programs: Provide additional professional development support for all newly licensed nurses but vary from institution to institution. Residency programs are structured to provide a variety of learning opportunities, including nursing skill development, peer networking, and mentorship. (Chapter 12.5)

Nursing assistants (NAs): A type of unlicensed assistive personnel (UAP) trained to function in a supportive role, regardless of title, to whom a nursing responsibility may be delegated. In some states, nursing assistants must complete a state-approved nursing assistant training program and successfully pass the state competency evaluation to become a certified nurse assistant (CNA) to work in long-term care centers. NAs provide basic care and help clients with activities of daily living. (Chapter 1.1)

Nursing team: The nursing team includes registered nurses (RNs), licensed practical/vocational nurses (LPN/VNs), and assistive personnel (AP). (Chapter 1.1)

Nystagmus: Rapid, uncontrollable eye movements. (Chapter 9.7)

O

Oblique fracture: Bone is broken at an angle. (Chapter 10.6)

Obstetric/gynecological surgery: Surgical procedures related to pregnancy, childbirth, and the female reproductive organs. (Chapter 2.2)

Occipital: Posterior skull and base of the skull. (Chapter 10.2)

Oligomenorrhea: Infrequent or irregular menstrual periods. (Chapter 7.7)

Oliguria: Decreased urine output, defined as less than 500 mL of urine in adults in a 24-hour period. (Chapter 8.2)

Oncogene activation: Occurs when specific genes within a cell's normal

makeup become replicated out of control due to loss of cellular regulation or exposure to carcinogenic agents. (Chapter 4.3)

Oncogenes: Substances that promote cell growth. (Chapter 4.3)

Oncological emergencies: A variety of emergency conditions that can arise in a client with cancer. These emergencies can be related to metabolic changes in the body that are associated with cancer, structural changes in which a cancerous tumor is impinging on other organs or structures, or a result of cancer treatment. (Chapter 4.3)

Oncotic pressure: Colloidal pressure that is created by the protein content of the blood that helps hold water inside of capillaries. (Chapter 8.2)

Onycholysis: Separation of fingernails from the nail bed. (Chapter 7.6)

Open or compound fracture: Broken bone penetrates the skin, or there's an open wound leading to the fracture site. (Chapter 10.6)

Open reduction and internal fixation (ORIF): Involves the surgical realignment of the fractured bones using screws, plates, or rods to stabilize and hold them in place while they heal. (Chapter 10.6)

Open surgical repair: An operation where the aneurysm is directly accessed, and a graft is sewn into place to replace the weakened section of the artery. (Chapter 5.12)

Oral cavity: The mouth area, encompassing the lips, cheeks, palate, and floor of the mouth. (Chapter 11.2)

Oral glucose tolerance tests (GTT): Evaluates the body's ability to regulate blood glucose levels, especially after consuming a high dose of glucose. (Chapter 7.5)

Orientation: May last anywhere from one to four months but can be longer depending on the specialty. Orientation is based on the new nurse's demonstration and completion of competencies. During this time, the novice nurse will work with a preceptor. (Chapter 12.5)

Orthopedic surgery: Surgery related to the musculoskeletal system, dealing with bones, joints, muscles, ligaments, and tendons. (Chapter 2.2)

Orthopnea: Shortness of breath when lying flat. (Chapter 5.3, Chapter 5.8)

Osler's nodes: Tender subcutaneous nodules often found on the fingertips. (Chapter 5.13)

Osmoreceptors: Specialized sensory neurons or cells that are responsible for detecting changes in osmotic pressure within the body. (Chapter 7.2)

Osmosis: The movement of water across a semipermeable membrane that is impermeable to a solute. (Chapter 8.2)

Osteoarthritis (OA): A degenerative joint disease characterized by the breakdown of joint cartilage and underlying bone changes. (Chapter 10.7)

Osteoblasts: Bone-forming cells. (Chapter 10.2)

Osteoclasts: Cells responsible for bone breakdown. (Chapter 10.2)

Osteocytes: Mature bone cells. (Chapter 10.2)

Osteomyelitis: An infection in a bone. Infections can reach a bone by traveling through the bloodstream or spreading from nearby tissue. (Chapter 10.10)

Osteonecrosis: Bone death. (Chapter 3.8)

Osteopenia: Abnormal reduction of bone mass. (Chapter 10.2, Chapter 10.8)

Osteoporosis: A progressive bone disease characterized by a decrease in bone density and deterioration of bone tissue, leading to increased bone fragility and a higher risk of fractures. (Chapter 10.2, Chapter 10.8)

Outpatient/ambulatory surgery: Surgery requiring the client to go to the surgical area on the day of the surgery and return home the same day; also known as “same-day surgery.” (Chapter 2.2)

Outpatient clinic surgical setting: Surgery performed in health care facilities where clients receive medical care or procedures without requiring hospitalization. (Chapter 2.2)

Overflow incontinence: Continuous or intermittent leakage of small amounts of urine due to incomplete bladder emptying. (Chapter 8.10)

Oxytocin: Stimulates labor contractions and lactation after delivery. (Chapter 7.2)

P

Palatine: Pair of L-shaped bones between the maxilla and the sphenoid that form the hard palate, walls of the nasal cavity, and orbital floor of the eye. (Chapter 10.2)

Palliative surgery: Surgery performed to alleviate symptoms, reduce pain, or improve the client’s comfort without curing the disease. (Chapter 2.2, Chapter 4.3)

Pancreas: A large gland behind the stomach that secretes digestive enzymes into the duodenum and hormones into the blood. (Chapter 7.2, Chapter 11.2)

Pancreatic juice: Digestive enzymes secreted by the pancreas and delivered to the duodenum. (Chapter 11.2)

Pancreatitis: Inflammation of the pancreas. (Chapter 11.15)

Pancytopenia: A reduction in all three major blood cell types and occurs when the bone marrow fails to produce an adequate number of blood cells, leading to a decrease in circulating levels in the bloodstream. (Chapter 3.12)

Paralysis: Occurs when an injury or medical condition disrupts the nerve signals to the muscles, resulting in being unable to make voluntary movements. (Chapter 10.10)

Paralytic ileus: Temporary paralysis of the intestines, leading to the absence of bowel sounds and inability to pass flatus or stool. (Chapter 2.5)

Paraplegia: An injury that occurs lower on the spinal cord may only affect the lower body and legs. (Chapter 9.12)

Parathyroid glands: Four small masses of tissue are embedded on the surface of the thyroid gland. (Chapter 7.2)

Parathyroid hormone (PTH): Maintains homeostasis between calcium and phosphorus via a negative feedback loop. (Chapter 7.2, Chapter 7.8)

Paresthesia: Symptoms including pain, tingling, and numbness. (Chapter 7.5, Chapter 9.10)

Parietal: Upper lateral sides of the skull. (Chapter 10.2)

Parietal cells: Cells found in the glands of the stomach that produce and secrete hydrochloric acid and intrinsic factor. (Chapter 11.2)

Parkinson's disease (PD): A common, progressive neurological movement disorder of older adults that eventually leads to disability. (Chapter 9.6)

Paroxysmal nocturnal dyspnea: Sudden nighttime breathlessness. (Chapter 5.3)

Partial seizures: Also known as focal seizures; occur within one cerebral hemisphere of the brain. (Chapter 9.7)

Passive-avoidant leadership: Similar to laissez-faire leadership; the leader avoids taking responsibility and confronting others. (Chapter 1.3)

Passive immunity: The transfer of immunity due to antibodies that are produced in a body other than one's own. (Chapter 4.2)

Patella: Kneecap. (Chapter 10.2)

Pathogens: Microorganisms that cause infection. (Chapter 4.2)

Pathologic fracture: A fracture that occurs due to disease process. (Chapter 10.6)

Peak expiratory flow rate (PEFR): Measures the rate of air that can be forcefully breathed out of the lungs. (Chapter 6.5)

Peak flow monitoring: Involves a handheld device called a peak flow meter that measures the rate of air that can be forcefully breathed out of the lungs. (Chapter 6.5)

Pectoralis major: A thick, fan-shaped muscle situated on the chest. (Chapter 10.2)

Pectus carinatum: Protrusion of the chest. (Chapter 5.3)

Pectus excavatum: Depression of the chest. (Chapter 5.3)

Pelvic girdle: Structure formed by the two hip bones, the sacrum, the coccyx. (Chapter 10.2)

Pepsin: A digestive enzyme that breaks down protein; formed when pepsinogen is exposed to acid. (Chapter 11.2)

Peptic ulcer disease: Characterized by erosions or ulcers in the gastrointestinal tract. (Chapter 11.10)

Percutaneous nephrolithotomy: The removal of larger stones from the kidney using a nephroscope inserted through a small incision in the back. (Chapter 8.11)

Percutaneous transluminal angioplasty (PTA): A minimally invasive procedure in which a catheter is inserted into a narrowed artery and a balloon is inflated to compress the plaque and widen the artery. (Chapter 5.9)

Perfusion: The passage of blood through the blood vessels. (Chapter 5.2, Chapter 6.2)

Pericardial friction rub: A high-pitched, scratchy sound that occurs when the inflamed pericardial layers rub against each other. (Chapter 5.3)

Perioperative care: A client's surgical experience. (Chapter 2.1)

Peripheral artery disease (PAD): A type of atherosclerosis in which

narrowed or blocked arteries reduce blood flow to the limbs, usually the legs; also known as peripheral vascular disease (PVD). (Chapter 5.9)

Peripheral blood smear: A test that can be used to diagnose SCD where a thin layer of cells is examined under a microscope to determine the shape of red blood cells. (Chapter 3.8)

Peripheral nervous system (PNS): The remaining parts of the nervous system outside of the brain and spinal cord, including the cranial nerves that branch out from the brain and the spinal nerves that branch out from the spinal cord. (Chapter 9.2)

Peripheral neuropathy: Numbness or tingling in extremities. (Chapter 3.9)

Peristalsis: The involuntary constriction and relaxation of the muscles in the gastrointestinal system, creating wave-like movements that push food forward. (Chapter 11.2)

Peritoneal dialysis: Dialysis using the peritoneum, a membrane lining the abdominal cavity, as a natural filter. (Chapter 8.5)

Peritonitis: Inflammation of the peritoneum, the tissue that lines the inner wall of the abdomen and covers and supports most of the abdominal organs. (Chapter 11.5)

Pernicious anemia: A type of vitamin B12 anemia and an autoimmune disorder in which antibodies are formed that attack intrinsic factors or the cells that produce intrinsic factors. (Chapter 3.7)

Personal protective equipment (PPE): Barriers between the health care provider and hazardous substances to prevent direct contact and reduce the potential for exposure. (Chapter 4.3)

Pessaries: Medical devices inserted into the vagina to support the bladder or urethra in cases of stress incontinence. (Chapter 8.10)

Petechiae: Tiny red spots on skin. (Chapter 3.10, Chapter 3.12)

Phagocytosis: The process of specific white blood cells engulfing and destroying pathogens. (Chapter 3.2, Chapter 4.2)

Phalanges: Fingers (and toes). (Chapter 10.2)

Phalanx: Single finger. (Chapter 10.2)

Phantom limb pain: Refers to the sensation of pain or discomfort felt in an amputated limb. (Chapter 10.5)

Pharyngitis: Inflammation of the pharynx. (Chapter 6.2, Chapter 6.11)

Pharynx: The muscular tube extending from the back of the nasal cavities and the mouth to the esophagus; known as the throat. (Chapter 6.2, Chapter 11.2)

Pia mater: Meninge that serves as the delicate inner layer. (Chapter 9.2)

Pica: Craving and consumption of non-food items (e.g., ice, clay, dirt). (Chapter 3.6)

Pill-rolling: A repetitive, constant, slow-turning motion between the forearm, hand, and thumb. (Chapter 9.6)

Pineal gland: A small cone-shaped structure that extends posteriorly from a ventricle of the brain. (Chapter 7.2)

Pituitary gland: Gland located at the base of the brain that makes, stores, and releases hormones. (Chapter 7.2)

Plasmapheresis: A process in which the client's plasma and plasma components are removed, including the antibodies and then the cleansed plasma is returned to the client or replaced with donor plasma. (Chapter 3.9, Chapter 8.9, Chapter 9.11)

Plasmin: An enzyme that is responsible for breaking down fibrin, the mesh-like structure of a blood clot. (Chapter 3.2)

Platelet aggregation: Platelets stick together. (Chapter 3.2)

Platelet plug: Occurs when activated platelets stick together at the site of an injury, which helps to temporarily seal the wound. (Chapter 3.2)

Platelets: Assist in blood clotting and release growth factors to repair and heal tissue; also called thrombocytes. (Chapter 3.2)

Pleural cavity: Area between the two membranes of the lung. (Chapter 6.2)

Pleural effusion: Excessive fluid between the pleural membranes caused by disease or trauma. (Chapter 4.6, Chapter 6.2)

Pleural fluid culture: A procedure where a health care provider uses a needle to take a sample of fluid from the pleural space between the lungs and chest wall. (Chapter 6.7)

Pleural rub: The rubbing together of leather and can be heard on inspiration and expiration. (Chapter 6.2)

Pleuritic chest pain: Pain that worsens with deep breathing or coughing. (Chapter 6.3)

Pleuritis: Inflammation of chest wall. (Chapter 4.6)

Pneumonia: Characterized by inflammation and infection within the alveoli, causing them to fill with fluid or purulent material, resulting in a productive cough, fever, chills, and difficulty breathing. (Chapter 2.5, Chapter 6.7)

Poikilothermia: Coolness in an affected limb. (Chapter 5.9)

Point of maximum impulse (PMI): The location where the apex of the heart touches the chest wall. (Chapter 5.3)

Polycythemia: A medical condition with an excessive number of abnormal red blood cells. (Chapter 3.9)

Polycythemia vera: A medical condition that results from an abnormal increase in red blood cells, white blood cells, and platelets in the blood. (Chapter 3.9)

Polydipsia: Excessive thirst. (Chapter 7.5)

Polyphagia: Excessive hunger. (Chapter 7.5)

Polyuria: Greater than 2.5 liters of urine output over 24 hours; also referred to as diuresis. (Chapter 7.5, Chapter 8.2)

Portfolio: A compilation of materials showcasing examples of previous work demonstrating one's skills, qualifications, education, training, and experience. They can be submitted in electronic or paper form. (Chapter 12.4)

Positive inotropic factors: Factors that increase contractility. (Chapter 5.2)

Posterior pituitary gland: Gland that secretes two hormones produced by the hypothalamus called oxytocin and antidiuretic hormone (ADH). (Chapter 7.2)

Postictal: Time after the seizure. (Chapter 9.7)

Postictal phase: The recovery period after the seizure. (Chapter 9.7)

Postoperative period: The phase of client care that occurs after a surgical procedure. (Chapter 2.5)

Postural disturbances: Characteristic posture is caused by the forward flexion of the neck, hips, knees, and elbows. (Chapter 9.6)

Preceptors: Experienced and competent nurses who serve as a role model and a resource to a newly hired nurse. (Chapter 12.5)

Precordium: Area over the heart. (Chapter 5.3)

Preload: End diastolic volume. (Chapter 5.2)

Preoperative period: The phase of client care that occurs before a surgical procedure. (Chapter 2.3)

Primary hypertension: The most common type of hypertension that typically has no identifiable cause. It tends to develop gradually over time and is influenced by various risk factors such as genetics, age, race, diet, lifestyle, and stress. (Chapter 5.5)

Primary prevention: Strategies aimed at preventing the initial occurrence of cancer. (Chapter 4.3)

Primary progressive MS: The type of MS that causes a steady and gradual neurologic deterioration without remission of symptoms. (Chapter 9.10)

Prioritization: The ability to assess a client or a group of clients and determine what is critical, what is important, and what is time-sensitive to establish a preferential order of nursing actions. (Chapter 1.9)

Processus vaginalis: Forms in fetal development. In males it aids in the descent of the testicles through the inguinal canal, and in females it plays a role in the development of the round ligament. (Chapter 11.14)

Prodromal or preictal phase: Sensations or behavior changes that precede a seizure. (Chapter 9.7)

Progesterone: Hormone that causes the uterine lining to thicken in preparation for pregnancy. (Chapter 7.2)

Progressive-relapsing MS: A type of MS in which clients may have frequent relapses with partial recovery, but they do not return to baseline. (Chapter 9.10)

Prolactin: Stimulates breast development and milk production in females. (Chapter 7.2)

Prosthesis: An artificial body part. (Chapter 10.5)

Proteinuria: Protein in urine. (Chapter 4.6)

Protuberant: Convex or bulging appearance of the abdomen. (Chapter 11.3)

Pruritus: Itchy skin; a common symptom of kidney failure. (Chapter 3.9, Chapter 8.2)

Psychosis: A mental health disorder characterized by inappropriate affect and impaired thinking and perception that can be caused by surgery and/or anesthesia. (Chapter 2.5)

Ptosis: Drooping of the eyelids. (Chapter 9.11)

Pubis: Forms the anterior portion of the hip bone. (Chapter 10.2)

Pulmonary circulation: The flow of blood in the lungs. (Chapter 6.2)

Pulmonary edema: Fluid accumulation in alveoli; often caused by heart failure or kidney failure. (Chapter 6.2)

Pulmonary function tests (PFTs): Group of noninvasive diagnostic tests that assess the function of the respiratory system. (Chapter 6.3)

Pulmonary rehabilitation: A supervised program that includes exercise training, health education, and breathing techniques for people who have chronic lung conditions. (Chapter 6.6)

Pulsatile tinnitus: Rhythmic pulsing sound in the ear. (Chapter 3.9)

Pulse: Expansion and recoiling of the arterial wall. (Chapter 5.2)

Purpura: Purple or red spots on skin. (Chapter 3.10)

Pursed-lip breathing: A technique that decreases dyspnea by teaching people to control their oxygenation and ventilation. (Chapter 6.3)

Pyelonephritis: Bacterial infection that typically starts as a urinary tract infection (UTI) that progresses up the ureters to the kidneys. (Chapter 8.7, Chapter 8.8)

Pyloric sphincter: A ring of smooth muscle at the end of the stomach, regulating the flow of partially digested food into the small intestine. (Chapter 11.2)

Pyuria: White blood cells in a urine sample indicating infection. In severe infections, pus may be visible in the urine. (Chapter 8.2)

Q

Quadriceps: A large muscle group on the front of the thigh. (Chapter 10.2)

Quantitative ultrasound (QUS): Measures bone density at peripheral sites such as the heel with sound waves. (Chapter 10.8)

R

Radiation therapy: Therapy using high-energy rays or particles to target and damage cancer cells. (Chapter 4.3)

Radical prostatectomy: A surgical procedure to remove the prostate, surrounding tissue, and seminal vesicles. (Chapter 8.13)

Radioactive iodine (RAI) therapy: A common treatment for hyperthyroidism in conditions like Graves' disease that utilizes radioactive iodine. (Chapter 7.6)

Radiofrequency ablation (RFA): A minimally invasive procedure that uses

radiofrequency energy to heat and destroy thyroid nodules or hyperactive tissue. (Chapter 7.6)

Radius: The thumb side of the forearm. (Chapter 10.2)

Rales: Also called fine crackles; popping or crackling sounds heard on inspiration. (Chapter 6.2)

Random blood glucose: Measures the level of glucose in the blood at any given time, without the requirement for fasting. (Chapter 7.5)

Ratio-based staffing models: A strategy for making client assignments where each nurse or UAP is assigned care for a set number of clients during their shift. (Chapter 1.9)

Rebound tenderness: Pain when hand is withdrawn during palpation. (Chapter 11.3, Chapter 11.5)

Reconstructive/restorative surgery: Surgery performed to restore form and function after injury, disease, or previous surgical procedures. (Chapter 2.2)

Rectum: The final section of the large intestine, terminating at the anus. (Chapter 11.2)

Rectus abdominis: A paired muscle running vertically on each side of the anterior wall of the abdomen. (Chapter 10.2)

Red blood cells (RBCs): Transport oxygen and carbon dioxide between tissues and the lungs; also called erythrocytes. (Chapter 3.2)

Reducible hernia: When a hernia and its contents can be pushed back into their normal anatomical space. (Chapter 11.14)

Regional anesthesia: Medications used to numb a large area of the body, such as an entire limb or a section of the body, by blocking the nerve signals in that region. (Chapter 2.2)

Registered nurse (RN): A nurse who has completed a required program of study, successfully passed the NCLEX-RN, and received an RN nursing license. RNs utilize the nursing process in the execution of general nursing procedures in the maintenance of health, prevention of illness, or care of the ill. The nursing process consists of the steps of assessment, diagnosis, outcome identification, planning, implementation of interventions, and evaluation. (Chapter 1.1, Chapter 1.7)

Regurgitation: Refers to backwards flow of acidic gastric contents into the esophagus or mouth. (Chapter 11.9)

Relapsing-remitting MS: The most common type of MS characterized by exacerbations that cause new or worsening neurological symptoms following by periods of partial or complete recovery. (Chapter 9.10)

Resonant leaders: Leaders who are in tune with the emotions of those around them, use empathy, and manage their own emotions effectively. Resonant leaders build strong, trusting relationships and create a climate of optimism that inspires commitment even in the face of adversity. (Chapter 1.3)

Respiratory arrest: Cessation of breathing. (Chapter 6.3)

Respiratory rate: The number of breaths taken per minute. (Chapter 6.2)

Resting tremors: Tremors that disappear with purposeful, voluntary movement, but become apparent when the person's extremities are motionless. (Chapter 9.6)

Resume: A document that highlights one's background, education, skills, and accomplishments to potential employers. (Chapter 12.4)

Retinopathy: Inflammation of the retina affecting vision. (Chapter 4.6)

Rhabdomyolysis: Refers to the breakdown of muscles that causes damage to the kidney. (Chapter 10.10)

Rheumatoid arthritis (RA): A chronic and systemic autoimmune disorder primarily affecting the synovial tissue. (Chapter 10.9)

Rhinitis: Inflammation of the nasal mucosa. (Chapter 6.2)

Rhinorrhagia: Bleeding from the nose. (Chapter 6.2)

Rhinorrhea: Commonly referred to as a "runny nose"; medical term for excess mucus production by the nasal cavities. (Chapter 6.2)

Rhinoviruses: The most common cause of the common cold and are responsible for a large proportion of upper respiratory tract infections worldwide. (Chapter 6.10)

Rhonchi: Also referred to as coarse crackles; low-pitched, continuous sounds heard on expiration that are a sign of turbulent airflow through mucus in the large airways. (Chapter 6.2)

Rigidity: Involuntary contraction of the abdominal musculature in response to peritoneal inflammation. (Chapter 11.3)

Rome IV criteria: A set of diagnostic criteria utilized to help diagnose IBS. (Chapter 11.12)

Rotator cuff: A group of muscles and tendons that stabilize the shoulder. (Chapter 10.2)

Roth spots: Retinal hemorrhages that are visible on fundoscopy. (Chapter 5.13)

RSV: A common cause of respiratory infections in infants and young children, is characterized by symptoms similar to the common cold, including coughing, sneezing, and fever. (Chapter 6.10)

S

S1: The first heart sound, often described as "lub," that corresponds to the closure of the atrioventricular valves (i.e., the mitral and tricuspid valves). (Chapter 5.3)

S2: The second heart sound, described as "dub," that corresponds to the closure of the semilunar valves (aortic and pulmonic valves). (Chapter 5.3)

S3: A low frequency heart sound, known as a ventricular gallop, that is heard shortly after the S2 and precedes S1. (Chapter 5.3)

S4: A sound heard late in the cardiac cycle, just before S1; known as an atrial gallop. (Chapter 5.3)

Sacrum: The triangular-shaped bone at the base of the spine, formed by the fusion of five sacral vertebrae, a process that does not begin until after the age of 20. (Chapter 10.2)

Salivary glands: Small glands in the mucous membranes of the mouth and tongue that secrete saliva directly into the oral cavity or indirectly through salivary ducts. (Chapter 11.2)

Scaphoid: Sunken appearance. (Chapter 11.3)

Scapula: Shoulder blade. (Chapter 10.2)

Scoliosis: A sideways curve of the spine. (Chapter 10.10)

Secondary hypertension: Hypertension that occurs as the result of an underlying medical condition or medication. (Chapter 5.5)

Secondary prevention: Strategies focused on early detection and intervention to identify cancer at an early stage. (Chapter 4.3)

Secondary progressive MS: A type of MS that develops following a relapsing-remitting course in which neurologic function and disability worsen progressively over time. (Chapter 9.10)

Segmental pressure measurements: Blood pressure readings at multiple

levels along the limbs (e.g., thigh, calf, ankle) to help identify specific locations of arterial narrowing or blockage. (Chapter 5.9)

Segmentation: The mechanical mixing of food with digestive juices. (Chapter 11.2)

Seizure: The abnormal transient discharges of neurons within the brain that are sudden, excessive, and uncontrolled. (Chapter 9.7)

Seizure triggers: Conditions that can provoke seizures in people diagnosed with epilepsy and taking medications. (Chapter 9.7)

Servant leadership: The leader focuses on the professional growth of employees while simultaneously promoting improved quality care through a combination of interprofessional teamwork and shared decision-making. (Chapter 1.3)

Set test: A neurological test for clients who are unable to read in which the client is asked to name ten items in each of four sets: fruits, animals, colors, and twins. (Chapter 9.5)

Shock wave lithotripsy (SWL): A medical procedure that utilizes shock waves to break larger stones into smaller fragments, making them easier to pass through the urinary tract. (Chapter 8.11)

Shuffling gait: Compensatory movement for postural disturbance in which individuals move their feet forward under the body's center of gravity. (Chapter 9.6)

Sickle cell disease: A genetic disorder characterized by abnormal hemoglobin molecules in red blood cells, leading to the formation of sickle-shaped cells instead of the usual biconcave disc-shaped cells. (Chapter 3.8)

Sigmoid colon: The last part of the colon that leads into the rectum; shaped like an "S." (Chapter 11.2)

Simple partial seizure: A seizure in which the client remains conscious throughout. (Chapter 9.7)

Sinoatrial (SA) node: Establishes normal cardiac rhythm within the heart. (Chapter 5.2)

Sinusitis: Inflammation of the sinus cavities. (Chapter 6.2, Chapter 6.11)

Sinus rhythm: Normal electrical pattern of the heart. (Chapter 5.2)

Six P's: Acronym to describe warning signs of acute compartment syndrome. (Chapter 10.6)

Skeletal muscle: Voluntary muscle that produces movement of the arms, legs, back, neck, and maintains posture by resisting gravity. (Chapter 10.2)

Skip lesions: Lesions that have normal areas of bowel between them; a hallmark symptom of Crohn's disease. (Chapter 1.11)

Skull fracture: Cracks in one or more of the bones that form the skull. (Chapter 9.12)

Small intestine: The part of the intestine where most of the digestion and absorption of food occurs, extending between the stomach and large intestine. (Chapter 11.2)

Smooth muscle: Muscle that is responsible for involuntary muscle movement. (Chapter 10.2)

Somatostatin: Slows down the secretion of insulin and glucagon when needed to maintain blood glucose homeostasis. (Chapter 7.2)

Spastic: The muscles tighten, causing uncontrollable jerks and spasms. (Chapter 10.10)

Spasticity: Stiff muscles. (Chapter 10.10)

Sphenoid: Posterior eye sockets and part of the base of the skull. (Chapter 10.2)

Sphincters: Circular muscles constricting an orifice. (Chapter 8.2)

Spinal blocks: Anesthetic medications injected into the cerebrospinal fluid (CSF) in the subarachnoid space, providing anesthesia for lower abdominal surgeries, pelvic procedures, hip, and knee surgeries. (Chapter 2.2)

Spinal cord injury (SCI): Refers to damage to the bundle of nerves and nerve fibers that sends and receives signals from the brain. (Chapter 9.12)

Spinal nerves: Named based on the level of the spinal cord where they emerge. (Chapter 9.2)

Spinal stenosis: Narrowing of the spinal canal. (Chapter 9.12)

Spiral fracture: Bone has twisted apart. (Chapter 10.6)

Spirometry: Diagnostic testing that provides information about lung volume and airflow resistance. (Chapter 6.3)

Spleen: Stores and filters red blood cells and functions as the location of immune responses to blood-borne pathogens. (Chapter 4.2)

Splenectomy: Surgical removal of the spleen. (Chapter 3.2)

Splenomegaly: Enlargement of the spleen. (Chapter 3.2)

Splinter hemorrhages: Linear hemorrhages under the nails. (Chapter 5.13)

Sprain: An injury to a joint when a ligament is stretched or torn. (Chapter 10.10)

Sputum: Mucus secretions that can be expelled through the mouth. (Chapter 6.2, Chapter 6.3)

Staging: Completed by a health care provider to determine how big a tumor is and whether or not it has metastasized to other parts of the body. (Chapter 4.3)

Status asthmaticus: A severe and life-threatening asthma attack that is unresponsive to standard treatments such as bronchodilators and corticosteroids. (Chapter 6.5)

Status epilepticus: Refers to a seizure lasting more than five minutes or two more sequential seizures without full recovery of consciousness between the seizures. (Chapter 9.7)

Steatorrhea: The excretion of abnormal quantities of fat with the feces. (Chapter 11.2)

Stem cells: Undifferentiated cells with the unique ability to differentiate into different cell types. (Chapter 4.3)

Stem cell treatment: Treatment that encompasses various techniques and focuses on using stem cells to replace damaged tissues, enhance the body's natural healing processes, and combat cancerous growth. (Chapter 4.3)

Stent: Insertion of a small mesh tube to help expand an artery. (Chapter 5.3)

Sternum: The breastbone. (Chapter 10.2)

Stevens-Johnson syndrome: A rare, serious disorder of the skin and mucous membranes. (Chapter 9.7)

Stomach: A sac-like organ of the digestive system where food is mixed with gastric juice. (Chapter 11.2)

Stomatitis: A condition characterized by inflammation and ulcers in the oral mucous membranes due to the effects of chemotherapy and radiation therapy. (Chapter 4.4)

Strain: An injury to a muscle or tendon from being overstretched or torn, causing pain. (Chapter 10.10)

Strangulated hernia: When a hernia undergoes a reduction in oxygen

supply due to reduced blood flow; considered a medical emergency. (Chapter 11.14)

Stress fracture: Small crack in a bone. (Chapter 10.6)

Stress incontinence: Involuntary loss of urine due to weakened pelvic floor muscles, leading to leakage during physical activities, coughing, sneezing, or laughing. (Chapter 8.10)

Striae: White or silver markings from stretching of the skin; also known as stretch marks. (Chapter 7.7, Chapter 11.3)

Striated muscle: Muscle that contains functional units called sarcomeres. (Chapter 10.2)

Strictures: Narrowing. (Chapter 11.11)

Stridor: Heard only on inspiration; sound associated with obstruction of the trachea/upper airway. (Chapter 6.2)

Stroke volume (SV): The quantity of blood pumped out of the left ventricle with contraction of the heart muscle. (Chapter 5.2)

Subarachnoid space: The space between the arachnoid membrane and the pia mater. (Chapter 9.2)

Subcutaneous emphysema: Occurs when air leaks from the pleural space into subcutaneous tissue, resulting in crepitus and swelling. (Chapter 6.3)

Subdural space: A space between the dura and the arachnoid mater, containing a thin layer of serous fluid. (Chapter 9.2)

Subluxation: Refers to partial dislocation of a joint resulting in structural displacement. (Chapter 10.10)

Subtotal thyroidectomy: Surgical removal of a portion of the thyroid gland. (Chapter 7.6)

Sudomotor neuropathy: Absence of sweating in the extremities that causes dry skin and can lead to foot ulcerations. (Chapter 7.5)

Sundowning: Increased confusion at night or when lighting is inadequate. (Chapter 9.5)

Superior vena cava syndrome: Compression of the superior vena cava by a cancerous tumor. (Chapter 4.3, Chapter 6.8)

Supervision: After delegating a task to another nursing team member, the nurse verifies and evaluates that the task was performed correctly, appropriately, safely, and competently. (Chapter 1.8)

Surfactant: Substance that keeps the lungs from collapsing. (Chapter 6.2)

Surgical time out: A purposeful pause before the procedure begins in which the surgical team confirms the procedure to be performed and the correct client. (Chapter 2.4)

Suture: The narrow fibrous joint found between the skull bones. (Chapter 10.2)

Swan-like deformity: A bending in (flexion) of the base of the finger, a straightening out (extension) of the middle joint, and a bending in (flexion) of the outermost joint. (Chapter 10.9)

Syndrome of inappropriate antidiuretic hormone (SIADH): When cancerous tumors produce excessive antidiuretic hormone. Can also be caused by some chemotherapy medications. Leads to water retention. (Chapter 4.3)

Synovial fluid: The lubricating fluid found between synovial joints. (Chapter 10.2)

Synovial joints: Fully movable joints; have a fluid-filled space where two bones come together. (Chapter 10.2)

Synovial membrane: The lining or covering of synovial joints. (Chapter 10.2)

Systemic chemotherapy: Medications used to treat cancers that have spread to distant parts of the body that are effective against rapidly dividing cells. (Chapter 4.3)

Systemic lupus erythematosus (SLE): A chronic autoimmune disease that can affect various different organs and tissues in the body, characterized by the immune system mistakenly attacking healthy cells and tissues, leading to inflammation and damage. (Chapter 4.6)

Systole: Period of contraction that the heart undergoes while it pumps blood into circulation. (Chapter 5.2)

T

Tachycardia: Heart rate over 100 beats per minute. (Chapter 2.5, Chapter 3.6, Chapter 5.2, Chapter 5.3)

Tachypnea: Rapid respiratory rate. (Chapter 3.6, Chapter 6.2)

Tarsals: Bones of the posterior half of the foot. (Chapter 10.2)

T cells: Cells that destroy the body's own cells that have been taken over by viruses or become cancerous. (Chapter 4.2)

Teletherapy: Therapy involving directing radiation beams from outside the body toward the tumor. (Chapter 4.3)

Temporal: Lower lateral sides of the skull. (Chapter 10.2)

Temporomandibular joint (TMJ): A hinge joint between the temporal bone and the mandible that allows for the opening, closing, protrusion, retraction, and lateral movement of the lower jaw. (Chapter 10.2)

Tendon: Narrow bands of fibrous connective tissue that connect a bone to a bone. (Chapter 10.2)

Tendonitis: Refers to inflammation of a tendon, causing pain around a joint. (Chapter 10.10)

Tenesmus: The frequent urge to have a bowel movement or the sensation that the bowels are not empty. (Chapter 11.11)

Tension pneumothorax: Occurs when pressure builds within the pleural space and compresses the lung. (Chapter 6.3)

Tertiary prevention: A type of prevention that focuses on managing symptoms, enhancing the quality of life, and reducing the risk of complications for someone who is diagnosed with cancer. (Chapter 4.3)

Testosterone: Hormone that is responsible for the growth and development of the male reproductive structures, increased skeletal and muscular growth, enlargement of the larynx, and growth and distribution of body hair. (Chapter 7.2)

Tetany: Involuntary contraction or spasm of muscles. (Chapter 7.6, Chapter 7.8)

Tetraplegia: Paralysis in most of the body and all limbs. (Chapter 9.12)

Thalamus: The relay center for sensory and motor signals to the cerebral cortex. (Chapter 9.2)

Third spacing: Abnormal accumulation of fluid within interstitial spaces causing swelling within tissues. (Chapter 8.3)

Thoracentesis: Medical procedure performed as a diagnostic tool and to alleviate respiratory discomfort by aspirating pleural fluid (effusion) or air (pneumothorax) from the pleural space. (Chapter 6.3)

Thoracic: The 12 vertebrae that form the outward curvature of the spine, T1 to T12. (Chapter 10.2)

Thoracic cavity: Space inside the chest that contains the heart, lungs and other organs. (Chapter 6.2)

Thrills: Vibratory sensations over the precordium, particularly in areas where murmurs are suspected. (Chapter 5.3, Chapter 8.6)

Thrombocytes: Platelets. (Chapter 3.2)

Thrombocytopenia: A medical condition characterized by a decreased number of platelets in the blood. (Chapter 3.10)

Thrombopoietin: The growth factor that regulates platelet production. (Chapter 3.2)

Thymectomy: Surgical removal of the thymus gland. (Chapter 9.11)

Thymus gland: An organ found in the space between the sternum and the aorta; place where immature T cells mature. (Chapter 4.2, Chapter 7.2)

Thyroid gland: A butterfly-shaped endocrine gland located in the neck, just below the larynx. (Chapter 7.2)

Thyroid-stimulating hormone (TSH): Stimulates thyroid hormone release by the thyroid gland. (Chapter 7.2, Chapter 7.6)

Thyroid storm: A severe state of hyperthyroidism that is a life-threatening medical condition. (Chapter 7.6)

Thyroxine (T4): A prohormone that is produced and secreted by the thyroid gland; serves as a precursor to triiodothyronine. (Chapter 7.6)

Tibia: The medial bone and main weight-bearing bone of the lower leg, commonly called the shin. (Chapter 10.2)

Time management: Time management in nursing helps nurses organize and prioritize client care, internal administrative tasks, educational responsibilities, and personal needs and obligations. (Chapter 1.10)

Toe or partial foot amputation: Removal of toes or a part of the foot that preserves the foot structure, aiding in maintaining balance and mobility. (Chapter 10.5)

Tongue: A muscular organ in the mouth, aiding in ingestion, digestion, sensation of food, swallowing, and speaking. (Chapter 11.2)

Tonic: Usually lasts for 30 seconds to several minutes and involves an abrupt increase in muscle tone, loss of consciousness, and possible changes in heart rate, blood pressure, and respirations. (Chapter 9.7)

Tonic-clonic: Last approximately 2-5 minutes; begins with a tonic phase

with stiffening and rigidity of the muscles (typically of arms and legs) and then followed by immediate loss of consciousness and rhythmic jerking of all extremities. (Chapter 9.7)

Tonsillitis: Inflammation of the tonsils. (Chapter 6.11)

Tonsils: Lymphoid nodules located along the inner surface of the pharynx and are important in developing immunity to oral pathogens. (Chapter 4.2)

Total colectomy: Surgical removal of the entire colon. (Chapter 11.11)

Total thyroidectomy: Surgical removal of the entire thyroid gland. (Chapter 7.6)

Toxic epidermal necrolysis: Extensive exfoliation of the epidermis and mucous membrane, which may result in sepsis and death. (Chapter 9.7)

Trachea: Formed by stacked C-shaped pieces of cartilage that are connected by dense connective tissue. (Chapter 6.2)

Tracheostomy: An incision created in the trachea to create an artificial opening to allow breathing when an obstruction is present. (Chapter 6.2)

Traction: Application of a pulling force to the affected limb or body part using weights and pulleys to align and immobilize the fracture. (Chapter 10.6)

Transactional leadership: Both the leader and the follower receive something for their efforts; the leader gets the job done and the follower receives pay, recognition, rewards, or punishment based on how well they perform the tasks assigned to them. (Chapter 1.3)

Transesophageal echocardiogram: An invasive procedure that involves the insertion of an ultrasound probe via the esophagus to produce a more detailed ultrasound image of heart. (Chapter 5.3)

Transformational leadership: The leader motivates followers to perform beyond expectations by creating a sense of ownership in reaching a shared vision. It is characterized by a leader's charismatic influence over team members and includes effective communication, valued relationships, and consideration of team member input. (Chapter 1.3)

Transient ischemic attacks (TIAs): Temporary periods of symptoms similar to a stroke, but irreversible damage to the brain cells do not occur. (Chapter 9.9)

Transplantation surgery: Surgery that involves the replacement of a failed organ or tissue with a healthy organ or tissue from a donor. (Chapter 2.2)

Transthoracic echocardiogram: A noninvasive diagnostic test that uses sound waves (ultrasound) to create real-time images of the heart's structure and function. (Chapter 5.3)

Transurethral resection of the prostate (TURP): A surgical procedure to remove tissue from the prostate using a resectoscope (a thin, lighted tube with a cutting tool) inserted through the urethra. (Chapter 8.13)

Transvenous pacemakers: Pacemakers inserted through a vein and threaded into the heart. (Chapter 5.3)

Transverse colon: The middle part of the colon that travels across the abdomen. (Chapter 11.2)

Transverse fracture: Bone is broken straight across. (Chapter 10.5)

Traumatic amputation: Amputation that occurs due to accidents, injuries, or severe trauma, resulting in the sudden loss of a limb. (Chapter 10.5)

Traumatic brain injury (TBI): Can be caused by a forceful bump, blow, or jolt to the head or body or from an object that pierces the skull and enters the brain. (Chapter 9.12)

Triceps brachii: Muscle on the posterior of the upper arm. (Chapter 10.2)

Triiodothyronine (T3): The active form of thyroid hormone, directly impacts the body's metabolic rate by affecting the function of cells throughout the body. (Chapter 7.6)

Tropic hormones: Turn on or off the function of other endocrine glands. (Chapter 7.2)

Trousseau's sign: A hand spasm caused by inflating a blood pressure cuff to a level above systolic pressure for three minutes. (Chapter 7.8)

True ribs: Ribs 1-7 that are attached to the front of the sternum. (Chapter 10.2)

Tuberculosis (TB): A contagious bacterial infection caused by *Mycobacterium* tuberculosis. (Chapter 6.9)

Tumor lysis syndrome: Tumor cells break down in response to cancer treatment and release intracellular contents into the bloodstream. Can also occur spontaneously in some cancers. This disrupts the normal balance of electrolytes in the body. (Chapter 4.3)

Tumor suppressor genes: Genes that regulate cell growth and prevent mutations. (Chapter 4.3)

Turbidity: Cloudiness of urine caused by the presence of suspended particles that are not easily seen. (Chapter 8.3)

Type 1 diabetes: The immune system mistakenly attacks and destroys beta cells, leading to an absolute deficiency of insulin. (Chapter 7.5)

Type 2 diabetes: The body either becomes resistant to the effects of insulin or does not produce sufficient insulin to meet the body's needs. (Chapter 7.5)

Type 1 Hypersensitivity (Immediate): The most common type of hypersensitivity reaction that involves rapid and excessive immune responses to harmless allergens. (Chapter 4.5)

Type 2 Hypersensitivity (Cytotoxic): A hypersensitivity reaction that involves antibodies targeting antigens on cell surfaces, leading to the destruction or dysfunction of the affected cells. (Chapter 4.5)

Type 3 Hypersensitivity (Immune Complex): A hypersensitivity reaction that involves immune complexes formed between antibodies and soluble antigens that deposit in various tissues, leading to localized inflammation and tissue damage. (Chapter 4.5)

Type 4 Hypersensitivity (Delayed): A hypersensitivity reaction that involves cell-mediated immune responses mediated by T cells, causing inflammation and tissue damage. (Chapter 4.5)

Type 5 Stimulated (Autoimmune Reaction): A hypersensitivity reaction that occurs when the immune system mistakenly attacks the body's own cells and tissues as if they were foreign antigens, leading to chronic inflammation and tissue damage. (Chapter 4.5)

U

Ulna: The fifth finger side of the forearm. (Chapter 10.2)

Ultrasound: Uses sound waves to create images of the body. (Chapter 11.3)

Ultrasound imaging: Ultrasound imaging uses sound waves to create images of soft tissues, tendons, and muscles. (Chapter 10.3)

Unclassified seizures: Seizures that occur for no known reason so are also known as idiopathic. (Chapter 9.7)

Unexpected versus expected conditions: A prioritization strategy that considers if a client's signs and symptoms are "expected" or "unexpected" based on their overall condition. Unexpected conditions are findings that are not likely to occur in the normal progression of an illness, disease, or injury.

Expected conditions are findings that are likely to occur or are anticipated in the course of an illness, disease, or injury. Unexpected findings often require immediate action by the nurse. (Chapter 1.9)

Universal time-out: Before the start of any surgical procedure, the entire operating room team reviews the client's identity, the procedure, and the surgical site before surgical incision or the start of the procedure; designed by The Joint Commission to reduce the occurrence of wrong-site, wrong-procedure, and wrong-person surgery. (Chapter 2.4)

Unlicensed assistive personnel (UAP): Any unlicensed personnel trained to function in a supportive role, regardless of title, to whom a nursing responsibility may be delegated. UAPs provide basic care and help clients with activities of daily living. (Chapter 1.1)

Upper respiratory infection (URI): Viral infection of the nose, nasal cavities, sinuses, pharynx, and larynx. (Chapter 6.2)

Urea: A waste product made when the liver breaks down protein into amino acids, and then deamination converts the amino acids into ammonia, urea, or uric acid. (Chapter 8.2)

Uremia: Elevated urea and nitrogenous waste in the blood. (Chapter 8.5)

Uremic encephalopathy: A cerebral dysfunction caused by the accumulation of toxins resulting from acute or chronic kidney failure. (Chapter 8.3)

Uremic frost: Whitish coating of urea crystals on the skin when there is a significant buildup of urea in the bloodstream during severe kidney failure. (Chapter 8.5)

Ureter: The duct by which urine passes from the kidney to the bladder. (Chapter 8.2)

Ureterolithiasis: Stones in the ureter(s). (Chapter 8.11)

Ureteroscopy: A medical procedure where a thin tube is passed through the urethra and bladder into the ureter to remove stones. (Chapter 8.11)

Urethra: Transports urine from the bladder to the outside of the body during urination. (Chapter 8.2)

Urge incontinence: Incontinence caused by a sudden, strong urge to urinate followed by involuntary loss of urine. (Chapter 8.2, Chapter 8.10)

Urgency: A sensation of an urgent need to void. (Chapter 8.2)

Urinary retention: Inability of the bladder to completely empty, leaving residual urine in the bladder. (Chapter 2.5, Chapter 8.12)

Urinary system: Also referred to as the renal system or urinary tract; consists of the kidneys, ureters, bladder, and urethra. (Chapter 8.2)

Urinate: The process of passing urine; also referred as void or micturate. (Chapter 8.2)

Urolithiasis: The formation of stones or calculi within the urinary tract. (Chapter 8.11)

Urological surgery: Surgery related to the urinary system and male reproductive organs. (Chapter 2.2)

Uvula: A fleshy extension at the back of the soft palate that hangs above the throat. (Chapter 11.2)

V

Vaccine: An agent administered by injection, orally, or by nasal spray that provides active acquired immunity to a particular infectious disease. (Chapter 4.2)

Varices: Enlarged veins in the esophagus that occur due to portal hypertension. (Chapter 11.15)

Veins: Blood vessels that return blood to the heart. (Chapter 5.2)

Venous insufficiency: A condition that occurs when the veins in the legs have difficulty returning blood back to the heart. (Chapter 5.10)

Venous reserve: Volume of venous blood located in venous networks within the liver, bone marrow, and integument. (Chapter 5.2)

Venous stasis: Slow blood flow in the veins, usually in the legs. (Chapter 5.8, Chapter 5.11)

Ventilation: The mechanical movement of air into and out of the lungs. (Chapter 6.2)

Ventilator-associated pneumonia (VAP): Refers to when someone gets pneumonia during or after being on a ventilator. (Chapter 6.7)

Ventral hernia: A hernia that occurs in the wall of the abdomen and is neither inguinal nor hiatal in origin. (Chapter 11.14)

Ventricles: Interconnected, fluid-filled cavities within the brain. (Chapter 9.2)

Venules: Small veins. (Chapter 5.2)

Vertebrae: Bones of the back. (Chapter 10.2)

Vertebral column: Vertebrae that are separated by intervertebral disks. (Chapter 10.2)

Vertebroplasty: Involves the injection of cement into fractured vertebrae to stabilize the fracture areas. (Chapter 10.8)

Vibratory positive expiratory pressure (PEP) therapy: Therapy that uses handheld devices such as flutter valves or Acapella devices for clients who need assistance in clearing mucus from their airways. (Chapter 6.3, Chapter 6.7)

Villi: Small, finger-like projections that protrude from the epithelial lining of the intestinal wall, increasing the surface area for absorption. (Chapter 11.2)

Vitiligo: Loss of skin pigmentation. (Chapter 7.7)

Voluntary guarding: Voluntary contraction of abdominal wall musculature; may be related to fear, anxiety, or presence of cold hands. (Chapter 11.3)

Volvulus: A type of bowel obstruction caused by twisting of the intestines. (Chapter 11.13)

Vomer: Bone that separates the left and right nasal cavity. (Chapter 10.2)

V/Q mismatch: Hypoxia occurring due to inadequate ventilation or impaired perfusion. (Chapter 6.2)

V/Q scan: A diagnostic test used to assess lung function and rule out pulmonary embolism. (Chapter 6.3)

W

Watchful waiting: Refers to treatment used for older men whose prostate cancer is found during a screening test, but do not have signs or symptoms. (Chapter 8.13)

Wheezes: Whistling noises produced when air is forced through airways narrowed by bronchoconstriction or mucosal edema. (Chapter 6.2)

White blood cells: Provide immune function and body defenses against disease; also called leukocytes. (Chapter 3.2)

World Health Organization (WHO) Surgical Safety Checklist: A tool designed to improve client safety throughout the perioperative period. It serves as a standardized framework that helps health care teams ensure critical safety measures are consistently implemented before, during, and after surgery. (Chapter 2.2)

Wrist disarticulation: Amputation at the wrist joint. (Chapter 10.5)

X

Xiphoid process: The lower portion of the sternum made of cartilage. (Chapter 10.2)

Z

Zygomatic: Pair of cheekbones. (Chapter 10.2)