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Introduction

This textbook is an open educational resource (OER) with CC-BY 4.0 licensing. It is aligned with the course competencies of Wisconsin Technical College System's Medical Terminology course (10-501-101). The Medical Terminology course focuses on learning the components of medical terms, including prefixes, suffixes, and word roots, and also introduces students to diagnostic, therapeutic, surgical, and symptomatic terminology of all body systems.

A workgroup of WTCS faculty, led by Chippewa Valley Technical College, created this second edition based on peer reviewer feedback received for the first edition of the WTCS *Medical Terminology* OER textbook. Here is a summary of revisions and additions made in the second edition.

This online book is free and can also be downloaded in multiple formats for offline use and for printing. The online version is required to complete interactive learning activities included in each chapter. 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/medterm/?p=4#oembed-1

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Preface

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PART I

CHAPTER 1 FOUNDATIONAL CONCEPTS - IDENTIFYING WORD PARTS

1.1 Introduction to Identifying Word Parts

Learning Objectives

- Apply the basic rules for analyzing and building medical terms
- Identify four components of medical terms
- Define common prefixes, word roots, and suffixes
- Pronounce medical terms
- Apply the rules of medical language
- Identify meanings of key word components

Have you ever visited a health care professional and heard long, unfamiliar medical terms used to describe your condition? Many people feel as if medical professionals use a different language when talking about medical issues that can be difficult to understand. A medical term describes a word or condition that under normal circumstances would take several words to describe. Medical terminology facilitates effective and efficient communication by health care professionals by conveying a great quantity of information with precision in the fewest number of words.

This chapter will describe the components of medical terms, including common prefixes, word roots, and suffixes. By understanding the meaning of common components included in a medical term, you can easily construct the meaning of the term based on the meanings of its components. Specific

medical terms related to body systems will be further discussed in the remaining chapters of this book.

1.2 Components and Categories of Medical Terms

WORD COMPONENTS

Medical terms can be defined by breaking down the term into word components and defining each component. These word components include prefixes, word roots, and suffixes.

- The **prefix (P)** appears at the beginning of the medical term and adds meaning to the word root.
- The **word root (WR)** is the core of many medical terms and refers to the body part or body system to which the term is referring.
- The **suffix (S)** is at the end of the medical term and usually indicates a procedure, condition, or disease. When defining a medical term, start the definition with the suffix. For example, consider the common medical condition *tonsillitis*. The word root "tonsil" refers to the tonsils, an anatomical part of the body found in the throat. The suffix "-itis" refers to inflammation. Therefore, the definition of the medical term *tonsillitis* is "inflammation of the tonsils."
- **Combining vowel (CV)** is typically the letter "o" that helps with pronunciation. A combining vowel can connect a word root and a suffix or two word roots. When a word root is combined with a combining vowel, the word part is referred to as a **combining form (CF)**. See examples of word components in Table 1.2a.

Table 1.2a. Components of Medical Terms

Component	Definition	Example
Word Root (WR)	Core of the word	**hepat/**itis **hepat** = liver
Prefix (P)	Attached to the beginning of the word root to alter its meaning	**sub/**hepatic **sub-** = below
Suffix (S)	Attached to the end of a word root to alter its meaning	hepat/**itis** **-itis** = inflammation
Combining Vowel (CV)	Typically, an "o" is used to assist with pronunciation	hepat**/o/**megaly
Combining Form (CF)	Word root with a combining vowel	**hepat/o**

By defining the meaning of each component of a medical term, you can easily construct the full meaning of the term based on the meanings of its components. See an example of defining a medical term by its components in the following box.

Defining a Medical Term by its Components

The medical term ***arthropathy*** contains the following word components:

- The word root "**arthr-**" that refers to a joint
- The combining vowel "**o**" that creates the combining form arthro-
- The suffix "**-pathy**" that refers to a disease

When putting the meaning of these components together, the medical term *arthropathy* means "**disease of a joint**."

Definitions of common prefixes, word roots, suffixes, and combining vowels will be discussed in greater detail in the following sections of this chapter.

Check your knowledge of the components of medical terms on the right by dragging them to their corresponding definitions on the left.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=85#h5p-1

TYPES OF MEDICAL TERMS

Medical terms can be divided into three categories of terms, based on the origin of their components:

1. Terms built from word components of Greek and Latin origin
2. Terms NOT built from word components of Greek and Latin origin
3. Terms that look like they are made from word parts but are not easily translated

Definitions of medical terms built from word components of Greek and Latin origin can be easily identified by analyzing the components, defining each component, and then building the meaning of the term based on the meaning of its components.

Medical terms NOT built from word components of Greek and Latin origin, or terms that are not easily translated, must be learned by memorizing and recalling the definitions. See Table 1.2b for examples of these categories of medical terms.

Table 1.2b. Types of Medical Terms

Type	Origin	Examples	Methods
Terms That Can Be Easily Built From Word Components	Word components of Greek and Latin origin that are combined to create literal translations	Hepatitis Arthropathy	Definitions are identified by analyzing the word components, defining the word components, and then building the meaning of a medical term based on the meaning of its components
Terms NOT Easily Built From Word Components	**Eponyms** (i.e., a disease or procedure named after someone who discovered it)	Parkinson's disease – a disease first described by a physician named James Parkinson	Definitions are learned by memorizing and recalling definitions
	Acronyms (i.e., an abbreviation formed from the initial letters of other words and pronounced as a word)	AIDS – an acronym that stands for the disease called **a**cquired **i**mmuno**d**eficiency **s**yndrome	
	Modern language (i.e., terms created in a language currently used)	Post-traumatic stress disorder – a mental health diagnosis created by using the English language	

DEFINING MEDICAL TERMS BY BREAKING DOWN COMPONENTS

Defining medical terms built from word components is easily accomplished by analyzing the components of the term, defining each component, and then building the overall definition of the medical term.

For example, see Table 1.2c for instructions on how the definition of the

medical term “osteoarthropathy” can be identified by breaking down its components and defining them.

Table 1.2c. Technique for Defining Medical Terms Based on Their Components

Technique	Instructions	Steps
Analyze Components	1. Divide into word parts. 2. Label the word parts. 3. Underline and label each combining form.	1. oste/o/arthr/o/pathy 2. **oste** = WR/; **o** = CV/; **arthr** = WR/; **o** = CV/; **pathy** = S 3. oste/o/arthr/o/pathy
Define Components	1. Define each word part in the term.	1. **oste** = bone; **arthr** = joint; **pathy** = disease
Build Definition	1. Place word parts together to define the term. Begin by defining the suffix, and then move to the beginning of the term in the order they appear. 2. Add combining vowels to pronounce the term.	1. **Disease** of the **bone** and **joint** 2. oste/**o**/arthr/**o**/pathy

When breaking down medical terms into its components, place slashes between the components and a slash on each side of a combining vowel. Notice how the term is defined by beginning with the meaning of the suffix and then shifts to the beginning of the term with the meaning of the word parts in the order they appear. Additional examples of identifying definitions of medical terms by analyzing their components are provided in the following box.

Additional Examples of Identifying Definitions of Medical Terms by Analyzing Their Components

Example: Osteoarthritis

1. Analyze Components: **oste/o/arthr/itis**

2. Define Components:
oste is a word root (WR) that means “bone”
/o/ is a combining vowel (CV)
arthr is a word root (WR) that means “joint”
-itis is a suffix (S) that means “inflammation”
3. Build Definition: **Inflammation of bone and joint**

Example: Intravenous
1. Analyze Components: **intra/ven/ous**
2. Define Components:
intra- is a prefix (P) that means “within”
ven is a word root (WR) that means “vein”
-ous is a suffix (S) that means “pertaining to”
3. Build Definition: **Pertaining to within a vein**

LANGUAGE RULES

Language rules are a good place to start when building foundational knowledge of medical terminology. Many medical terms are built from word parts and can be translated literally. At first, literal translations sound awkward. However, after you build a medical vocabulary and become proficient at using it, the awkwardness will slip away. Suffixes will no longer be stated and will be assumed. For example, the definition of *intravenous* can be condensed from “pertaining to within a vein” to “within the vein.” It should be noted that as with all language rules there are always exceptions, often referred to as “rebels.”

By the end of this book, by using these simple rules and processes, you will easily learn hundreds of medical terms.

PRONUNCIATION

Pronouncing complex medical terms can be challenging. When learning how to pronounce medical terms, special marking above vowels indicates the proper pronunciation. When you see a macron (i.e., straight line) above the vowel, that means the vowel sound is long. A u-shaped symbol above a vowel indicates a short vowel sound. Additionally, capital letters indicate where to place the emphasis when pronouncing a word. See examples of pronunciation markings in the Table 1.2d. Try pronouncing each example out loud.

Table 1.2d. Pronunciation Guidelines

Guidelines	Example
Markings indicate the proper phonetic sounds.	doctor (dŏk-tŏr)
A macron (a line above the letter) indicates a long vowel sound. Examples: ā in “play” ē in “bee” ī in “wine” ō in “go” ū in “mule”	prorate (prō-rāt)
A u-shaped mark above the vowel indicates a short sound. Examples: ă in “mad” ĕ in “bet” ĭ in “tip” ŏ in “mop” ŭ in “cup”	medical (mĕd-ĭ-căl)
Primary emphasis of pronunciation is indicated by capital letters.	debride (di-BRĒD) dehydration (dē-hī-DRĀ-shŏn)

CATEGORIES OF MEDICAL TERMS

Medical terms can be classified into the following general categories of terms:

- **Anatomical:** Terms used to describe specific areas and movement of the body, as well as the relation of body parts to each other.
    - An example of an anatomical term is *medial*, which describes the middle or direction toward the middle of the body.
- **Disease and Disorder:** Terms that describe deviation from the normal

structural or functional state of an organism, generally associated with certain signs and symptoms.

    - An example of a disease is *bronchopneumonia*, an infection of the bronchi in the lungs.
- **Diagnostic/Procedural:** Terms related to the process of identifying a disease, condition, or injury.
    - An example of a diagnostic term is *transrectal ultrasound*, an ultrasound procedure used to diagnose prostate cancer.
- **Therapeutic:** Terms regarding the treating or curing of diseases.
    - An example of a therapeutic term is *nebulizer*, which is a device that creates a mist used to deliver medication for respiratory treatment.

These categories will be used to discuss medical terms by body systems throughout the remaining chapters of the book.

1.3 Common Prefixes

The prefix appears at the beginning of a medical term and adds meaning to the root word, like adjectives add meaning to nouns in the English language.

Prefixes often indicate:

- **Number**, such as *bi-*, meaning “two”
- **Position**, such as *sub-*, meaning “under”
- **Direction**, such as *intra-*, meaning “within”
- **Time**, such as *brady-*, meaning “slow”
- **Negation**, such as *a-* and *an-*, meaning “without”

COMMON PREFIXES

Here is a list of commonly used prefixes. It is helpful to memorize these common prefixes as you build your knowledge of medical terminology:

- **a-, an-**: Absence of, without, not
- **ab-**: Away from, take away
- **ad-**: Towards, to, near
- **ambi-, ambo-**: Both
- **amphi-**: Double, both sides
- **ana-**: Up, apart
- **ante-**: Before, in front of, forward
- **anti-**: Opposing, against
- **ap-, apo-**: Separated, derived from
- **aut-, auto-**: Self, by yourself
- **bi-**: Double, two, twice, both
- **brachy-**: Short
- **brady-**: Slow

- **cata-**: Lower, down, against
- **circum-**: Around
- **co-, con-, com-**: Together, with
- **contra-**: Against, opposed to
- **de-**: Down, from
- **di-**: Twice, two
- **dia-**: Through, apart, across, between
- **dis-**: Apart from, free from
- **dys-**: Bad, painful, difficult
- **e-, ec-, ex-**: From, away from, out of
- **ect-, exo-, ecto-**: Outside, outer, on
- **em-, en-**: In
- **end-, endo-, ent-, ento-**: Within, inner
- **epi-, ep-**: Upon, over, on
- **eu-**: Normal
- **extra-, extro-**: Beyond, outside of, outward
- **hemi-, semi-**: Half, half of
- **hyper-**: Above, excessive, beyond
- **hyp-, hypo-**: Below, beneath, deficient
- **im-, in-**: Intro, in, within
- **infra-**: Below, beneath
- **inter-**: Between
- **intra-**: Within, inside
- **intro-**: Into, within
- **iso-**: Same, equal
- **macro-**: Large
- **mal-**: Bad
- **mes-, meso-**: Middle
- **meta-**: Beyond, changing
- **micro-, micr-**: Tiny, small
- **mono-, uni-**: One
- **mult-, multi-**: Many, multiple
- **neo-**: New, recent
- **nulli-**: None

- **oligo-**: Small amount
- **ortho-**: Straight, normal
- **pan-**: All
- **para-**: Beyond, beside, after
- **per-**: Through
- **peri-**: Around
- **poly-**: Many, excessive
- **post-**: After, following, behind
- **pre-, pro-**: In front of, before, preceding
- **presby-**: Old age
- **pseudo-**: False
- **quadri-**: Four
- **re-**: Backward, again
- **retro-**: Behind, backward
- **semi-**: Half, partial
- **sub-**: Under, beneath
- **super-, supra-**: Above, excessive, superior
- **sym-, syn-**: With, together
- **tachy-**: Rapid, fast
- **trans-**: Through, across
- **tri-**: Three
- **ultra-**: Excessive, beyond
- **uni-**: One

See the following box for examples of commonly used prefixes in body-related medical terms. Additional prefixes will be discussed in each chapter related to specific body systems.

Examples of Common Prefixes in Medical Terms

- **Bi**lateral: Both sides
- **Dys**uria: Painful urination

- **Hyper**tension: Excessive/high blood pressure
- **Olig**uria: Small amount of urine production
- **Peri**cardial: Around the heart
- **Tachy**cardia: Rapid heart rate

1.4 Common Word Roots and Combining Vowels

A word root is the primary building block of a medical term and refers to the body part or body system to which the term is referring. Some words contain more than one word root. The order is generally dictated by common practice. As you practice throughout this course, you will learn more about how to determine the order of word roots. Word roots will be further discussed in more detail in each chapter as they relate to specific body systems.

A combining vowel is a word part, most often the letter “o,” that helps pronunciation.

COMMON WORD ROOTS AND THEIR COMBINING VOWEL

Here is a list of commonly used word roots and their combining vowel. It is helpful to memorize these components as you build your knowledge of medical terminology.

- **abdomin**/o: Abdomen
- **andr**/o: Male
- **angi**/o: Vessel
- **arteri**/o: Artery
- **arthr**/o: Joint
- **audi**/o: Hearing
- **bronch**/i, **bronch**/o: Bronchus/lung
- **carcin**/o: Cancer

- **cardi**/o: Heart
- **cholecyst**/o: Gallbladder
- **chrondr**/i, **chrondr**/o: Cartilage
- **col**/o: Colon
- **cysti**, **cyst**/o: Bladder or cyst
- **cyt**/o: Cell
- **duoden**/o: Duodenum
- **encephal**/o: Brain
- **erythr**/o: Red
- **esophag**/: Esophagus
- **gastr**/o: Stomach
- **glyc**/o: Sugar
- **gynec**/o: Female reproductive system
- **hemat**/o, **hem**/o: Blood
- **hist**/o: Tissue
- **hyster**/o: Uterus
- **laryng**/o: Larynx
- **leuk**/o: White
- **men**/o: Menstruation
- **my**/o: Muscle
- **nephr**/o: Kidney
- **neur**/o: Nerve
- **opt**/o: Vision
- **orch**/o: Testis, testicle
- **pneum**/o: Lungs
- **thorac**/o: Chest

See the following box for examples of common word roots in medical terms.

Examples of Common Word Roots in Medical Terms

Cardiomegaly: Enlargement of the heart

Encephalitis: Inflammation of the brain

Gynecologist: Specialist who treats disorders and diseases of female reproductive organs

Pneumonia: Disease state of the lung

MORE ON COMBINING VOWELS

A combining vowel is placed to connect two word roots or to connect a word root and a suffix. However, a combining vowel should not be used to connect a prefix and a word root. Note that not all medical terms will have combining vowels. See guidelines on using combining vowels in Table 1.4a.

Table 1.4a. Guidelines on Combining Vowels

Guideline	Example
When connecting a word root and a suffix, a combining vowel is used if the suffix DOES NOT begin with a vowel.	arthr/**o**/pathy
When connecting a word root and a suffix, a combining vowel is usually NOT USED if the suffix begins with a vowel.	hepat/ic
When connecting two word roots, a combining vowel is used even if vowels are present at the junction.	oste/**o**/arthr/itis
A combining vowel is NOT USED when connecting a prefix and a word root.	sub/hepat/ic

1.5 Common Suffixes

The suffix is at the end of the word and adds meaning. When building a definition of a medical term from its components, start with the meaning of the suffix. For example, *hepat/**itis*** is defined as “inflammation of the liver.”

Suffixes often indicate:

- **Procedures:** For example, *-scopy* means “visual examination”
- **Conditions:** For example, *-itis* means “inflammation”
- **Diseases:** For example, *-oma* means “tumor”

COMMON SUFFIXES

Here is a list of commonly used suffixes in medical terms. It is helpful to memorize these common suffixes as you build your knowledge of medical terminology.

- **-ac**: Pertaining to
- **-ad**: Toward
- **-al**: Pertaining to
- **-algia, -dynia**: Pain
- **-ar**: Pertaining to
- **-ary**: Pertaining to
- **-cele**: Protrusion
- **-centesis**: Surgical withdrawal of fluid
- **-cide, -cidal**: Kill, destroy
- **-coccus**: Berry shaped
- **-cyte**: Cell
- **-eal**: Pertaining to
- **-ectomy**: Surgical removal

- **-emia**: Pertaining to blood
- **-esis**: Condition
- **-gen**: Substance that produces/causes
- **-genic**: Produced by
- **-gram**: Record of
- **-graph**: Instrument used to record
- **-graphy**: A process of recording
- **-ia**: Condition of, diseased state, abnormal state
- **-ic, -ior**: Pertaining to
- **-ism**: State of, condition, theory
- **-itis**: Inflammation
- **-logist**: Specialist who studies and treats disorders
- **-logy**: Study of
- **-lysis**: Destruction, breakdown
- **-megaly**: Enlargement
- **-meter**: Instrument used to measure
- **-metry**: Process of measuring
- **-oid**: Resembling
- **-oma**: Tumor
- **-opia**: Vision condition
- **-opsy**: To view
- **-osis**: Abnormal condition
- **-ous**: Pertaining to
- **-pathy**: Disease, abnormality
- **-penia**: Lack of, deficiency
- **-pexy**: Surgical fixation, suspension
- **-phagia**: Eating
- **-phobia**: Intense fear of
- **-plasia**: Formation, development
- **-plasm**: Growth, substance, formation
- **-plasty**: Surgical reconstruction
- **-plegia**: Paralysis
- **-pnea**: Breathing
- **-poiesis, -poietic**: Production, manufacture of

- **-ptosis**: Drooping
- **-rrhage**: Excessive flow
- –**rrhagia**: Excessive flow
- **-rrhaphy**: Suturing in place, fixation
- **-rrhea**: Flow, discharge
- **-rrhexis**: Rupture or breaking away
- **-sclerosis**: Hardening
- **-scope**: Instrument used to visually examine
- **-scopic**: Visual examination
- **-scopy**: Process of visual examination
- **-spasm**: Sudden, involuntary
- **-stasis**: To stop
- **-stomy**: Artificial surgical opening
- **-tome**: Instrument used to cut
- **-tomy**: Process of incision, cutting into
- **-tripsy**: Crushing
- **-trophic, -trophy**: Growth, development

Note there are several suffixes that mean “pertaining to,” such as -ac, -al, -ar, -ary, -eal, -ic, -ior, and -ous.

Examples of Common Suffixes in Medical Terms

- Arachno**phobia**: Fear of spiders
- Amnio**centesis**: Procedure to withdraw fluid from the amniotic sac
- An**emia**: Low levels of hemoglobin in the blood
- Cardio**megaly**: Enlargement of the heart
- Colono**scopy**: Procedure that visually examines the colon
- Dys**pnea**: Difficulty breathing
- Hemi**plegia**: Paralysis of one side of the body
- Mammo**graphy**: Radiological process of examining the

breast tissue

- My**algia**: Muscle pain

Additional suffixes will be discussed in each chapter related to specific body systems.

1.6 Foundational Concepts - Identifying Word Parts Learning Activities

Interactive Learning Activity: Study terms discussed in this chapter using these flashcards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2634#h5p-170

Interactive Learning Activity: Test your knowledge with this matching activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2634#h5p-160

Interactive Learning Activity: Test your knowledge with this quiz.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2634#h5p-168

Interactive Learning Activity: Practice identifying word parts with these interactive activities.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2634#h5p-169

You can also print this as a Chapter 1 Practice Worksheet and check your answers with this Answer Key PDF.

1.7 Glossary

Combining form (CF): When a word root (WR) is combined with a combining vowel, the word part is referred to as a combining form. (Chapter 1.2)

Combining vowel (CV): A word component, typically the letter “o,” that helps with pronunciation. A combining vowel can connect a word root and a suffix or two word roots. (Chapter 1.2)

Prefix (P): A word component that appears at the beginning of the medical term and adds meaning to the word root. Prefixes often indicate number, position, direction, time, or negation. (Chapter 1.2)

Suffix (S): A word component at the end of the medical term that usually indicates a procedure, condition, or disease. (Chapter 1.2)

Word root (WR): A word component that is the core of many medical terms and refers to the body part or body system to which the term is referring. (Chapter 1.2)

PART II

CHAPTER 2 MEDICAL LANGUAGE RELATED TO THE WHOLE BODY

2.1 Medical Language Introduction

Learning Objectives

- Use the anatomic reference system to identify the anatomic position of the body
- Use the anatomic reference system to identify the body planes
- Use the anatomic reference system to identify the body cavities
- Use the anatomic reference system to identify the directional terms
- Use the anatomic reference system to identify the divisions of the body
- Describe the structural organization of the body

In Chapter 1, the components of medical terms were introduced. As you continue to learn medical language, it is important to contextualize the meaning of these terms based on human anatomy. This chapter will review anatomical terminology related to organ systems, body cavities, body regions, and tissue membranes. It will also discuss the standardized anatomical position, directional terms, and planes of the body.

2.2 Levels of Organization

Anatomy focuses on structure, and **physiology** focuses on function. Much of the study of physiology centers on the body's tendency to maintain homeostasis. **Homeostasis** (hō-mē-ō-STĀ-sĭs) refers to the body's biological processes that result in stable equilibrium.

LEVELS OF ORGANIZATION

The body has fundamental levels of organization that increase in complexity from chemical (atoms and molecules) to cells, tissues, organs, organ systems, to the organismal level. See Figure 2.1[1] for an illustration of these levels of organization.

1. "101_Levels_of_Org_in_Body.jpg" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

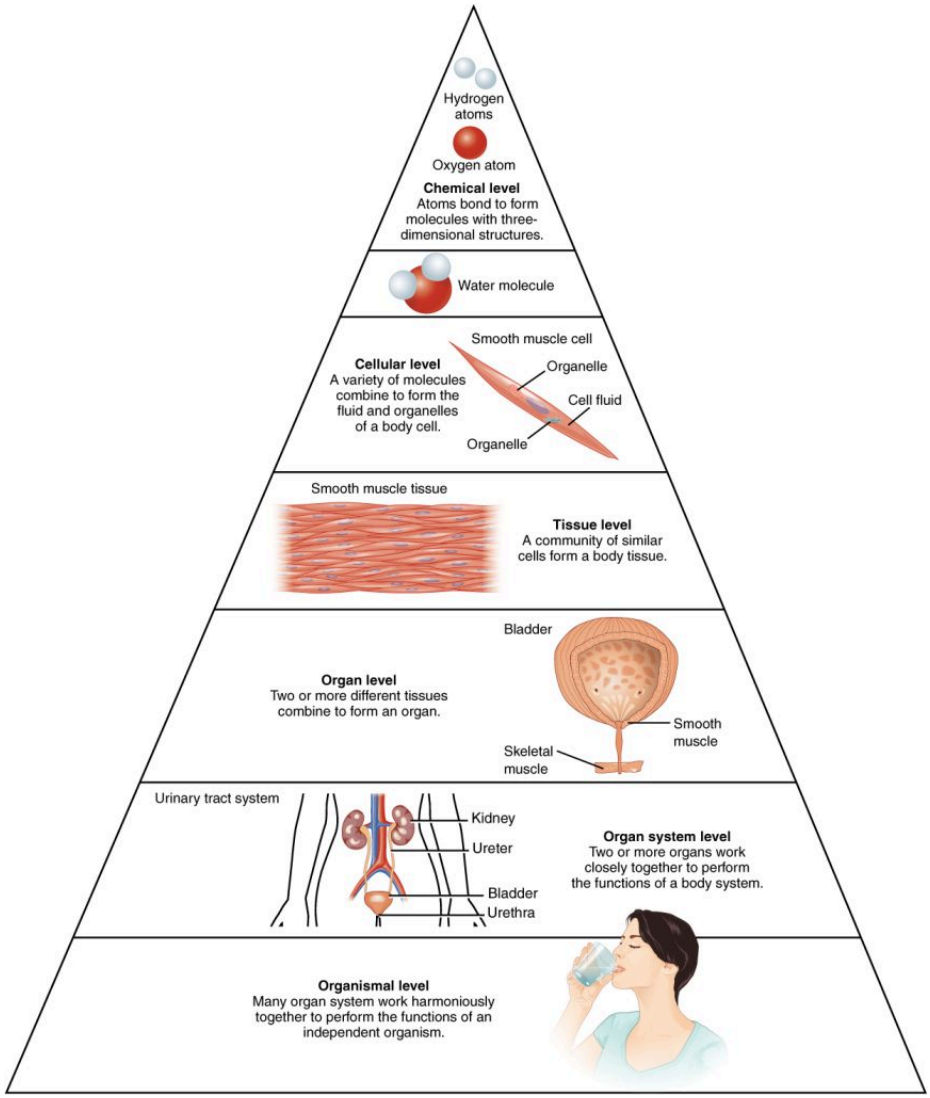

Figure 2.1 Levels of Structural Organization of the Human Body

The smallest unit of matter is an atom. Atoms are made up of subatomic particles, including protons, electrons, and neutrons. Two or more atoms combine to form a molecule, such as the water molecules, proteins, and sugars found in living things. Molecules are the chemical building blocks of all body structures.

A cell is the smallest independently functioning unit of a living organism. Even bacteria, which are extremely small, independently living organisms, have a cellular structure. Each bacterium is a single cell. All living structures of

the human body contain cells, and almost all functions of the human body are performed in cells or are initiated by cells.

A tissue is a group of similar cells that work together to perform a specific function. An organ is an anatomically distinct structure of the body composed of two or more tissue types. Each organ performs one or more specific physiological functions. A system is a group of organs that work together to perform major functions or meet the physiological needs of the body.

The organism level is the highest level of organization. An organism is a living being that has a cellular structure and that can independently perform all physiologic functions necessary for life. In multicellular organisms, including humans, all cells, tissues, organs, and organ systems work together to maintain the life and health of the organism.

Organ Systems

There are eleven distinct **organ systems** in the human body. See Figure 2.2[2] illustrations of organ systems, including the integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary, and male and female reproductive systems.

2. "Organ_Systems_II.jpg" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

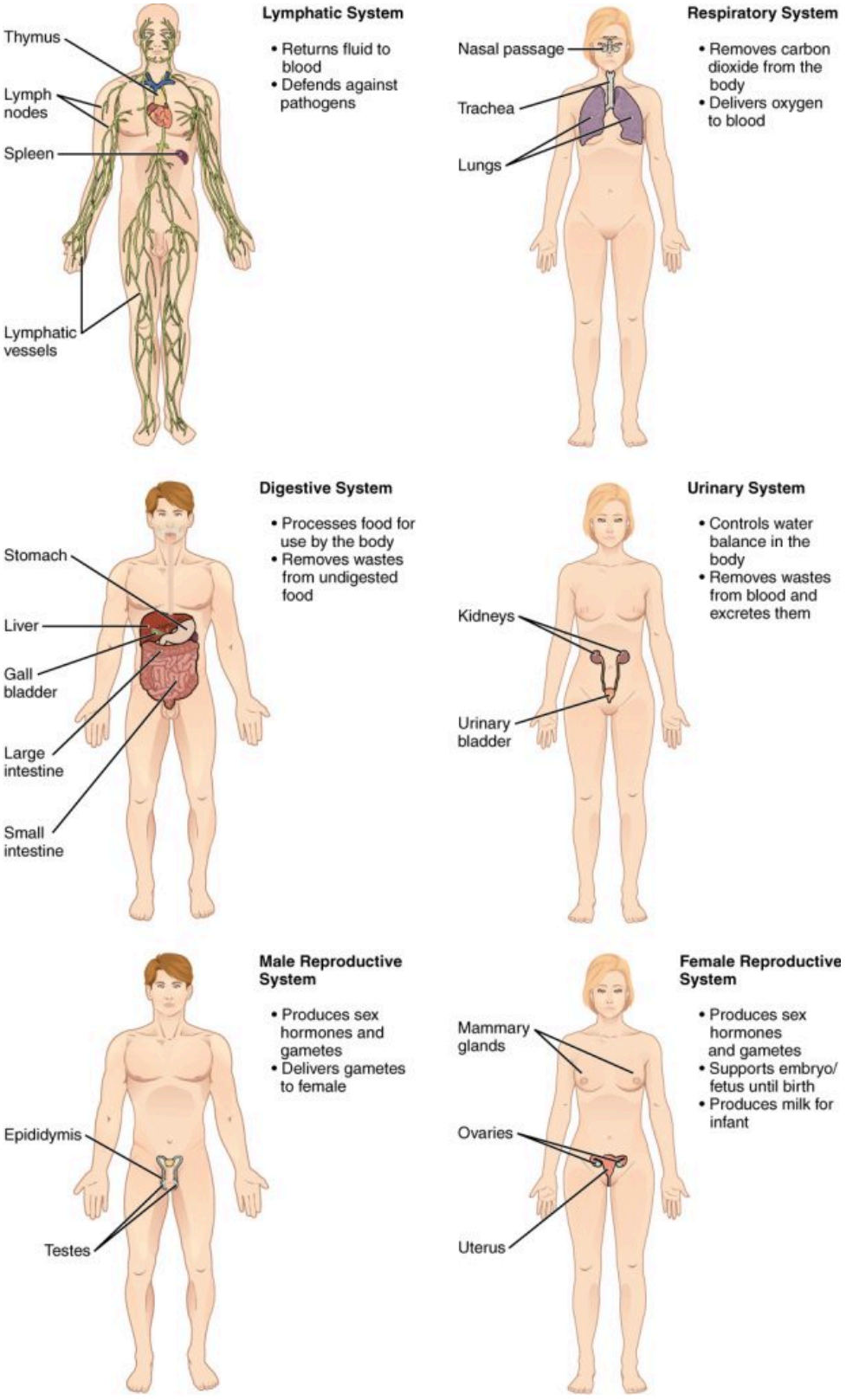

Figure 2.2 Organ Systems of the Human Body

The remaining chapters of this book will discuss medical terms by organ system.

View a supplementary YouTube video[3] for an introduction to anatomy and physiology: Introduction to Anatomy & Physiology: Crash Course Anatomy & Physiology #1

3. CrashCourse. (2015, January 6). *Introduction to anatomy & physiology: Crash course A&P #1* [Video]. YouTube. https://youtu.be/uBGl2BujkPQ

2.3 Body Cavities

BODY CAVITIES

The body maintains its internal organization by membranes and other structures that separate compartments. The dorsal (posterior) cavity and the ventral (anterior) cavity are the largest compartments of the body, as shown in Figure 2.3.[1] The **dorsal (posterior) cavity** includes the cranial and spinal (vertebral) cavities. The **ventral (anterior) cavity** includes the thoracic and abdominopelvic cavities.

1. "Dorsal_Ventral_Body_Cavities.jpg" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

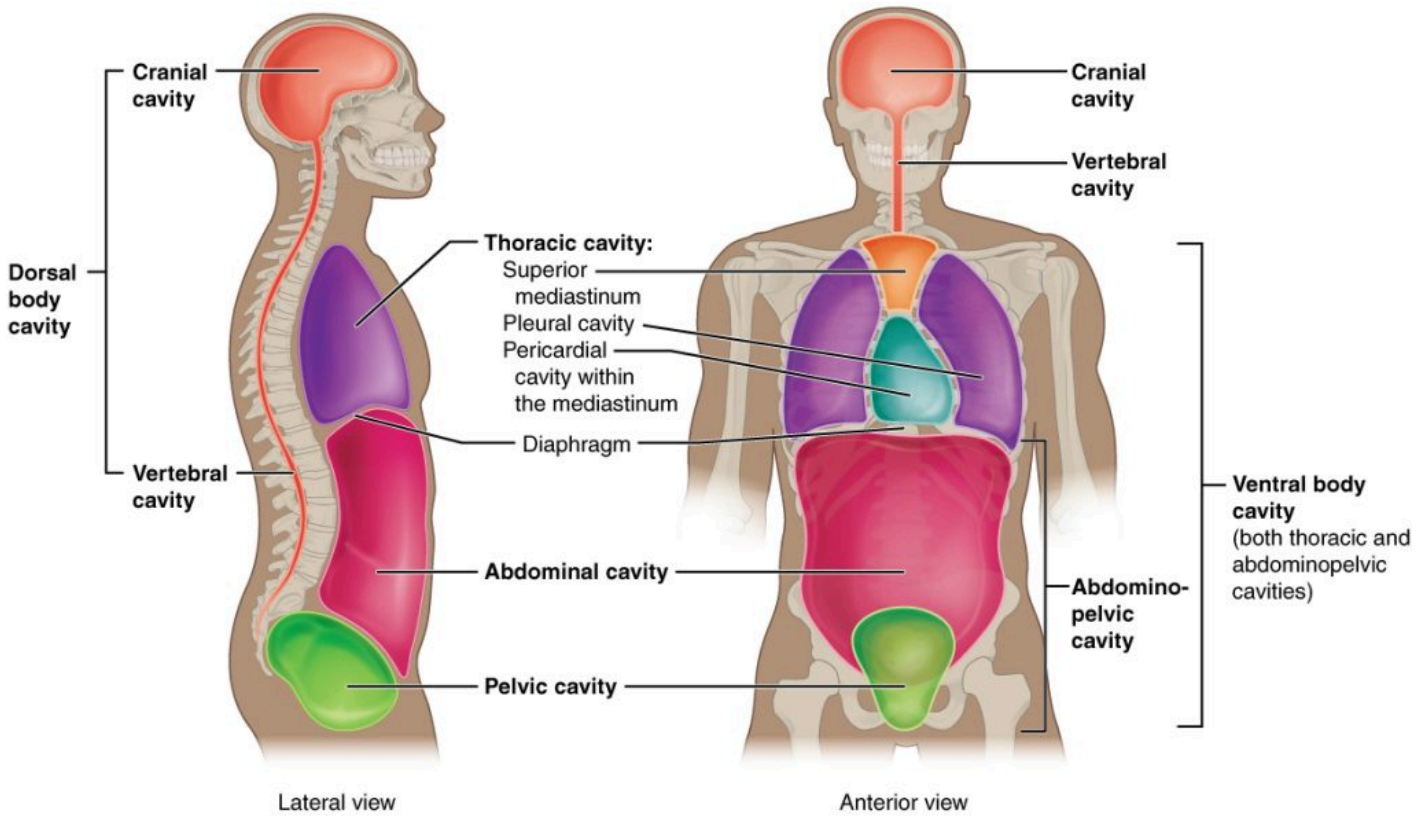

Figure 2.3 Dorsal and Ventral Body Cavities

In the dorsal cavity, the **cranial cavity** houses the brain. The brain is protected by the bones of the skulls and the cerebrospinal fluid. The **spinal cavity** (vertebral cavity) encloses the spinal cord. It is protected by the vertebral column and cerebrospinal fluid. In the ventral cavity, the **thoracic cavity** is superior in position to the abdominopelvic cavity, and it is enclosed by the rib cage. The thoracic cavity contains the lungs and the heart. The diaphragm forms the floor of the thoracic cavity and separates it from the abdominopelvic cavity. The **abdominopelvic cavity** is the largest cavity in the body. The abdominopelvic cavity houses the digestive organs, the pelvic cavity, and the reproductive organs. The ventral cavity also allows for significant changes in the size and shape of the organs as they perform their functions. For example, the lungs, heart, stomach, and intestines can expand and contract without distorting other tissues or disrupting the activity of nearby organs.

View a supplementary YouTube video[2] on body cavities and membranes:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/medterm/?p=107#oembed-1

2. RegisteredNurseRN. (2019, June 12). *Body cavities and membranes (Dorsal, Ventral) – Anatomy and physiology* [Video]. All rights reserved. Reused with permission. https://www.youtube.com/watch?v=4GLMjSj4k9U

2.4 Body Regions

BODY REGIONS

Body regions are used to specifically identify a body area, such as the abdominopelvic region and the spinal region.

Abdominopelvic Region

The abdominopelvic region can be divided into nine anatomic regions to assess and precisely communicate abdominal and pelvic locations. These regions include three across the top, three across the middle, and three across the bottom. See Figure 2.4[1] for an illustration of the abdominal region.

1. "Abdominal_Quadrant_Regions.jpg" by OpenStax is licensed under CC BY 3.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

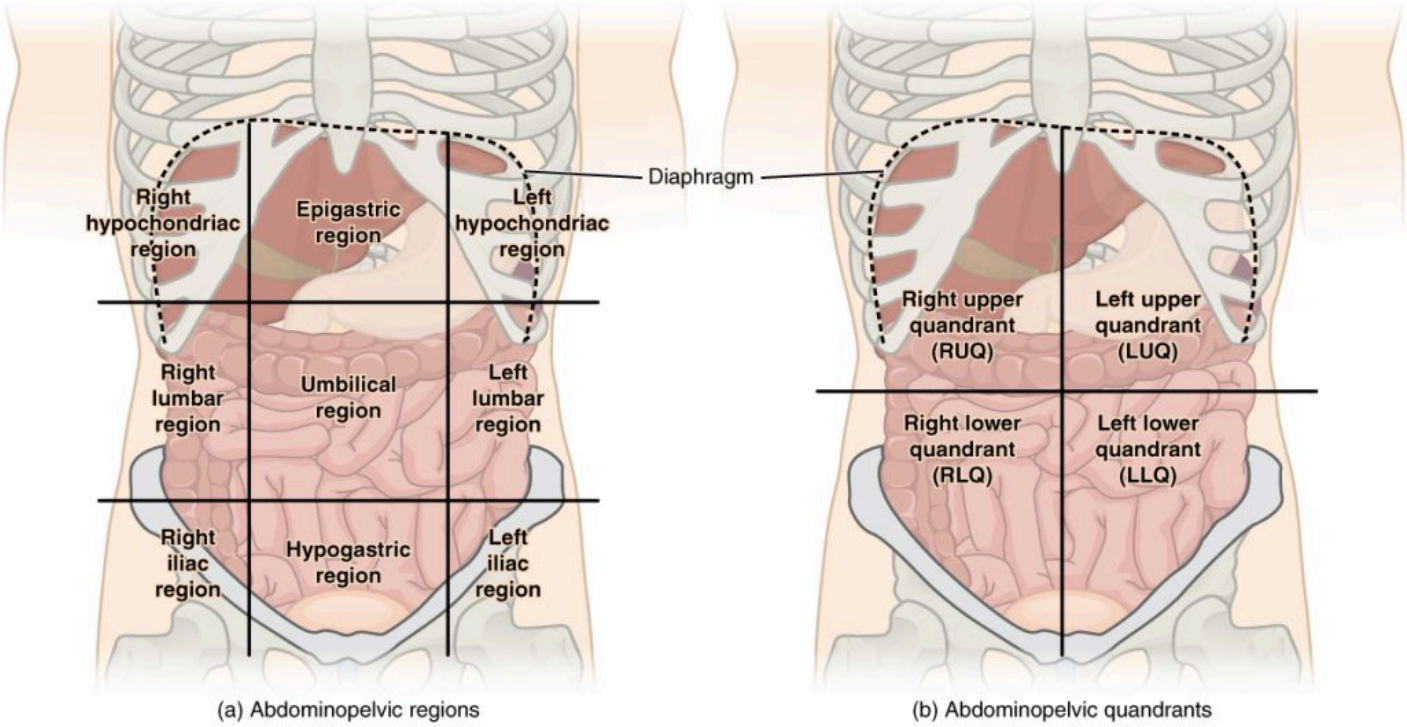

Figure 2.4 (a) Abdominopelvic Regions; (b) Abdominal Quadrants

The center portion of the nine squares is the umbilical region. Directly above the umbilical region is the epigastric region. Directly below the umbilical region is the hypogastric region. On either side of the epigastric region are the right and left hypochondriac regions. On either side of the hypogastric region are the right and left iliac regions. For example, a nurse may document that an individual has "pain in the epigastric region after eating spicy meals."

As illustrated in Figure 2.4, the abdominopelvic area can also be divided into four abdominal quadrants:

- **Right upper quadrant (RUQ):** Contains the gallbladder, the right lobe of the liver, and parts of the small and large intestines.
- **Left upper quadrant (LUQ):** Contains the stomach, pancreas, spleen, left lobe of the liver, and parts of the small and large intestines.
- **Right lower quadrant (RLQ):** Contains the appendix, right ureter, right ovary and Fallopian tube, and parts of the small and large intestines.
- **Left lower quadrant (LLQ):** Contains the left ureter, left ovary and Fallopian tube, and parts of the small and large intestines.

For example, a nurse may document that a patient with severe constipation "has a firm mass in the left lower quadrant." Keep in mind that "right" and "left" refer to the patient's right and left side, not the examiner's view of the individual.

View the following YouTube video[2] on abdominopelvic quadrants and organs contained in each quadrant:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/medterm/?p=109#oembed-1

Vertebral Cavity Regions

The vertebral (i.e., spinal) cavity is divided into five regions. From the top, near the head, to the bottom, near the tailbone, these regions are as follows[3]:

- **Cervical region:** The neck region with seven cervical vertebrae from C1 to C7.
- **Thoracic region:** The chest region, including the thoracic vertebrae from T1 to T12. Each vertebra in this region is joined to a rib.
- **Lumbar region:** The region between the ribs and the hip bones, including lumbar vertebrae L1 to L5.

2. RegisteredNurseRN. (2019, May 23). *Four abdominal quadrants and nice abdominal regions – Anatomy and physiology* [Video]. YouTube. All rights reserved. Reused with permission. https://www.youtube.com/watch?v=ELRzBa-eAA

3. This work is a derivative of StatPearls by Peabody, Black, & Das and is licensed under CC BY 4.0

- **Sacral region:** Five sacral vertebrae, S1 to S5, that are fused to form the sacrum.
- **Coccygeal region:** The coccyx (i.e., tailbone) that is composed of several fused bones.

For example, a physician may document that a patient has “chronic pain in the L4 region.”

Vertebrae are further discussed in the “Anatomy of the Skeletal System” section.

2.5 Tissue Membranes

TISSUE MEMBRANES

A tissue membrane is a thin layer of cells that covers the outside of the body, an organ, internal passageways that lead to the exterior of the body, or the lining of joint cavities. See Figure 2.5[1] for an illustration of tissue membranes. Consider these examples of tissue membranes:

- **Synovial membranes** line movable joints and produce fluid within the joint.
- **Epithelial membranes** can be found in the skin, which covers and protects the surface of the body.
- **Mucous membranes** are epithelial membranes that line and protect the digestive, respiratory, urinary, and reproductive tracts and are coated with mucous for protection.
- **Serous membranes** line body cavities such as the peritoneal, pleural, and pericardial cavities.

1. "413_Types_of_Membranes.jpg" by OpenStax is licensed under CC BY 3.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

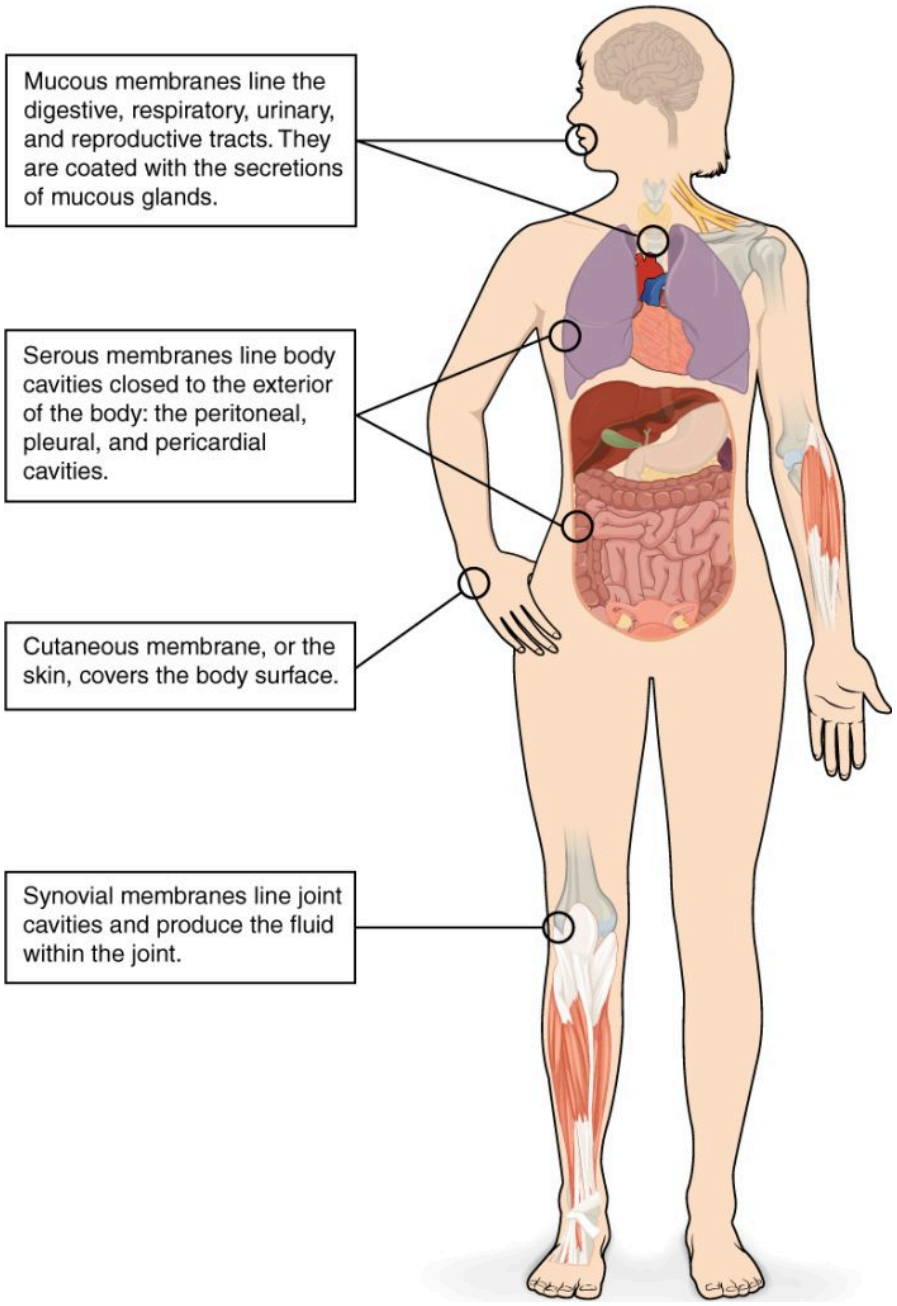

Figure 2.5 Tissue Membranes

Connective Tissue Membranes

Connective tissue membranes are formed solely from connective tissue and cover organs and line movable joints.

A synovial membrane is a type of connective tissue membrane that lines the cavities of joints that hold synovial fluid. Synovial fluid lubricates joints for movement. For example, synovial membranes surround the joints of the shoulder, elbow, and knee.

Epithelial Membranes

Epithelial membranes are composed of a thin layer of protective cells and are attached to a layer of connective tissue. Skin, mucous membranes, and serous membranes are types of epithelial membranes.

Skin is an epithelial membrane, also referred to as cutaneous membrane, that rests on top of connective tissue. The outer surface of the epithelial membrane is exposed to the external environment and is covered with dead, tough cells to protect the body from invading organisms and from desiccation (i.e., drying out).

Mucous membranes are another type of epithelial membrane that line body cavities and their passageways that open to the external environment. Mucus covers the epithelial membrane and provides protection. The digestive, respiratory, excretory, and reproductive tracts contain mucous membranes.

Serous membranes are a third type of epithelial membrane that are contained in body cavities and are composed of layers. A **parietal layer** lines the walls of a body cavity, and a **visceral layer** covers the organ within the body cavity. (Note that *viscer* is the word root for “organ.”) Between the parietal and visceral layers is a thin, fluid-filled serous space. Serous membranes provide protection to the organs they enclose by reducing friction that can lead to inflammation of the organs. There are three body cavities with serous membranes:

- **Pleura:** Serous membranes surround the lungs in the pleural cavity and reduce friction between the lungs and the body wall.
- **Pericardium:** Serous membranes surround the heart in the pericardial cavity and reduce friction between the heart and the wall of the pericardium. (Note the word components of *pericardial* are *peri-*:

surrounding; *cardia-*: heart; and *-al*: pertaining to.)

- **Peritoneum:** Serous membranes surround several organs in the abdominopelvic cavity and reduce friction between the abdominal and pelvic organs and the body wall.

Consider the pericardium serous membranes around the heart as an example of a serous membrane. A visceral layer covers the heart, and a parietal layer lines the pericardial cavity. Between these two layers is a fluid-filled serous space that reduces friction for the beating heart. An analogy of this serous membrane is a fist surrounded by a thin, air-filled balloon to provide protection. See Figure 2.6[2] for an illustration of the visceral and parietal membranes of the pericardium compared to the analogy of a fist surrounded by a balloon.

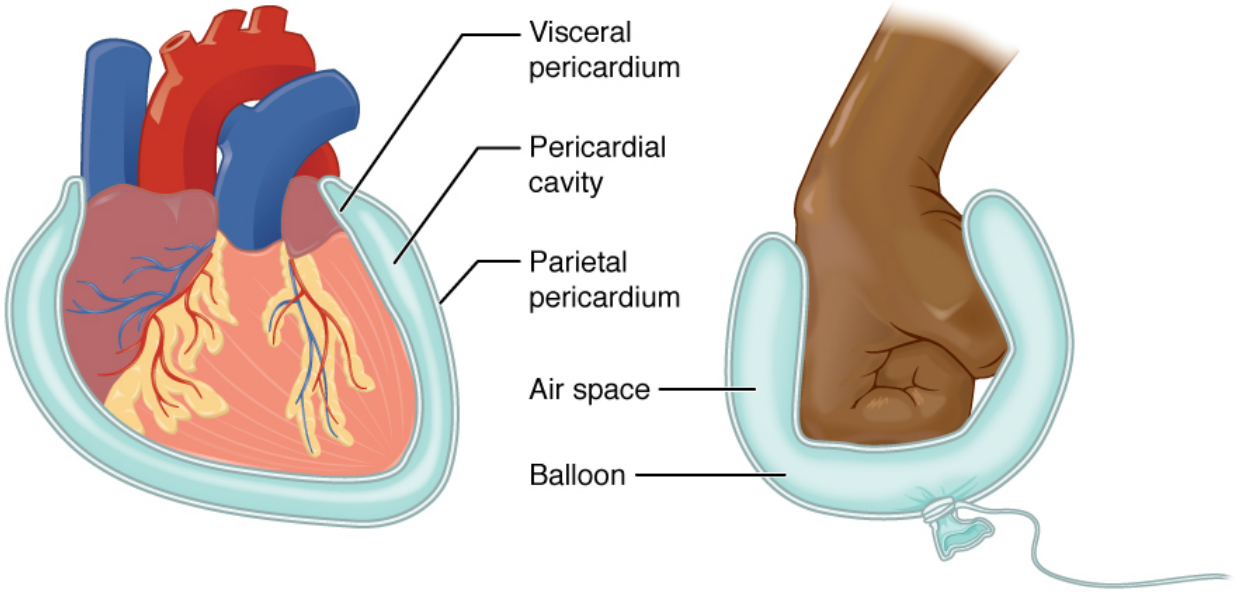

Figure 2.6 Serous Membranes of the Pericardium Compared to an Analogy of a Fist Surrounded by Two Membranes of an Air-Filled Balloon

2. "Serous_Membrane.jpg" by OpenStax is licensed under CC BY 3.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

2.6 Anatomical View of the Body, Positions, Locations, and Directional Terms

ANATOMICAL VIEW OF THE BODY

Health care professionals use precise medical terminology when communicating detailed information about the body and its parts to reduce medical errors that can result from ambiguity. To further increase precision, a standardized **anatomical view of the body** is used. Just like paper maps are oriented with north at the top of the page, the standardized anatomical view of the body is its position standing upright with the feet at shoulder width and parallel and toes facing forward. The upper limbs are held out to each side of the body, and the palms of the hands face forward. The **anterior** view is the front of the body, and the **posterior** view is the back of the body. See an illustration of the standard anatomical position of a human body in both anterior and posterior views in Figure 2.7.[1]

1. "Regions of the Body" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

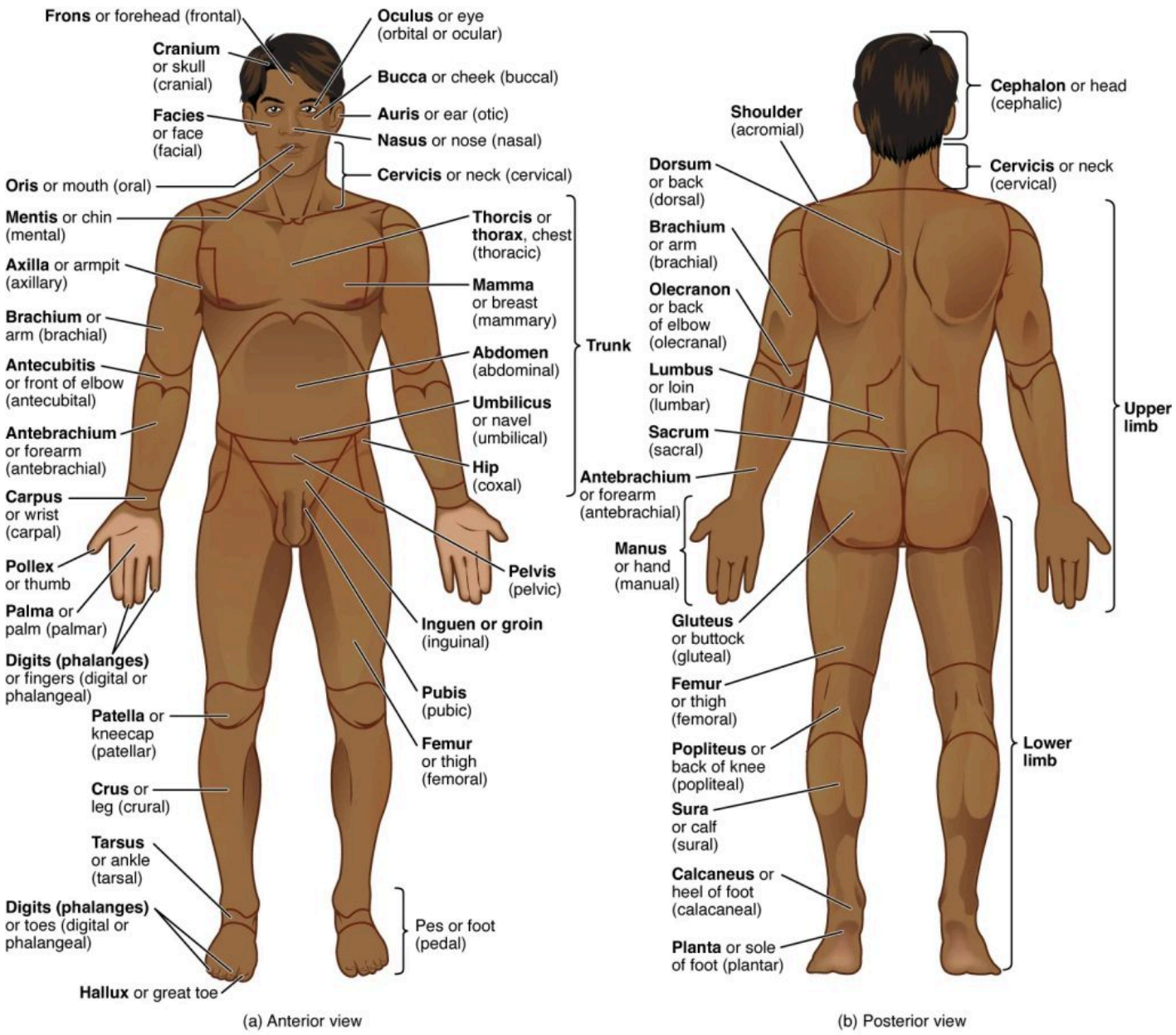

Figure 2.7 Standardized Anatomical View of the Human Body in (a) Anterior View and (b) Posterior View

Using this standardized anatomical view of the body reduces the potential for inaccuracy or error. It does not matter how a person who is being described is currently positioned when being examined; the terms for anatomical position are used as if the body is in this standard anatomical position. For example, if a patient is being examined while seated with their hand facing palm down

on a table and has a scar present on the palmar side of their wrist, the scar is described as being present on the "anterior wrist region."

ANATOMICAL POSITIONS AND LOCATIONS

In addition to using a standardized anatomical view of the body, several medical terms are used to describe the positioning or location of the body or body parts, especially during specific procedures. For example, an individual lying down on their back is referred to as **supine**. If they are lying on the abdomen, their position is referred to as **prone**. If they are lying on their side, their position is referred to as **lateral** or side-lying.

If a condition occurs on one side of the body, it is referred to as **unilateral**, whereas if it occurs on both sides of the body, it is referred to as **bilateral**. For example, if an individual is having weakness in both legs, this condition may be documented as "bilateral leg weakness."

Specific terms also refer to the location on an individual's hand or foot. For example, **dorsum** refers to the top of one's hand or foot. **Palmar** refers to the palm side of one's hand, and **plantar** refers to the sole side of one's foot.

View additional information and images about positioning in the "Repositioning Patients" subsection of the "Basic Concepts" section in the "Mobility" chapter in Open RN *Nursing Fundamentals*.

DIRECTIONAL TERMS

Directional terms describe the locations of body structures related to each other. For example, a physician might document a tumor as "superficial to" a deeper body structure. See Figure 2.8[2] for an illustration of directional terms.

- **Anterior(or ventral):** The front or direction toward the front of the body. For example, the kneecap is on the anterior side of the leg.
- **Contralateral:** Positioned on the opposite side. For example, the left arm and right arm are contralateral to each other.
- **Deep:** A position farther from the surface of the body. For example, the brain is deep in the skull.
- **Distal:** A position in a limb that is farther from the point of attachment or the trunk of the body. For example, the hand is at the distal end of the forearm.
- **Inferior (or caudal):** A position below or lower than another part of the body; near the coccyx or lowest part of the spinal column. For example, the pelvis is inferior to the abdomen.
- **Ipsilateral:** Positioned on the same side. For example, the left arm and left leg are ipsilateral to each other.
- **Lateral:** The side or direction toward the side of the body. For example, the thumb is lateral to the digits.
- **Medial:** The middle or direction toward the middle of the body. For example, the hallux (commonly called the "big toe") is the medial toe.
- **Posterior (or dorsal):** The back or direction toward the back of the body. For example, the shoulder blades are on the posterior side of the chest.
- **Proximal:** A position in a limb that is nearer to the point of attachment or the trunk of the body. For example, the proximal end of the femur joins

2. "Directions Terms" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

the pelvis.

- **Superficial:** A position closer to the surface of the body. For example, the skin is superficial to the bones.
- **Superior (or cranial or cephalic):** A position above or higher than another part of the body. For example, the head is superior to the neck.

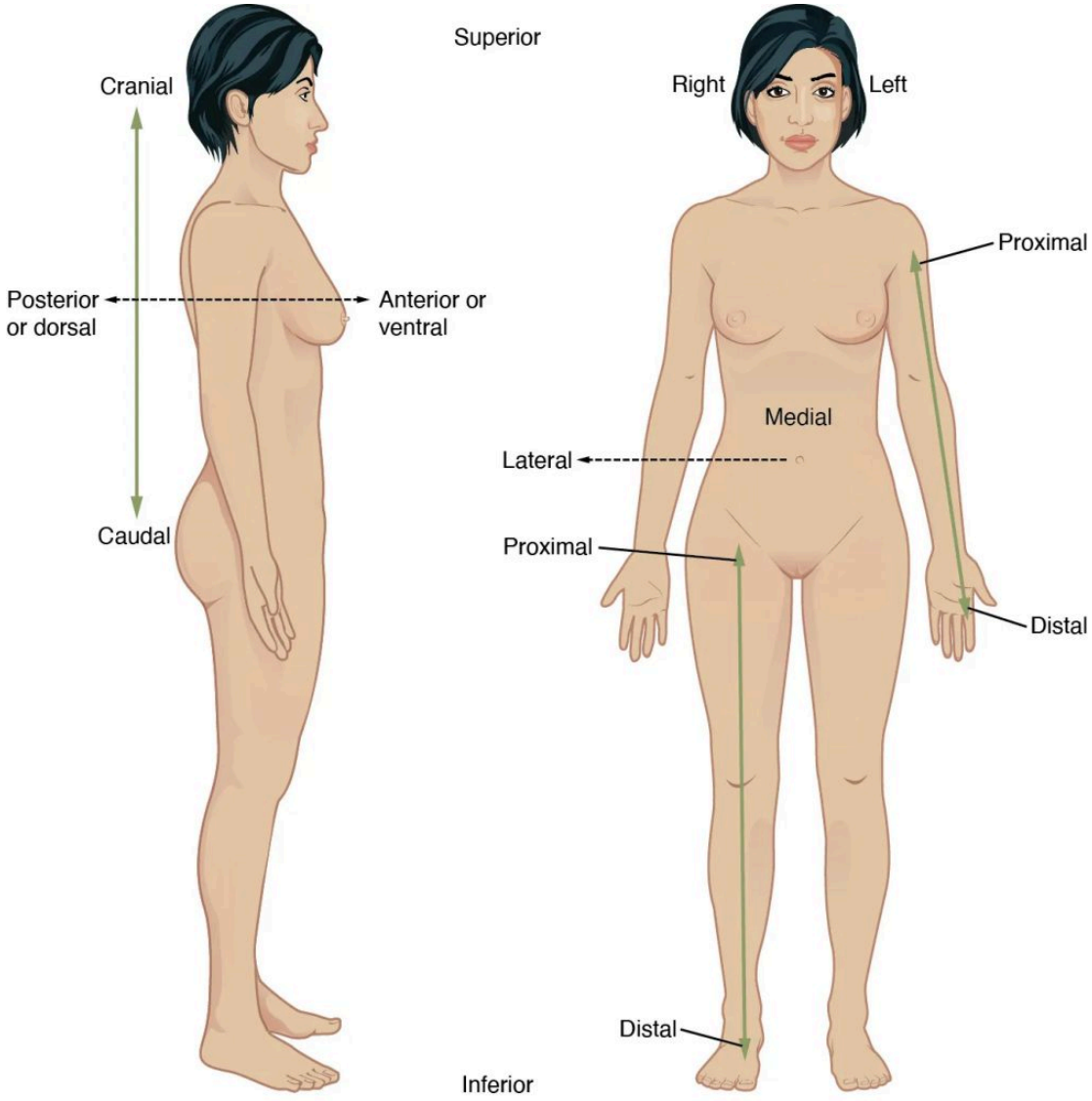

Figure 2.8 Directional Terms Applied to the Human Body

2.7 Body Planes

BODY PLANES

Medical imaging, such as CT scans, obtain images of an individual's body or an organ in sections. A section is a two-dimensional surface of a three-dimensional structure that has been virtually cut. In order for scans to be correctly interpreted, the viewer must understand the plane along which the section was made. A **plane** is an imaginary two-dimensional surface that passes through the body. Four planes commonly referred to the medical field are frontal (coronal), sagittal (lateral), transverse (axial), and oblique:

- **Frontal (coronal) plane:** A vertical plane running from side to side that divides the body or any of its parts into anterior and posterior portions.
- **Sagittal (lateral) plane:** A vertical plane running from front to back that divides the body or any of its parts into right and left sides. If this vertical plane runs directly down the middle of the body, it is called the **midsagittal** or **median** plane. If the plane divides the body into unequal right and left sides, it is called a **parasagittal** plane or **longitudinal** section.
- **Transverse (axial) plane:** A horizontal plane that divides the body or any of its parts into upper and lower parts. Transverse planes produce images often referred to as "cross-sections."
- **Oblique plane:** Divides the body at an angle between the horizontal and vertical planes.

See Figure 2.9[1] for an illustration of body planes.

1. "Planes_of_Body.jpg" by OpenStax is licensed under CC BY 4.0. Access for free

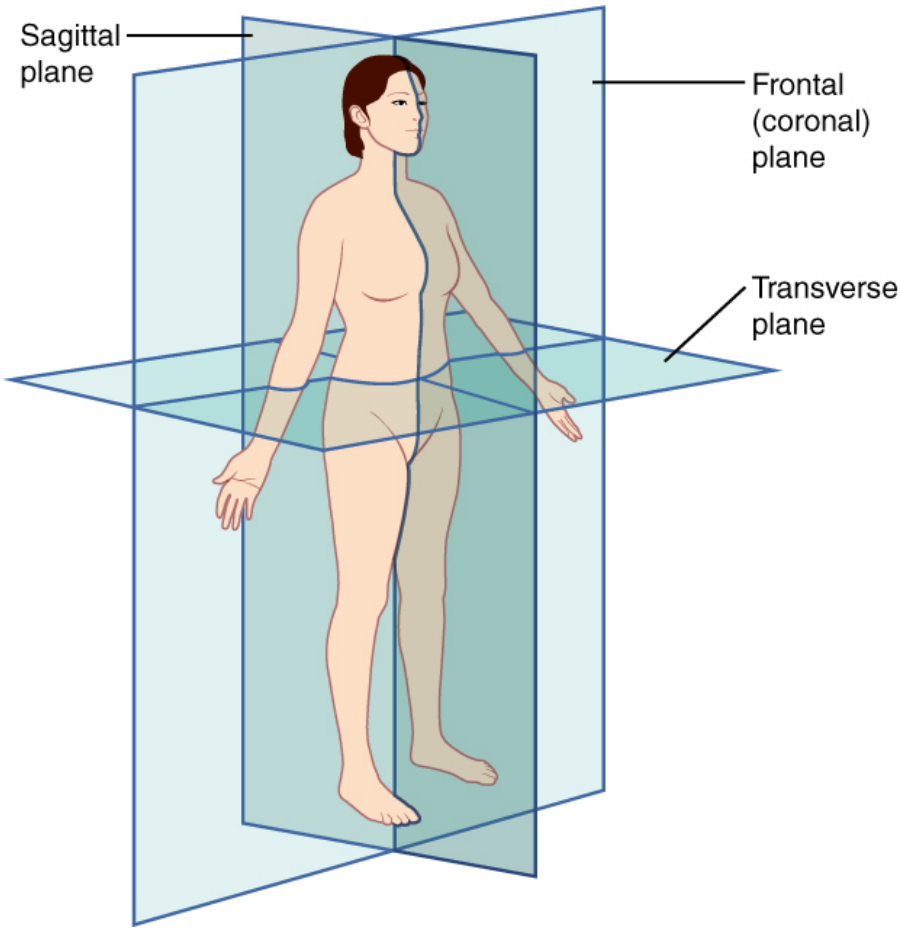

Figure 2.9 Body Planes

View a supplementary YouTube video[2] on body planes:

at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

2. RegisteredNurseRN. (2019, May 17). *Body planes and sections: Frontal, sagittal, oblique, transverse | Anatomy and Physiology*. [Video].

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/medterm/?p=105#oembed-1

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https://www.youtube.com/watch?v=0EjklfLrEW8

2.8 Medical Language Related to the Whole Body Learning Activities

Interactive Learning Activity: Practice labelling body cavities with this drag and drop activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-5

Interactive Learning Activity: Practice labelling quadrants with this drag and drop activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-7

Interactive Learning Activity: Practice labelling planes by dragging the name of the plane to its corresponding position.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-3

Interactive Learning Activity: Study terms discussed in this chapter using these flashcards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-171

Interactive Learning Activity: Quiz yourself on terms related to the human body.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-9

Interactive Learning Activity: Quiz yourself on terms related to the human body.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-162

Interactive Learning Activity: Drag and drop terms describing body planes.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-163

Interactive Learning Activity: Match opposite directional terms.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2767#h5p-164

You can also print this as a Chapter 2 Practice Worksheet and check your answers with this Answer Key PDF.

2.9 Glossary

Abdominopelvic cavity: Part of the ventral (anterior) cavity; the abdominopelvic cavity is the largest cavity in the body and houses the digestive organs, the pelvic cavity, and the reproductive organs. (Chapter 2.3)

Anatomical view of the body: A standardized view of the human body used for precise documentation and communication, in the position of standing upright with the feet at shoulder width and parallel and toes facing forward. The upper limbs are held out to each side of the body, and the palms of the hands face forward. (Chapter 2.6)

Anatomy: The structure of body systems. (Chapter 2.2)

Anterior: The front or direction toward the front of the body. For example, the kneecap is on the anterior side of the leg. (Chapter 2.6)

Bilateral: On both sides of the body. (Chapter 2.6)

Contralateral: Positioned on the opposite side. For example, the left arm and right arm are contralateral to each other. (Chapter 2.6)

Cranial cavity: Part of the dorsal (posterior) cavity that houses the brain. (Chapter 2.3)

Deep: A position or direction farther from the surface of the body. For example, the brain is deep in the skull. (Chapter 2.6)

Distal: A position in a limb that is farther from the point of attachment or the trunk of the body. For example, the hand is at the distal end of the forearm. (Chapter 2.6)

Dorsal (posterior) cavity: The body cavity that includes the cranial and spinal (vertebral) cavities. (Chapter 2.3)

Dorsum: The top of one's hand or foot. (Chapter 2.6)

Frontal (coronal) plane: A vertical plane running from side to side that divides the body or any of its parts into anterior and posterior portions. (Chapter 2.7)

Homeostasis (hō-mē-ō-STĀ-sĭs): The body's biological processes that result in stable equilibrium. (Chapter 2.2)

Inferior or caudal: A position below or lower than another part of the body;

near the coccyx or lowest part of the spinal column. For example, the pelvis is inferior to the abdomen. (Chapter 2.6)

Ipsilateral: Positioned on the same side. For example, the left arm and left leg are ipsilateral to each other. (Chapter 2.6)

Lateral: The position of lying on one's side or the direction toward the side of the body. For example, the thumb is lateral to the digits. (Chapter 2.6)

Medial: The middle or the direction toward the middle of the body. For example, the hallux is the medial toe. (Chapter 2.6)

Mucous membranes: A type of epithelial membrane that lines body cavities and their passageways that open to the external environment. Mucus, produced by epithelial exocrine glands, covers the epithelial membrane and provides protection. The digestive, respiratory, excretory, and reproductive tracts contain mucous membranes. (Chapter 2.5)

Oblique plane: Divides the body at an angle between the horizontal and vertical planes. (Chapter 2.7)

Organ systems: A group of organs that work together to perform major functions or meet the physiological needs of the body. There are eleven distinct organ systems in the human body, including the integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary, and male and female reproductive systems. (Chapter 2.2)

Palmar: The palm side of one's hand. (Chapter 2.6)

Physiology: The function of body structures. (Chapter 2.2)

Plantar: The sole side of one's foot. (Chapter 2.6)

Posterior: The back or direction toward the back of the body. For example, the shoulder blades are on the posterior side of the chest. (Chapter 2.6)

Prone: The position of lying on one's abdomen. (Chapter 2.6)

Proximal: A position in a limb that is nearer to the point of attachment or the trunk of the body. For example, the proximal end of the femur joins the pelvis. (Chapter 2.6)

Sagittal (lateral) plane: A vertical plane running from front to back that divides the body or any of its parts into right and left sides. If this vertical plane runs directly down the middle of the body, it is called the midsagittal or median plane. If the plane divides the body into unequal right and left sides, it is called a parasagittal plane or longitudinal section. (Chapter 2.7)

Serous membranes: A type of epithelial membrane that is contained in body cavities and is composed of layers. A parietal layer lines the walls of a body cavity, and a visceral layer covers the organ within the body cavity. Between the parietal and visceral layers is a thin, fluid-filled serous space. Serous membranes provide protection to the organs they enclose by reducing friction that can lead to inflammation of the organs. There are three body cavities with serous membranes, including
the pleura (lungs), pericardium (heart), and peritoneum (several organs in the abdominopelvic cavity). (Chapter 2.5)

Spinal cavity: Part of the dorsal (posterior) cavity; the spinal cavity (vertebral cavity) encloses the spinal cord and is protected by the vertebral column and cerebrospinal fluid. (Chapter 2.3)

Superficial: A position or direction closer to the surface of the body. For example, the skin is superficial to the bones. (Chapter 2.6)

Superior or cranial: A position above or higher than another part of the body. For example, the head is superior to the neck. (Chapter 2.6)

Supine: The position of lying down on one's back. (Chapter 2.6)

Synovial membranes: A type of connective tissue membrane that lines the cavities of joints that hold synovial fluid. Synovial fluid lubricates joints for movement. For example, synovial membranes surround the joints of the shoulder, elbow, and knee. (Chapter 2.5)

Thoracic cavity: Part of the ventral (anterior) cavity that is superior in position to the abdominopelvic cavity and enclosed by the rib cage. The thoracic cavity contains the lungs and the heart. (Chapter 2.3)

Transverse (axial) plane: A horizontal plane that divides the body or any of its parts into upper and lower parts. Transverse planes produce images often referred to as "cross sections." (Chapter 2.7)

Unilateral: One side of the body. (Chapter 2.6)

Ventral (anterior) cavity: The body cavity that includes the thoracic and abdominopelvic cavities. (Chapter 2.3)

PART III

CHAPTER 3 INTEGUMENTARY SYSTEM TERMINOLOGY

3.1 Integumentary System Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to the integumentary system
- Identify meanings of key word components of the integumentary system
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to the integumentary system
- Use terms related to the integumentary system
- Use terms related to the diseases and disorders of the integumentary system

Introduction to the Integumentary System

The integumentary system refers to the skin and accessory structures like hair, skin, and nails. This chapter will review common word components related to the integumentary system to assist students in learning how to analyze, build, and define terms. Other integumentary terms, whose definitions cannot be easily built from word components, will be described in context based on the anatomy and physiology of the integumentary system and common diseases and disorders. Medical specialists and procedures related to the integumentary system will also be discussed.

View the following YouTube video[1] for an introduction to the science of skin: The Science of Skin – Emma Bryce

1. TED-Ed. (2018, March 12). *The science of the skin – Emma Bryce* [Video]. YouTube. All rights reserved. https://youtu.be/OxPlCkTKhzY?si=oBrUcsTDLu2I3ivF

3.2 Word Components Related to the Integumentary System

This section will describe common word components related to the integumentary system. These word components will help you build definitions for many medical terms related to the integumentary system. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO THE INTEGUMENTARY SYSTEM

- **a-, an-**: Absence of, without, not
- **bi-**: Two or both
- **dia-**: Through, complete
- **dys-**: Difficult, painful, abnormal, labored
- **epi-**: Upon, on, over
- **hyper-**: Above, excessive
- **hypo-**: Deficient, below, under, incomplete
- **intra-**: Within, in
- **meta-**: Change, beyond, after
- **neo-**: New
- **para-**: Beside, around, beyond, abnormal
- **per-**: Through
- **pro-**: Before

- **sub-**: Under, below
- **trans-**: Through, across, beyond
- **uni-**: One

COMMON WORD ROOTS WITH A VOWEL (CALLED COMBINING FORMS) RELATED TO THE INTEGUMENTARY SYSTEM

- **aden**/o: Gland
- **adip**/o: Fat
- **albin**/o: White
- **aut**/o: Self
- **bi**/o: Life
- **coni**/o: Dust
- **cry**/o: Cold
- **crypt**/o: Hidden
- **cutane**/o: Skin
- **cyan**/o: Blue
- **derm**/o: Skin
- **dermat**/o: Skin
- **erythr**/o: Red
- **erythemat**/o: Redness
- **fibr**/o: Fibrous tissues
- **heter**/o: Other, different
- **hidr**/o: Sweat
- **kerat**/o: Hard, horny tissue, keratin
- **lei**/o: Smooth
- **leuk**/o: White
- **lip**/o, **lipid**/o: Fat
- **melan**/o: Black
- **myc**/o: Fungus

- **necr**/o: Death
- **onych**/o: Nail
- **pachy**/o: Thick
- **pil**/o: Hair
- **py**/o: Pus
- **rhytid**/o: Wrinkles
- **scler**/o: Hardening
- **seb**/o: Sebum
- **staphyl**/o: Grapelike clusters
- **steat**/o: Fat, sebum
- **strept**/o: Twisted chains
- **trich**/o: Hair
- **ungu**/o: Nail
- **xanth**/o: Yellow
- **xer**/o: Dryness, dry

COMMON SUFFIXES RELATED TO THE INTEGUMENTARY SYSTEM

- **-a**: No meaning, noun ending
- **-ad**: Toward
- **-al**: Pertaining to
- **-coccus**: Berry-shaped
- **-cyte**: Cell
- **-ectomy**: Excision
- **-gen**: Substance that produces/causes, agent that produces/causes
- **-genic**: Producing, originating, causing
- **-ia**: Condition of, diseased state, abnormal state
- **-ic**: Pertaining to
- **-ior**: Pertaining to
- **-itis**: Inflammation

- **-logist**: Specialist who studies and treats
- **-logy**: Study of
- **-malacia**: Softening
- **-megaly**: Enlarged, enlargement
- **-oid**: Resembling
- **-oma**: Tumor, swelling
- **-opsy**: View of, process of viewing, viewing
- **-osis**: Abnormal condition, increased numbers pertaining to blood
- **-ous**: Pertaining to
- **-pathy**: Disease
- **-phagia**: Eating, swallowing
- **-plasia**: Development, growth, condition of formation
- **-plasm**: Growth, substance, formation
- **-plasty**: Surgical repair
- **-rrhea**: Flow
- **-rrhage, -rrhagia:** Excessive discharge
- **-sis**: State of
- **-stasis**: Stop, controlling, standing
- **-tome**: Instrument used to cut

3.3 Examples of Integumentary Terms Easily Defined By Their Word Components

Here are examples of integumentary medical terms that can be easily defined by breaking them into word components.

Dermatologist

1. Break down the medical term into word components: **Dermat/o/logist**
2. Label the word parts: **Dermat** = WR; **o** = CV; **logist** = S
3. Define the word components: **Dermat** = skin; **logist** = specialist who studies and treats disorders
4. Create a final definition of the medical term: **A specialist who studies and treats disorders of the skin**

Epidermal

1. Break down the medical term into word components: **Epi/derm/al**
2. Label the word parts: **Epi** = P; **derm** = WR; **al** = S

3. Define the word components: **Epi** = upon/on; **derm** = skin; **al** = pertaining to
4. Create a final definition of the medical term: **Pertaining to upon/on the skin**

Hypodermic

1. Break down the medical term into word components: **Hypo/derm/ic**
2. Label the word parts: **Hypo** = P; **derm** = WR; **ic** = S
3. Define the word components: **Hypo** = below; **derm** = skin; **ic** = pertaining to
4. Create a final definition of the medical term: **Pertaining to below the skin**

Onychomycosis

1. Break down the medical term into word components: **Onych/o/myc/osis**
2. Label the word parts: **Oncyh** = WR; **o** = CV; **myc** = WR; **osis** = S
3. Define the word components: **Onych** = nail; **myc** = fungus; **osis** = abnormal condition
4. Create a final definition of the medical term: **Abnormal condition of a fungus in the nails**

Interactive Learning Activity: Practice pronouncing and defining medical terms related to the integumentary system by breaking them into word components.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2955#h5p-21

You can also print this as a Chapter 3 Student Companion Worksheet and check your answers with this Answer Key.

3.4 Anatomy and Physiology of the Integumentary System

This section will provide a general overview of the anatomy and physiology of the integumentary system.

ANATOMY OF THE INTEGUMENTARY SYSTEM

The skin and its accessory structures make up the integumentary system, which provides the body with overall protection. The skin is made of multiple layers of cells and tissues, which are held to underlying structures by connective tissue. The skin is composed of three main layers: the epidermis, dermis, and hypodermis.[1] See Figure 3.1[2] for an illustration of the three main layers of the skin and other anatomical structures.

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2. "501_Structure_of_the_skin.jpg" by J. Gordon Betts, et al., for OpenStax is licensed under CC BY 4.0

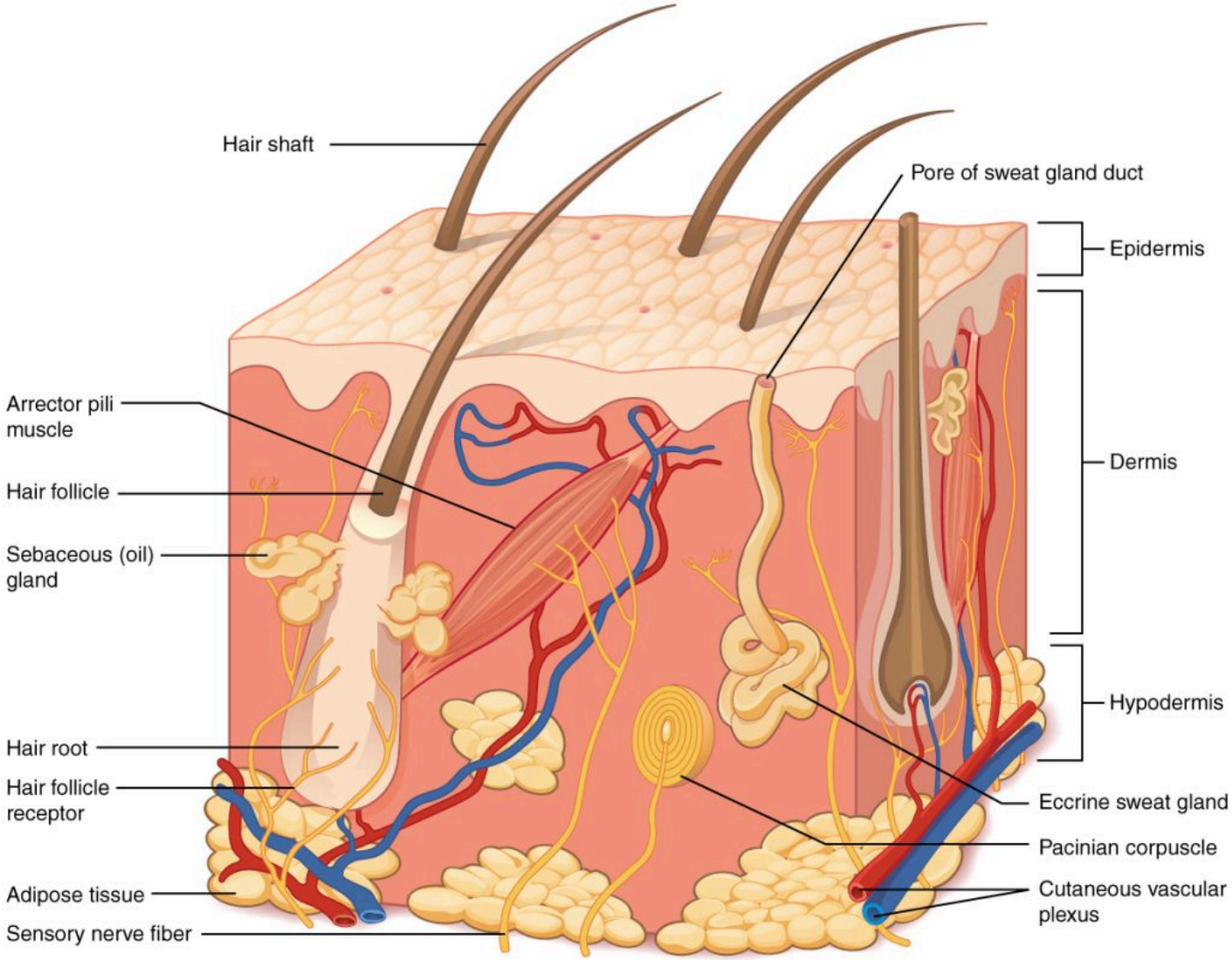

Figure 3.1 Layers of the Skin

The **epidermis** (ĕp-ī-DUR-mĭs) is the outermost layer of skin. It is composed of keratinized epithelium. **Keratin** (kĕr-ă-TIN) is an intracellular fibrous protein that gives hair, nails, and skin their hardness and water-resistant properties. The keratinocytes in the epithelium are dead and regularly slough away, being replaced by cells from the deeper layers. **Melanocytes** (MĚL-ăn-ō-sīts) are melanin-producing cells located in the

bottom layer of epidermis. Melanin is a dark pigment primarily responsible for skin color.[3]

The **dermis** (DĚR-mĭs) lies under the epidermis. It contains blood and lymph vessels, nerves, and other structures, such as hair follicles and sweat glands.

The **hypodermis** (hī-pō-DUR-mĭs), also referred to as **subcutaneous** (sub-kū-TĀ-nē-us) tissue, is the layer underneath the dermis. It consists of connective tissue that is **vascularized** (VĂS-kū-lə-rīzd) (i.e., provided with blood vessels) and **adipose** (AD-ĭ-pōs) tissue. Adipose tissue serves as fat storage and provides insulation and cushioning. **Elastin** (ĭ-LĀS-tĭn) is a protein in this connective tissue that makes skin stretchy. The hypodermis connects the skin to the underlying bones and muscles, referred to as the **fascia** (FASH-ē-ă). The underlying hypodermis has important roles in storing fats, forming a "cushion" over underlying structures and providing insulation from cold temperatures.[4]

ACCESSORY STRUCTURES

Accessory structures of the skin include hair, nails, sweat glands, and sebaceous glands.

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Hair

Hair is a keratinous filament growing out of the epidermis. It is primarily made of dead, keratinized cells. Strands of hair originate in the dermis in a structure called the hair follicle. The hair shaft is the part of the hair not anchored to the follicle, and much of this is exposed at the skin's surface. The rest of the hair, which is anchored in the follicle, lies below the surface of the skin and is referred to as the hair root.[5]

Each hair root is connected to a smooth muscle called the arrector pili that contracts in response to nerve signals from the **sympathetic nervous system** (sĭm-pă-THĔT-ĭk NĔR-vŭs SIS-tĕm). These signals make the external hair shaft "stand up," commonly referred to as "goose bumps." The primary purpose for this response is to trap a layer of air to add insulation and warmth.[6] See Figure 3.2[7] for an illustration of hair.

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7. "506_Hair.jpg" by OpenStax is licensed under CC BY 4.0

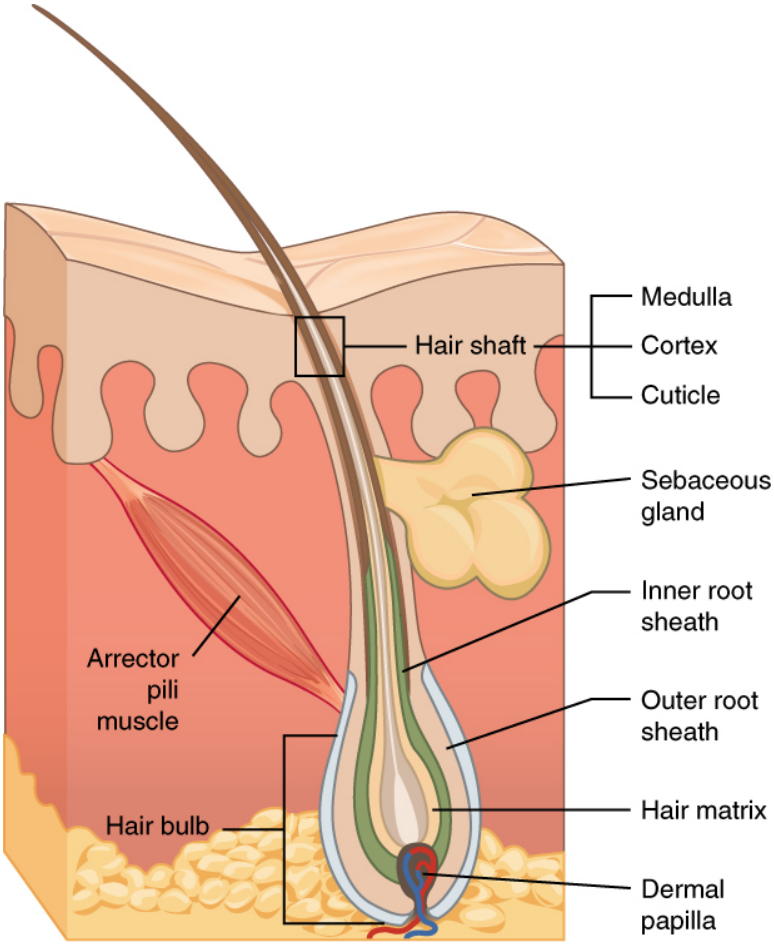

Figure 3.2 Hair

Hair serves a variety of functions, including protection, sensory input, thermoregulation, and communication. For example, hair in the nose and ears and around the eyes (eyelashes) defends the body by trapping and excluding dust particles that may contain allergens and microbes.[8]

Hair grows and is eventually shed and replaced by new hair. Hair loss occurs if there is more hair shed than what is replaced and can happen due to hormonal or dietary changes. Hair loss can also result from the aging process

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or the influence of hormones. **Alopecia** (ăl-ō-PĒ-shē-ă) is the medical term for hair loss in areas where hair normally grows. Conversely, **hirsutism** (HUR-sū-tĭz-əm) is the medical term for excessive hair growth in areas where hair is usually minimal or absent.

Similar to the skin, hair gets its color from the pigment melanin, and different hair color results from differences in the type of melanin. As a person ages, the melanin production decreases, and hair tends to lose its color and becomes gray and/or white.[9]

Dandruff (DĂN-drŭf) refers to flakes of dead skin from the scalp.

Nails

The nail bed is a specialized structure of the epidermis that is found at the tips of the fingers and toes. The nail body is formed on the nail bed and protects the tips of our fingers and toes as they are the farthest extremities and the parts of the body that experience the maximum mechanical stress. The term **cuticle** (KYŪ-tĭ-kĭl) refers to the protective layer of skin at the base of a nail.[10] See Figure 3.3[11] for an illustration of nails.

The nail body is composed of densely packed dead keratinocytes. The nail body forms a back support for picking up small objects with the fingers. The nail bed is rich in blood vessels, making it appear pink, except at the base,

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11. "507_Nails.jpg" by OpenStax is licensed under CC BY 4.0

where a thick layer of epithelium over the nail matrix forms a crescent-shaped region called the lunula.[12]

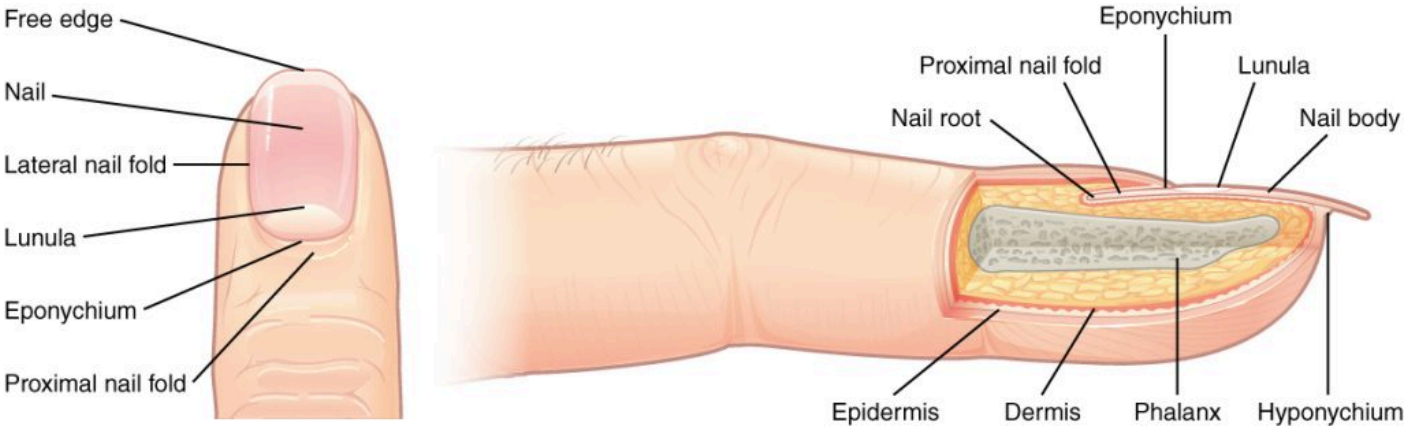

Figure 3.3 Nails

Onycholysis (ŏn-ĭ-KOL-ĭ-sĭs) refers to the separation of a fingernail or toenail from its nail bed. **Onychophagia** (ŏn-ĭ-KOF-ă-jē-ă) refers to the habit of biting one's nails.

Sweat Glands

When the body becomes warm, sweat glands produce sweat to cool the body. There are two types of sweat glands called eccrine sweat glands and apocrine sweat glands, each secreting slightly different products.

An **eccrine sweat gland** (ĔK-rĭn swĕt glănd) is type of gland that produces sweat for thermoregulation, as previously described in this section. These glands are found all over the skin's surface but are especially abundant on the palms of the hand, the soles of the feet, and the forehead. This type of sweat is

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composed mostly of water and some salt.[13] See Figure 3.4[14] for an illustration of an eccrine sweat gland.

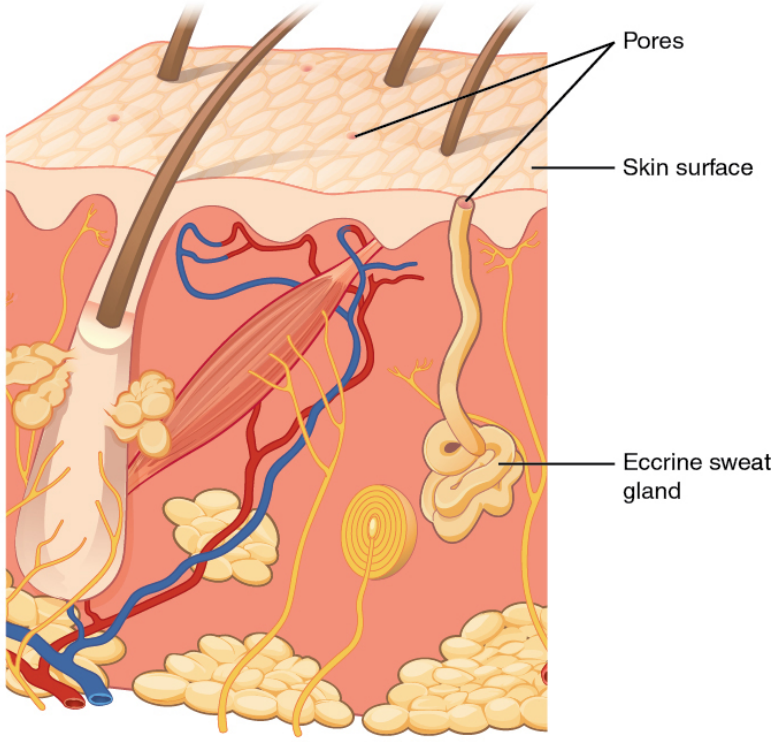

Figure 3.4 Eccrine Gland

Apocrine sweat glands (AP-ŏ-krĕn swĕt glănds) are found in hair follicles in densely hairy areas, such as the armpits and genital regions. In addition to water and salt, apocrine sweat glands release organic compounds that make the sweat thicker and subject to bacterial decomposition, resulting in odor. The release of apocrine sweat is controlled by hormones and the nervous system. Most commercial antiperspirants use an aluminum-based compound

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14. "508_Eccrine_gland.jpg" by OpenStax is licensed under CC BY 4.0

as their primary active ingredient to stop sweat. When the antiperspirant enters the sweat gland duct, the aluminum-based compounds physically block the duct and prevent sweat from coming out of the pore.[15]

Anhidrosis (ăn-hī-DRŌ-sĭs) is the medical term used for the absence of sweat production. **Hyperhidrosis** (hī-pĕr-hī-DRŌ-sĭs) is the medical term used for excessive sweating.

Sebaceous Glands

A **sebaceous gland** (sē-BĀ-shŭs glănd) is a type of oil gland that lubricates and waterproofs the skin and hair. Most sebaceous glands are associated with hair follicles. They generate and excrete sebum, a mixture of lipids, onto the skin surface, thereby naturally lubricating the dry and dead layer of keratinized cells. The fatty acids of sebum also have antibacterial properties and prevent water loss from the skin in low humidity environments. The secretion of sebum is stimulated by hormones, many of which do not become active until puberty. Thus, sebaceous glands are relatively inactive during childhood.[16]

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PHYSIOLOGY OF THE INTEGUMENTARY SYSTEM

The skin and accessory structures perform a variety of these essential functions[17]:

- Protecting the body from invasion by microorganisms, chemicals, and other environmental factors
- Acting as a sensory organ
- Modulating body temperature and electrolyte balance
- Synthesizing vitamin D

Protection

The skin protects the body from wind, water, and ultraviolet (UV) light. It acts as a protective barrier against excessive water loss referred to as **dehydration** (dē-hī-DRĀ-shŏn). It is also the first line of defense against abrasive activity such as grit, microbes, or harmful chemicals. Sweat excreted from sweat glands also deters microbes from overcolonizing the skin surface.[18]

Sensory Function

The epidermis, dermis, and the hypodermis contain specialized sensory nerve

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structures that detect touch, surface temperature, and pain. These receptors are concentrated on the tips of the fingers, which are very sensitive to touch.[19]

Thermoregulation

The integumentary system helps regulate body temperature in association with the sympathetic nervous system. The sympathetic nervous system is continuously monitoring body temperature and initiating appropriate motor responses.[20]

When the body becomes excessively warm, sweat glands secrete water, salt, and other substances to cool the body. Even when the body does not appear to be noticeably sweating, approximately 500 mL of sweat are secreted a day. This amount can greatly vary depending on the person's metabolic rate, physical activity, heat exposure, and medical condition. When the sweat evaporates from the skin surface, the body is cooled as body heat is dissipated. In addition to sweating, small blood vessels called arterioles in the dermis dilate so that excess heat carried by the blood can dissipate through the skin and into the surrounding environment.[21]

When body temperatures drop, the arterioles constrict to minimize heat loss, particularly in the ends of the fingers and toes and the tip of the nose. This constriction reduces blood flow to the skin to prevent the loss of heat and keep the internal organs warm. It can cause the skin to take on a whitish hue.

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If the temperature of the skin drops too much (such as in environmental temperatures below freezing), the conservation of body core heat can result in **frostbite** (FROST-bīt).[22] See Figure 3.5[23] for illustrations demonstrating thermoregulation.

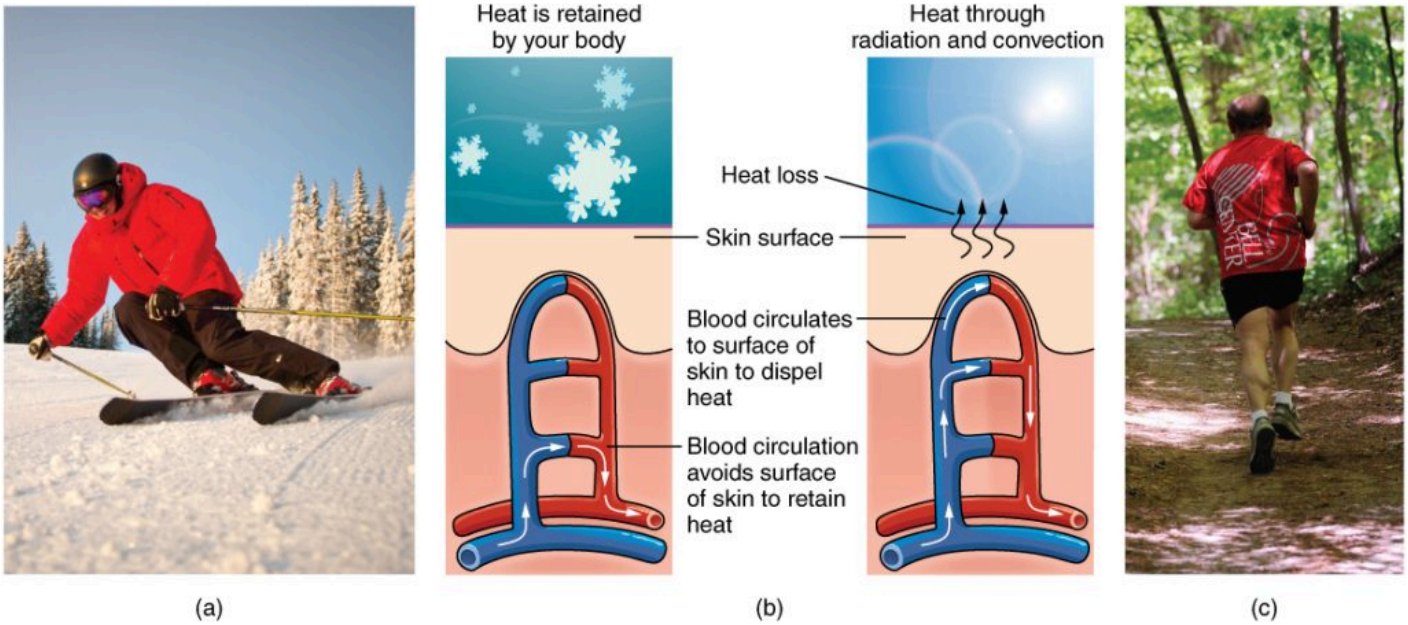

Figure 3.5 Thermoregulation

Medical conditions can cause excessive, profuse sweating referred to as **diaphoresis** (dī-ă-fŏ-RĒ-sĭs). For example, a significant symptom of a heart attack, in addition to chest pain, is diaphoresis.

Vitamin D Synthesis

The epidermal layer synthesizes vitamin D when exposed to UV light. Vitamin

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23. "515_Thermoregulation.jpg" by OpenStax is licensed under CC BY 4.0

D is essential for normal absorption of calcium and phosphorous, which are required for healthy bones. In addition to its essential role in bone health, vitamin D is essential for general immunity against bacterial, viral, and fungal infections. Significant absence of sun exposure can lead to a lack of vitamin D in the body called **rickets** (RIK-ĕts). For this reason, vitamin D is added as a supplement to many foods, including milk and orange juice.[24]

CHANGES IN THE INTEGUMENTARY SYSTEM DUE TO AGING

All body systems change as a person ages. In the skin, older adults develop a thinner epidermis. Additionally, the dermis, responsible for the elasticity and resilience of the skin, exhibits a reduced ability to regenerate, which leads to slower wound healing. The hypodermis, with its fat stores, loses structure due to the reduction and redistribution of fat, which, in turn, contributes to the thinning and sagging of skin.[25] See Figure 3.6[26] for an illustration of these signs of aging skin.

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26. "516_Aging.jpg" by OpenStax is licensed under CC BY 4.0

Figure 3.6 Signs of Aging Skin

The accessory structures also have lowered activity, generating thinner hair and nails and reduced amounts of sebum and sweat. A reduced sweating ability creates a risk for older adults in extreme heat. Other cells in the skin, such as melanocytes and dendritic cells, also become less active, leading to a paler skin tone and lowered immunity.[27]

View the following supplementary YouTube video[28] to

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28. CrashCourse. (2015, February 16). *The integumentary system, Part 2 –*

review the anatomy and physiology of the integumentary system: The Integumentary System, Part 2 – Skin Deeper: Crash Course A&P #7

Skin deeper: Crash Course Anatomy & Physiology #7 [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=EN-x-zXXVwQ

3.5 Diseases, Disorders, and Injuries of the Integumentary System

This section will provide a general overview of diseases, disorders, and injuries of the integumentary system.[1]

ACNE

Acne (AK-nē) is a skin condition characterized by inflamed or infected sebaceous glands in the skin, particularly on the face and back. Sebaceous glands (oil glands) produce sebum (an oily substance). An accumulation of sebum and keratin blocks hair follicles, resulting in acne. Acne is common

1. Unless otherwise indicated, this chapter contains material adapted from Anatomy and Physiology (on OpenStax), by Betts, et al. and is used under a CC BY 4.0 international license. Download and access this book for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

during puberty due to associated hormonal changes. Severe acne can cause scarring.[2] See Figure 3.7[3] for an image of acne.

Figure 3.7 Acne

BENIGN GROWTHS

Benign (bē-NĪN) growths or tumors are not cancerous and do not spread to other parts of the body like cancer does, but they may require removal. Examples of benign tumors in the integumentary system are **dermatofibroma** (dĕr-mă-tō-fī-BRŌ-mă), a firm, nodular growth on the skin, and **lipoma** (lī-PŌ-mă), a fatty tissue tumor.

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3. "Acne vulgaris on a very oily skin.jpg" by Roshu Bangal is licensed under CC BY-SA 4.0

BURNS

A **burn** (bûrn) results when the skin is damaged by intense heat, radiation, electricity, or chemicals. Burns can lead to a massive fluid loss due to loss of protection against dehydration by the skin. Burned skin is also extremely susceptible to infection due to the loss of protection against pathogens by the skin.

Burns were traditionally classified by their degree of severity as first-degree, second-degree, third-degree, and fourth-degree burns. This historic classification of burns has been replaced by a system reflecting the need for surgical intervention. They are referred to as superficial, superficial partial-thickness, deep partial-thickness, and full-thickness burns:

- A **first-degree burn**, now referred to as a superficial burn, only affects the epidermis. Although the skin may be painful and swollen, these burns typically heal on their own within a few days. Mild sunburn fits into the category of a first-degree burn.
- A **second-degree burn**, now referred to as a partial thickness burn, affects both the epidermis and a portion of the dermis. These burns result in swelling and a painful blistering of the skin. It is important to keep the burn site clean to prevent infection. With good care, a second-degree burn will heal within several weeks.
- A **third-degree burn**, now referred to as a full-thickness burn, extends fully into the epidermis and dermis, destroying the tissue and affecting the nerve endings and sensory function. These are serious burns that require immediate medical attention.
- A **fourth-degree burn**, now referred to as a deep full-thickness burn, is even more severe, affecting the underlying muscle and bone.

Full-thickness burns require **debridement** (di-BRĒD-mĕnt), surgical removal of dead tissue, followed by grafting skin from an unaffected part of the body

or from skin grown in tissue culture.[4] See Figure 3.8[5] for an image of a patient recovering from a second-degree burn on the hand.

Figure 3.8 Recovering Second-Degree Burn

Severe burns are quickly measured in emergency departments using a tool called the "**Rule of Nines**," which associates specific anatomical locations with a percentage of the body that is a factor of nine. Rapid estimate of the burned surface area is used to estimate the amount of intravenous fluids needed to

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5. "1Veertje hand-burn-do8.jpg" by 1Veertje is licensed under CC BY-SA 3.0

replace fluid loss.[6] See Figure 3.9[7] for an illustration of the Rule of Nines. Using the Rule of Nines, the head is calculated as 9%, the upper limbs are 9% (4.5% on each side), the lower limbs are 18% (9% on each side), and the trunk is 36% (18% on each side), and the perineum/genitalia is 1%.

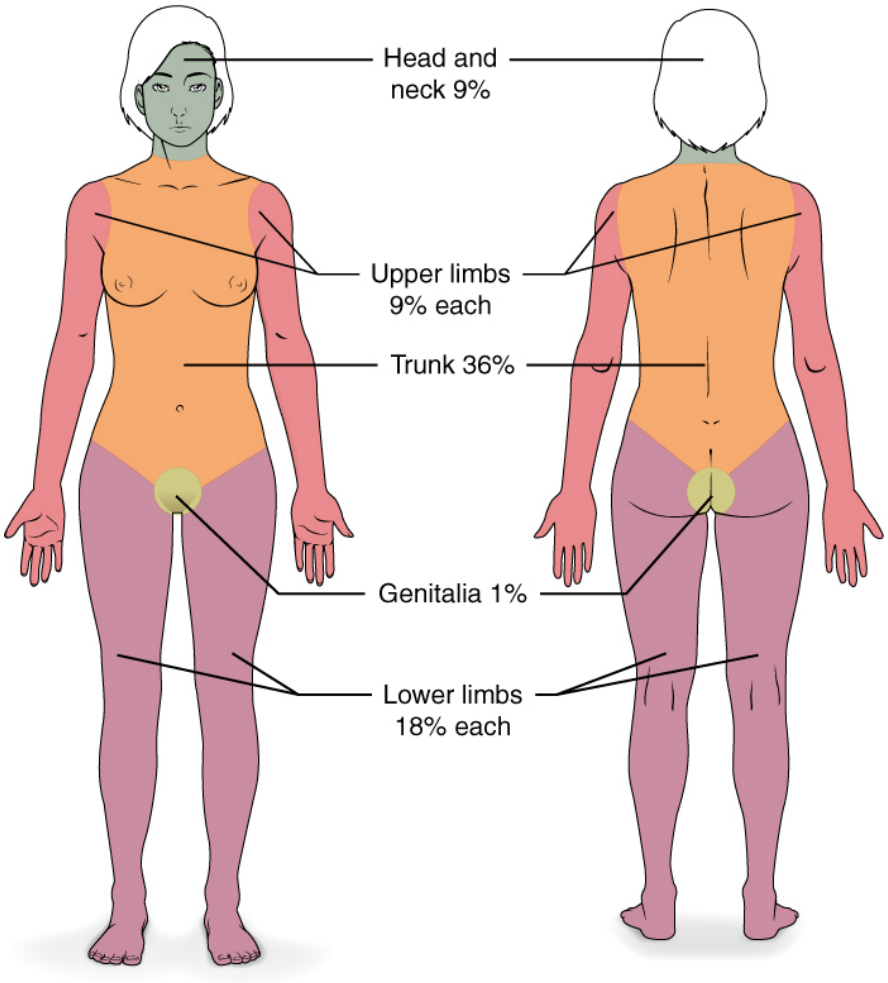

Figure 3.9 Rule of Nines

6. This work is a derivative of StatPearls by Moore, Waheed, and Burns and is licensed under CC BY 4.0

7. "513 Degree of burns.jpg" by OpenStax is licensed under CC BY 3.0

ECZEMA

Eczema (eg-ZĒ-mă) is an allergic, inflammatory condition that manifests as dry, itchy patches of skin that resemble a red, flaky rash. It can occur in individuals of all ages. See an image of eczema in Figure 3.10.[8] Eczema may be accompanied by swelling of the skin, flaking, and, in severe cases, bleeding. Symptoms are usually managed with moisturizers, corticosteroid creams, and immunosuppressant medication.

Figure 3.10 Eczema

EDEMA

Edema (ĕ-DĒ-mă) is caused by fluid accumulation within the tissues often caused by underlying cardiovascular or renal disease. **Lymphedema** (lim-fĕ-DĒ-mă) is the medical term for a type of swelling that occurs when lymphatic

8. "Eczema-arms.jpg" by Jambula at English Wikipedia is licensed in the Public Domain.

fluid builds up in the body's soft tissues due to damage to the lymph system. It often occurs unilaterally in the arms or legs after surgery has been performed that injured the regional lymph nodes. See Figure 3.11[9] for an image of lymphedema. Causes of lymphedema include infection, cancer, scar tissue from radiation therapy, surgical removal of lymph nodes, or inherited conditions. There is no cure for lymphedema, but elevation of the affected extremity is vital. Compression devices and massage can help to manage the symptoms.

Figure 3.11 Lymphedema

INFECTIONS

An **infection** (in-FEK-shŏn) is caused by the invasion and multiplication of microorganisms in the body, such as **bacteria** (bak-TĒR-ē-a), viruses, fungi,

9. "Lymphedema_limbs.JPG" by medical doctors is licensed under CC BY-SA 4.0

and parasites. Microorganisms that cause infection are referred to as **pathogens** (path-Ŏ-jĕns).

Bacterial Infections

Bacterial skin infections are commonly caused by ***Staphylococcus*** (staf-ĭ-lō-KOK-ŭs) or ***Streptococcus*** (strep-tŏ-KOK-ŭs) bacteria. **Methicillin-resistant Staphylococcus aureus** (mĕth-ĭ-SĬL-ĭn rĕ-zĭs-tănt STĂF-ə-lō-KŌK-ŭs OWR-ē-ŭs) **(MRSA)** is a staph infection that is resistant to common antibiotics. There are two types of MRSA, referred to as community-acquired and hospital-acquired. **Hospital-acquired MRSA (HA-MRSA)** is diagnosed in people who acquired the infection while in the hospital or other health care setting and undergoing treatment for another medical condition. People in the hospital are at higher risk of becoming infected with MRSA because they often have breaks in their skin due to surgical wounds or intravenous lines (IVs) that allow bacteria to enter. **Community-acquired MRSA (CA-MRSA)** is a MRSA infection that is diagnosed in individuals outside of a hospital setting. It tends to occur in individuals who have had close skin-to-skin contact with another person with CA-MRSA. Different antibiotics are used to effectively treat HA-MRSA and CA-MRSA.

Bacterial infections often cause the development of pus. **Pus** (PŬS) is a thick, opaque yellow or green fluid produced in infected tissue, consisting of dead white blood cells, bacteria, and tissue debris. A **boil** (BOIL) is a painful, pus-filled bump that forms under the skin, often caused by an infected hair follicle. An **abscess** (ĂB-sĕs) is a swollen area within body tissue, containing an accumulation of pus.

Impetigo (ĭm-pĕ-TĪ-gō) is a contagious bacterial skin infection forming pustules and yellow, crusty sores, typically found in children between the ages of two and six. A **pustule** (PŬS-tūl) is a small blister or pimple on the skin that contains pus. See Figure 3.12[10] for an image of impetigo. Impetigo often starts when bacteria enter a break in the skin, such as a cut, scratch, or insect bite. Symptoms start with red or pimple-like sores surrounded by red skin. The

10. "Impetigo2020.jpg" by James Heilman, MD is licensed under CC BY-SA 4.0

sores fill with pus and then break open after a few days and form a thick crust. They are often itchy but scratching them can spread the sores. Impetigo can spread by contact with sores or nasal discharge from an infected person and is treated with antibiotics.

Figure 3.12 Impetigo

Cellulitis (sĕl-yū-LĪ-tĭs) is a bacterial infection of the skin and subcutaneous tissue, characterized by redness, pain, heat, and swelling. Untreated cellulitis can become severe and spread throughout the body.

Viral Infections

Viruses are contagious and are easily spread among individuals. They can cause several different types of skin infections. A **virus** (VĪ-rŭs) is a microorganism that spreads infection by invading the body's cells and replicating. For example, a **wart** (WART), also referred to as a **verruca** (vĕr-ROO-kă), is a small benign growth on the skin caused by a virus.

Genital warts are caused by **human papillomavirus** (hyū-măn pap-ĭ-lō-mă-VĪ-rŭs) **(HPV)**, the most common sexually transmitted infection in the United States. Genital warts appear as a small bump or group of bumps in the genital or anal area. They can be small or large, raised or flat, or shaped like a cauliflower. In some individuals, HPV can progress to cancer. HPV can cause

cervical, throat, and other cancers. HPV vaccines help prevent some of the health effects HPV causes.[11]

Shingles (SHING-gĭlz) is a viral disease that causes painful rashes on the skin. Shingles is caused by the varicella-zoster virus, the same virus responsible for chickenpox. A vaccine is available to prevent shingles and is recommended for adults over age 50 or for individuals with compromised immune systems.

Fungal and Yeast Infections

Tinea (TIN-ē-ă) is the name of a group of skin infections caused by a fungus. These infections are usually not serious, but they can be uncomfortable because of the symptoms of itching and burning. They can be transmitted by touching other people's infected areas, damp surfaces such as shower floors, or even from pets.[12]

Tinea infections are commonly referred to as ringworm, athlete's foot, and jock itch. Ringworm or **tinea corporis** (TĪ-nē-ă KŌR-pŏ-rĭs) is a type of rash that forms on the body that typically looks like a red ring with a clear center, although a worm doesn't cause it. Scalp ringworm or **tinea capitis** (TĪ-nē-ă KĂP-ĭ-tĭs) causes itchy, red patches on the head that can leave bald spots. Athlete's foot or **tinea pedis** (TĪ-nē-ă PĚD-ĭs) causes itching, burning, and cracked skin between the toes. Jock itch or **tinea cruris** (TĪ-nē-ă KRŌŏ-rĭs) causes an itchy, burning rash in the groin area. Fungal infections are often

11. Centers for Disease Prevention and Control. (2022, April 14). *Genital HPV infection – Basic fact sheet*. https://www.cdc.gov/std/hpv/stdfact-hpv.htm#:~:text=Human%20papillomavirus%20(HPV)%20is%20the,answers%20basic%20questions%20about%20HPV

12. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2020, Aug 17]. Tinea infections; [reviewed 2016, Apr 4; cited 2020, Sep 18]. https://medlineplus.gov/tineainfections.html#:~:text=Tinea%20is%20the%20name%20of,or%20even%20from%20a%20pet

treated successfully with over-the-counter creams and powders. See Figure 3.13[13] for an image of a tinea in a patient's groin.[14]

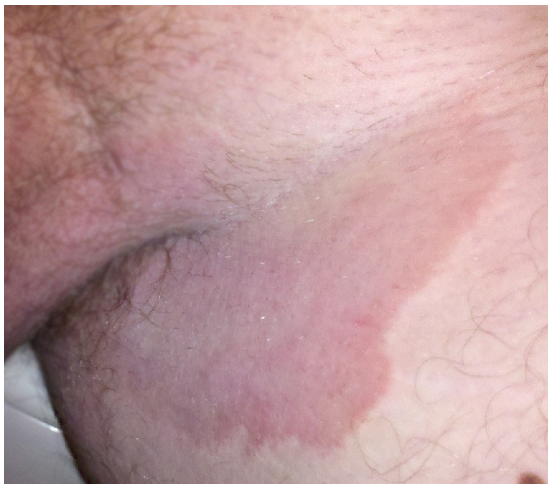

Figure 3.13 Fungal Infection in the Groin

Fungal infections of nails are referred to as **onychomycosis** (ŏn-ī-kō-mī-KŌ-sĭs).

Yeast infections (YĒST ĭn-FĕK-shŭns) are commonly caused by *Candida*, a type of fungus. *Candida* normally lives on people's skin and inside their body without causing problems. However, C*andida* can cause yeast infections if it grows out of control. It can be caused by antibiotics that kill the normal flora on the skin or by diseases that reduce an individual's immune response.

13. "Tinea cruris.jpg" by Robertgascoin is licensed under CC BY-SA 3.0

14. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2020, Aug 17]. Tinea infections; [reviewed 2016, Apr 4; cited 2020, Sep 18]. https://medlineplus.gov/tineainfections.html#:~:text=Tinea%20is%20the%20name%20of,or%20even%20from%20a%20pet

Read additional information about tinea at the Centers for Disease Control and Prevention's web page on fungal infections.

Lice

Head lice are tiny insects that live on a person's head. **Pediculosis** (pĕd-ĭ-kū-LŌ-sĭs) refers to a lice infection/infestation. Adult lice are about the size of a sesame seed, but the eggs, called nits, are smaller and can appear like a dandruff flake. See Figure 3.14[15] for an image of very small white nits in a person's hair.

Children ages 3-11 often get head lice at school or daycare because they have head-to-head contact while playing together. Lice move by crawling and spread by close person-to-person contact. Rarely, they can spread by sharing personal belongings such as hats or hairbrushes. Contrary to popular belief, personal hygiene and cleanliness have nothing to do with getting head lice. Symptoms of head lice include the following:

- Tickling feeling in the hair
- **Pruritus** (prū-RĪ-tŭs) or severe itching caused by an allergic reaction to the bites
- Sores from scratching, which can become infected with bacteria
- Trouble sleeping due to head lice being most active in the dark

Head lice are diagnosed after the observation of one live louse on a person's head. Because they are very small and move quickly, a magnifying lens and a fine-toothed comb may be needed to find lice or nits. Treatments for head

15. "Fig.5. Louse nites.jpg" by KostaMumcuoglu at English Wikipedia is licensed under CC BY-SA 3.0

lice include over-the-counter and prescription shampoos, creams, and lotions such as permethrin lotion.[16]

Figure 3.14 Nits

Scabies

Scabies (SKĀ-bēz) is an infection caused by tiny mites that burrow into the skin, leading to intense pruritis (itching).

INJURIES

There are many types of injuries that can occur to the skin:

16. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2020, Aug 17]. Head lice; [reviewed 2016, Sep 9; cited 2020, Sep 18]. https://medlineplus.gov/headlice.html

- An **abrasion** (ă-BRĀ-zhŏn) is an area of skin damaged by scraping or wearing away. See Figure 3.15[17] for an image of an abrasion.
- A **blister** (BLIS-tĕr) is a raised portion of the skin in which the epidermis becomes lifted up off the dermis and is filled with fluid. Blisters are typically caused by friction, burns, or other damage.
- A **bulla** (BOO-la) is a large blister.
- A **bruise** (BRŪZ), also referred to as a **contusion** (kŏn-TOO-zhŏn), is an injury appearing as an area of discolored skin on the body, caused by a blow or impact rupturing underlying blood vessels.
- A **laceration** (las-ĕ-RĀ-shŏn) is a deep cut or tear in skin and/or tissue.
- A skin **ulcer** (UL-sĕr) is an open sore on the body that is often slow to heal and prone to infection. There are many potential causes of ulcers, such as pressure injures and lack of blood flow from diabetes.
- **Calluses** (KĂL-ū-ses) are thick, hardened layers of skin that develop when the skin tries to protect itself against friction or pressure. For example, calluses can often form on fingers if they are subjected to constant mechanical stress, such as long periods of writing with a pencil or playing string instruments. A **corn** is a specialized form of callus that develops on the tops and sides of toes and can be painful.

17. "Abrasion_wound_on_arm.jpg" by ProjectManhattan is licensed under CC BY-SA 3.0

Figure 3.15 Abrasion

Pressure Injuries

Pressure injuries, formerly referred to as pressure ulcers or bedsores, form when a patient's skin and soft tissue press against a hard surface for a prolonged period of time. The pressure against a hard surface reduces blood supply to that area, causing damage to the skin tissue and possible ulcers. Patients are at high risk of developing a pressure injury if they spend a lot of time in one position without moving or have decreased sensation, poor nutrition, or bladder or bowel leakage.[18] See Figure 3.16[19] for an image of a pressure ulcer injury on the back of a patient who is bed-bound due to chronic illness. Pressure injuries are most common in patients who have debilitating conditions that cause them to be immobile. Nurses and other

18. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2020. Preventing pressure ulcers; [updated 2020, Sep 16; cited 2020, Sep 18]. https://medlineplus.gov/ency/patientinstructions/000147.htm

19. "Decubitus 01.jpg" by AfroBrazilian is licensed under CC BY-SA 3.0

health care professionals reposition immobile patients every few hours to prevent the formation of pressure injuries.

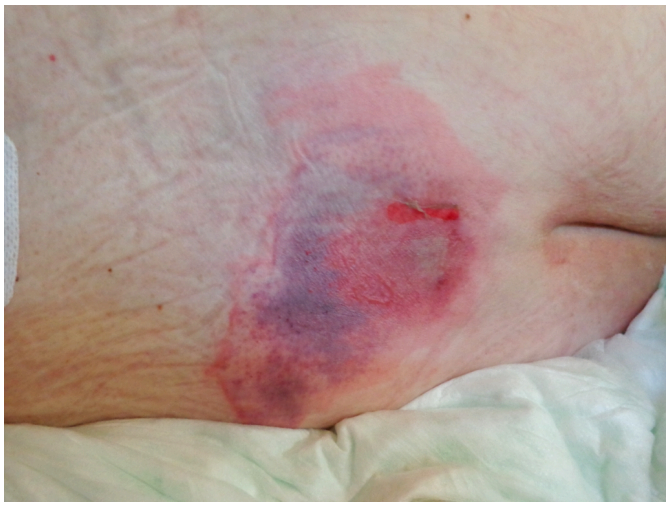

Figure 3.16 Pressure Ulcer Injury

For additional information and images of pressure injuries, go to the "Pressure Injuries" section of the "Integumentary" chapter in Open RN *Nursing Fundamentals*.

PSORIASIS

Psoriasis (sō-RĪ-ə-sĭs) is a skin condition marked by red, itchy, scaly patches found on the elbows, knees, scalp, low back, face, feet, fingernails, toenails,

and even the mouth. Treatments may include creams, ointments, ultraviolet light therapy, and medication.[20]

RASHES

A **rash** is an area of redness and small spots appearing on the skin due to allergy or illness. There are different types of rashes that may occur, each with different appearances and causes. Terms used to describe rashes include the following:

- **Macule** (MAK-ūl): A flat, discolored spot on the skin.
- **Papule** (PAP-ūl): A small, raised, solid bump.
- **Vesicle** (VES-ĭ-kĭl): A small, fluid-filled sac or blister within or under the epidermis.
- **Urticaria** (ur-tĭ-KĀR-ē-ă): Raised, itchy welts on the skin, also known as hives. A **wheal** refers to an individual hive.

Dermatitis (dûr-mă-TĪ-tĭs) is inflammation of the skin that can cause a rash. A common type of dermatitis is called contact dermatitis, caused by contact with a substance that causes an allergic reaction. For example, allergic skin reactions caused by latex allergy or poison ivy are examples of contact dermatitis. **Dermatoconiosis** (dûr-mă-tō-kō-nē-Ō-sĭs) is a type of dermatitis caused by dust contacting the skin.

Systemic lupus erythematosus (sis-TĚM-ik LOO-pŭs ĕr-i-thē-mă-TO-sŭs) **(SLE)**, commonly referred to as **lupus** (LOO-pŭs), is an autoimmune disease in which the immune system recognizes its own cell antigens as being "non-self" and mounts an immune response against them. As a result, skin, body

20. Centers for Disease Control and Prevention. (2018, October 25). *Psoriasis*. Centers for Disease Control and Prevention: Fungal Diseases. https://www.cdc.gov/psoriasis/

tissues, and vital organs become chronically inflamed and damaged. A common sign of lupus is a facial rash that resembles the wings of a butterfly unfolding across both cheeks. See Figure 3.17[21] for an image of a butterfly rash associated with lupus.

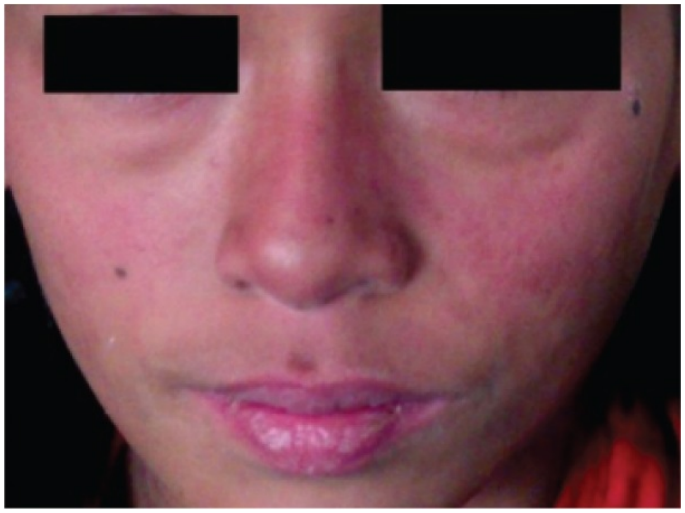

Figure 3.17 Butterfly Rash Associated With Lupus

Petechiae (pĕ-TĒK-ē-ī) are tiny red dots that can be mistaken as a rash but are actually caused by bleeding under the skin. Large petechiae are called **purpura** (PUR-pyŏŏ-ră). An easy method used to assess for petechiae is to apply pressure to the rash with a gloved finger. A rash will blanch (i.e., whiten with pressure), but petechiae and purpura do not blanch. See Figure 3.18[22] for an image of petechiae and purpura. New onset of petechiae should be

21. "Butterfly_rash_of_lupus_erythematosus.jpg" by CNX OpenStax is licensed under CC BY 4.0

22. "Purpura.jpg" by User:Hektor is licensed under CC BY-SA 3.0

immediately reported to a health care provider because it can indicate a serious underlying medical condition.[23]

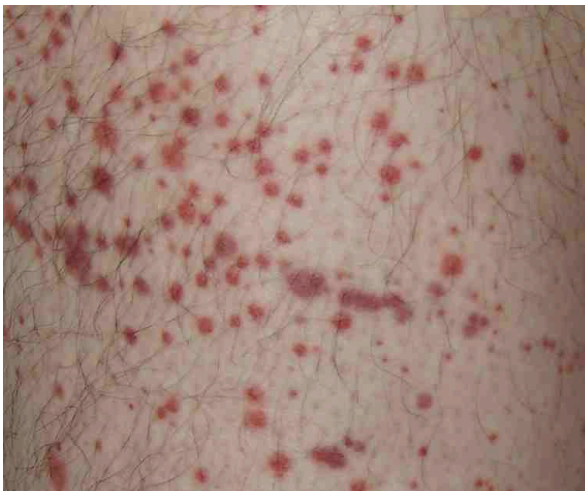

Figure 3.18 Petechiae and Purpura Can Be Mistaken For a Rash

SCARS AND KELOIDS

A **scar** (skăr) is a mark left on the skin where an injury, wound, or burn did not completely heal, resulting in collagen-rich fibrous connective tissue formation. Modern cosmetic procedures, such as dermabrasion, laser treatments, and filler injections are used to treat severe scarring. These procedures reorganize the structure of the epidermis and the underlying collagen tissue to make it look more natural.

In some individuals, an overproduction of scar tissue occurs when the process of collagen formation does not stop after the wound is healed. This

23. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2020. Bleeding into the skin; [updated 2020, Sep 16; cited 2020, Sep 18]. https://medlineplus.gov/ency/article/003235.htm

overproduction causes a raised scar called a **keloid** (KĒ-loyd).[24] Keloids are more common in patients with darker skin color. See Figure 3.19[25] for an image of a keloid that has developed from a scar on a patient's chest wall.

Figure 3.19 Keloid

SKIN CANCER

Skin cancer is common, with one in five Americans experiencing some type of skin cancer in their lifetime. **Basal cell carcinoma** (BĀ-săl sel kar-sĭn-Ō-ma) is the most common of all cancers that occur in the United States and is frequently found on areas most susceptible to long-term sun exposure such as the head, neck, arms, and back. Basal cell carcinomas start in the

24. This work is a derivative of Anatomy & Physiology by OpenStax and is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

25. "Keloid-Butterfly, Chest Wall.JPG" by Htirgan is licensed under CC BY-SA 3.0

epidermis and become an uneven patch, bump, growth, or scar on the skin surface. Treatment options include surgery, cryosurgery, and topical ointments.[26]

Squamous cell carcinoma (SKWĀ-mŭs sel kar-sĭn-Ō-mă) presents as lesions commonly found on the scalp, ears, and hands. If not removed, squamous cell carcinomas can **metastasize** (mĕ-TĂS-tă-sīz) to other parts of the body. Surgery and radiation are used to cure squamous cell carcinoma. See Figure 3.20[27] for an image of squamous cell carcinoma.[28]

Figure 3.20 Squamous Cell Carcinoma

26. This work is a derivative of Anatomy & Physiology by OpenStax and is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

27. "Squamous cell carcinoma (3).jpg" by unknown photographer, provided by National Cancer Institute is licensed under CC0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/5-4-diseases-disorders-and-injuries-of-the-integumentary-system

28. This work is a derivative of Anatomy & Physiology by OpenStax and is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

Melanoma (mel-ă-NŌ-mă) is skin cancer caused by the uncontrolled growth of melanocytes, the pigment-producing cells in the epidermis. Melanoma commonly develops from an existing mole that becomes abnormal. A **mole** (MŌL) is a small, dark, benign skin growth. See Figure 3.21[29] for an image of a melanoma.

Individuals are encouraged to evaluate moles with an unusual appearance using the "ABCDE" rule that describes the features of early melanoma. These are the features:

- **Asymmetry:** The shape of one half does not match the other half.
- **Border:** The border is irregular, meaning the edges are ragged, notched, or blurred. The pigment may spread into the surrounding skin.
- **Color:** There is uneven color with different shades of black, brown, and tan. Areas of white, gray, red, pink, or blue may also be seen.
- **Diameter:** There is an increased change in the size of the mole. Most melanomas are larger than six millimeters wide (about 1/4 inch).
- **Evolving:** The mole has changed over the past few weeks or months.

Melanoma is the most fatal of all skin cancers because it is highly metastatic and can be difficult to detect before it has spread to other organs. Common treatments include Moh's surgery and immunotherapy.[30] During **Mohs surgery** (MŌZ SŬR-jĕr-ē), the surgeon removes thin layers of skin one layer at a time and examines each layer under a microscope to determine if any

29. "Melanoma (2).jpg" by unknown photographer, provided by National Cancer Institute is in the Public Domain. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/5-4-diseases-disorders-and-injuries-of-the-integumentary-system

30. This work is a derivative of Anatomy & Physiology by OpenStax and is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

cancer remains. This procedure continues until only cancer-free tissue remains.[31]

> For additional information about Mohs surgery, visit the Skin Cancer Foundation's site on Mohs surgery.[32]

31. John's Hopkins Medicine. (n.d.). *Moh's surgery*. https://www.hopkinsmedicine.org/health/conditions-and-diseases/mohs-surgery

32. Mayo Clinic Staff. (2022, August 23). *Mohs surgery*. Mayo Clinic. https://www.mayoclinic.org/tests-procedures/mohs-surgery/about/pac-20385222#:~:text=Mohs%20surgery%20is%20a%20precise,known%20as%20Mohs%20micrographic%20surgery

Figure 3.21 Melanoma

SKIN COLOR CHANGES

Changes in the appearance of the color of an individual's skin can be a symptom of many types of disorders:

- Redness in the skin caused by capillary dilation is referred to as **erythema** (ĕr-ĭ-THĒ-mă).
- A drop in oxygenation can cause the skin to develop **pallor** (PĂL-or), the medical term for paleness. Severe or prolonged reduction in oxygen levels cause the skin to appear blue, referred to as **cyanosis** (sī-ă-NŌ-sĭs). See Figure 3.22[33] for an image of cyanosis in fingertips.
- Death of cells causes them to appear black, referred to as **necrosis** (nĕ-KRŌ-sĭs). See Figure 3.23[34] for an image of necrosis spreading after an

33. "Blue_finger_tips_3.jpg" by WaltFletcher is licensed under CC BY-SA 4.0

amputation.

- A yellow discoloration of the skin due to the accumulation of bilirubin is referred to as **jaundice** (JON-dĭs). Jaundice is discussed in more detail below the images.

Figure 3.22 Cyanosis

34. "Gangrene_early-01.jpg" by Drgnu23 is licensed under CC BY-SA 3.0

Figure 3.23 Necrosis

Jaundice causes skin and sclera (whites of the eyes) to turn yellow, also referred to as xanthoderma. See Figure 3.24[35] for an image of a patient with jaundice visible in the sclera and the skin. Jaundice is caused by too much bilirubin in the body. Bilirubin is a yellow chemical in hemoglobin, the substance that carries oxygen in red blood cells. As red blood cells break down, the old ones are processed by the liver. If the liver can't keep up due to large amounts of red blood cell breakdown or liver damage, bilirubin builds up and causes the skin and sclera to appear yellow. New onset of jaundice should always be reported to the health care provider. Jaundice can happen at any age for many reasons, such as liver disease, blood disease, infections, or side effects of some medications. Jaundice also occurs in newborns due to

35. "Cholangitis Jaundice.jpg" by Bobjgalindo is licensed under CC BY-SA 4.0

the immaturity of their livers, but it quickly resolves on its own or with phototherapy treatment.[36]

Figure 3.24 Jaundice

Albinism (AL-bĭ-nizm) is a genetic disorder that completely or partially affects the coloring of an individual's skin, hair, and eyes. This disorder is primarily due to the inability of melanocytes to produce melanin. Individuals with albinism tend to appear white or very pale due to the lack of melanin in their skin and hair. Recall that melanin helps protect the skin from the harmful effects of UV radiation. Individuals with albinism require additional protection from UV radiation because they are more prone to sunburns and skin cancer. They also tend to be more sensitive to light and have vision problems due to the lack of pigmentation on the retinal wall.

In **vitiligo** (vĭt-ĭ-LĪ-gō), the melanocytes in certain areas of an individual's body lose their ability to produce melanin, possibly due to an autoimmune

36. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2019, Oct 22]. Jaundice; [reviewed 2016, Aug 31; cited 2020, Sep 18]. https://medlineplus.gov/jaundice.html

reaction. This causes a loss of color in patches, as shown in Figure 3.25.[37] The condition is especially noticeable in individuals with darker skin.

Figure 3.25 Vitiligo

Other Skin Conditions

Other skin conditions include the following:

- A **birthmark** (BURTH-mark) is a benign irregularity on the skin which is present at birth or appears shortly after birth.
- A **cyst** (sist) is a closed sac containing fluid, air, or other substances.
- **Gangrene** (GANG-grēn) is the death and decomposition of tissue, resulting from either infection or loss of blood supply.
- A **lesion** (lĒ-zhŏn) is an area of tissue that has suffered damage through injury or disease, such as a wound, ulcer, abscess, or tumor.
- **Leukoplakia** (loo-kō-PLĀ-kē-ă) refers to white, thickened patches on mucous membrane tissue of the tongue or cheek that cannot be scraped off. Leukoplakia is associated with chronic irritation, such as from tobacco

37. "509_Vitiligo.jpg" by OpenStax College is licensed under CC BY 3.0

use, including smoking and chewing.

- A **nevus** (NĒ-vŭs) is a pigmented skin blemish, commonly referred to as a "mole."
- A **nodule** (NOJ-ool) is an abnormal growth of cells in the body that causes a lump and is distinct from its surroundings.
- **Pruritus** (proo-RĪT-ŭs) refers to severe itching. Pruritis can be caused by many types of disorders, such as contact dermatitis, insect bites, and viruses.
- **Rosacea** (rō-ZĀ-shē-ă) is a chronic skin disorder characterized by redness and pimples on the nose and cheeks.
- **Striae** (STRĪ-ē), commonly referred to as "stretch marks," are caused by pressure associated with rapid growth, such as during puberty and pregnancy. They commonly occur over the hips and abdomen. A stretch mark results when the dermis is stretched beyond its limits of elasticity to accommodate the rapid growth. They initially have a reddish hue but lighten over time. Other than for cosmetic reasons, treatment of stretch marks is not required.
- **Telangiectasia** (tĕl-an-jē-ĕk-TĀ-zē-ă), commonly referred to as "spider veins," refers to small, dilated blood vessels near the surface of the skin.
- **Xeroderma** (zē-rō-DUR-mă) refers to abnormally dry skin.

3.6 Medical Specialists and Procedures Related to the Integumentary System

A **dermatologist** (dĕr-mă-TŎL-ō-jĭst) is a physician who specializes in treating diseases, disorders, and injuries related to the integumentary system. There are many dermatologic subspecialties such as cosmetic dermatology, dermatopathology, and pediatric dermatology.

To learn more about the medical specialty of dermatology, visit the "What is a Dermatologist?" page of the American Academy of Dermatology Association website.

COMMON INTEGUMENTARY PROCEDURES

Common procedures performed on the integumentary system are as follows:

- **Biopsy** (BĪ-op-sē) is the removal of living tissue to be viewed under a microscope for diagnostic purposes.
- **Cauterization** (KAW-tĕr-īz-a-shŏn) is a procedure that burns selected tissue by various means with the intent to destroy damaged tissues, prevent infections, or coagulate blood vessels.
- **Debridement** (Di-BRĒD-mĕnt) is the removal of damaged tissue or

foreign objects from a wound.

- **Dermabrasion** (Dur-mă-BRĀ-shŏn) is a procedure to refinish the top skin layer by mechanical scraping.
- **Dermatoheteroplasty** (Dĕr-mă-tō-HĔT-ĕr-ō-plăs-tē) is surgical repair of the skin using skin from another individual.
- **Excision** (Ek-SIZH-ŏn) is a surgical procedure to cut out something.
- **Incision & drainage** (In-SIZH-ŏn & DRĀN-ăj) **(I&D)** is a surgical cut to allow the release of fluids from a lesion, wound, or cavity.
- **Laser surgery** (LĀ-zĕr SŬRJ-ĕ-rē) is a surgical procedure that uses a powerful beam of light to cut or burn tissue.
- **Rhytidectomy** (Rĭt-ĭ-DEK-tŏ-mē) is the surgical removal of wrinkles, commonly known as a facelift.
- **Suturing** (SOO-chŭr-ing) is a procedure of inserting a row of stitches to hold together the edges of a wound or surgical incision.

3.7 Integumentary System Learning Activities

Interactive Learning Activity: Practice labeling the layers of the skin using this drag and drop activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-22

Interactive Learning Activity: Study terms discussed in this chapter using these flashcards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-172

Interactive Learning Activity: Drag and drop matching definitions.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-165

Interactive Learning Activity: Match prefixes and suffixes.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-166

Interactive Learning Activity: Analyze spelling of integumentary-related words.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-167

Interactive Learning Activity: Test your knowledge on terms related to the skin.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-27

Interactive Learning Activity: Practice learning integumentary system terms by dragging the prefixes, suffixes, word roots, and combining vowels on the right to their appropriate spaces.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-26

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-25

Interactive Learning Activity: Practice identifying and defining word parts for terms discussed in this chapter:

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=2898#h5p-194

You can also print this as a Chapter 3 Practice Worksheet and check your answers with this Answer Key.

3.8 Glossary

Abrasion (ă-BRĀ-zhŏn): A wound caused by superficial damage to the skin by scraping or wearing away. (Chapter 3.5)

Abscess (ĂB-sĕs): A swollen area within body tissue containing an accumulation of pus. (Chapter 3.5)

Acne (AK-nē): A common skin condition characterized by the presence of pimples on the face, chest, and back due to inflammation or infection of the sebaceous glands and hair follicles. (Chapter 3.5)

Adipose (ĂD-ĭ-pōs): Pertaining to fat or fatty tissue. (Chapter 3.4)

Albinism (ĂL-bĭ-nĭz-əm): A group of inherited disorders characterized by little or no melanin production causing individuals to appear white or very pale. (Chapter 3.5)

Alopecia (ăl-ō-PĒ-shē-ă): A condition in which hair is lost from some or all areas of the body, typically the scalp. (Chapter 3.4)

Anhidrosis (ăn-hī-DRŌ-sĭs): Inability to sweat normally, which can lead to overheating. (Chapter 3.4)

Apocrine sweat glands (ĂP-ō-krĭn swĕt glănds): Sweat glands that produce a more viscous sweat; found in the armpit and genital areas. (Chapter 3.4)

Bacteria (bak-TĒR-ē-a): Members of a large group of microorganisms that have cell walls but lack organelles and an organized nucleus, including some that can cause disease. (Chapter 3.5)

Basal cell carcinoma (BĀ-săl sel kar-sĭn-Ō-mă): A type of skin cancer that begins in the basal cells of the skin and is usually caused by long-term exposure to UV radiation from sunlight; most common of all skin cancers. (Chapter 3.5)

Benign (bē-NĪN): A term used to describe tumors or growths that are not cancerous and do not spread to other parts of the body. (Chapter 3.5)

Biopsy (BĪ-op-sē): The removal of tissue from the body for examination, usually to diagnose a disease. (Chapter 3.6)

Birthmark (BURTH-mark): A benign irregularity on the skin present at birth or appearing shortly after birth. (Chapter 3.5)

Blister (BLĬS-tĕr): A small bubble on the skin filled with serum and caused by friction, burning, or other damage. (Chapter 3.5)

Boil (BOIL): A painful, pus-filled bump under the skin often caused by an infected hair follicle. (Chapter 3.5)

Bruise (BRŪZ): Also referred to as a contusion; an injury appearing as an area of discolored skin on the body, caused by a blow or impact rupturing underlying blood vessels. (Chapter 3.5)

Bulla (BŬL-lă): A large blister. (Chapter 3.5)

Burn (bûrn): An injury caused by exposure to heat, flame, radiation, electricity, or chemicals. (Chapter 3.5)

Calluses (KĂL-ū-ses): Thickened and hardened parts of the skin or soft tissue, especially in an area that has been subjected to friction. (Chapter 3.5)

Cauterization (KAW-tĕr-īz-a-shŏn): A medical procedure used to burn tissue to stop bleeding or to remove a lesion. (Chapter 3.6)

Cellulitis (sĕl-yū-LĪ-tĭs): A bacterial infection of the skin and subcutaneous tissue characterized by redness, pain, heat, and swelling. (Chapter 3.5)

Community-acquired MRSA (CA-MRSA): MRSA infection occurring in people in the wider community. (Chapter 3.5)

Contusion (kŏn-TOO-zhŏn): A region of injured tissue or skin in which blood capillaries have been ruptured; a bruise. (Chapter 3.5)

Corn: A thickened area of skin with a central core, typically found on the toes. (Chapter 3.5)

Cuticle (KYŪ-tĭ-kĭl): A protective thin layer of skin at the base of the fingernails and toenails. (Chapter 3.4)

Cyanosis (sī-ă-NŌ-sĭs): A bluish discoloration of the skin resulting from poor circulation or inadequate oxygenation of the blood. (Chapter 3.5)

Cyst (sist): A closed sac in or under the skin that contains fluid, air, or other substances. (Chapter 3.5)

Dandruff (DĂN-drŭf): The shedding of dead skin cells from the scalp. (Chapter 3.4)

Debridement (di-BRĒD-mĕnt): The removal of damaged tissue or foreign objects from a wound. (Chapter 3.5, Chapter 3.6)

Dehydration (dē-hī-DRĀ-shŏn): Excessive water loss. (Chapter 3.4)

Dermabrasion (dûr-mă-BRĀ-shŏn): A dermatological procedure that uses a rotating instrument to remove the outer layers of skin, typically on the face. (Chapter 3.6)

Dermatitis (dûr-mă-TĪ-tĭs): Inflammation of the skin that can cause a rash, including various types such as contact dermatitis and dermatitis caused by dust. (Chapter 3.5)

Dermatoconiosis (dûr-mă-tō-kō-nē-Ō-sĭs): A type of dermatitis caused by dust contacting the skin. (Chapter 3.5)

Dermatofibroma (dĕr-mă-tō-fī-BRŌ-mă): A common benign skin growth, often a small, firm nodular lesion on the skin. (Chapter 3.5)

Dermatoheteroplasty (dûr-mă-tō-HĔT-ĕr-ō-plăs-tē): Surgical repair of the skin using skin grafts from a donor. (Chapter 3.6)

Dermatologist (dûr-mă-TŎL-ŏ-jĭst): A physician who specializes in the diagnosis and treatment of skin disorders and diseases. (Chapter 3.6)

Dermis (DUR-mĭs): The middle layer of skin, containing tough connective tissue, hair follicles, and sweat glands. (Chapter 3.4)

Diaphoresis (dī-ă-fə-RĒ-sĭs): Excessive sweating, commonly associated with shock and other medical emergency conditions. (Chapter 3.4)

Eccrine sweat gland (ĔK-rĭn swĕt glănd): A small sweat gland that produces a watery secretion without removing cytoplasm from the secreting cells; found all over the body but especially abundant on the palms of the hand, soles of the feet, and forehead. (Chapter 3.4)

Eczema (eg-ZĒ-mă): An allergic inflammatory condition of the skin, manifesting as dry, itchy patches that resemble a red, flaky rash. (Chapter 3.5)

Edema (ĕ-DĒ-mă): Swelling caused by excess fluid trapped in the body's tissues; commonly seen in the extremities. (Chapter 3.5)

Elastin (ĭ-LĂS-tĭn): A protein in connective tissue that is elastic and allows many tissues in the body to resume their shape after stretching or contracting. (Chapter 3.4)

Epidermis (ĕp-ĭ-DUR-mĭs): The outermost layer of skin, providing a waterproof barrier and creating skin tone. (Chapter 3.4)

Erythema (ĕr-ĭ-THĒ-mă): Redness of the skin caused by capillary dilation. (Chapter 3.5)

Excision (ĕk-SIZH-ŏn): The surgical removal of tissue, typically involving cutting out or off. (Chapter 3.6)

Fascia (FĂSH-ē-ă): A band or sheet of connective tissue, primarily collagen, beneath the skin that attaches, stabilizes, encloses, and separates muscles, bones, and other internal organs. (Chapter 3.4)

First-degree burn: A mild burn characterized by heat, pain, and reddening of the burned surface but not exhibiting blistering or charring of tissues. (Chapter 3.5)

Fourth-degree burn: A burn which extends into deeper tissues, causing carbonization or charring of bones, muscles, and tendons underneath. (Chapter 3.5)

Frostbite (FRŌST-bīt): Injury to body tissues caused by exposure to extreme cold, typically affecting the nose, fingers, or toes and sometimes resulting in gangrene. (Chapter 3.4)

Gangrene (GANG-grēn): The death of body tissue due to a lack of blood flow or a bacterial infection. (Chapter 3.5)

Hirsutism (HUR-sū-tĭz-əm): Excessive hair growth on the face and body in areas where hair is usually minimal or absent, particularly in women. (Chapter 3.4)

Hospital-acquired MRSA (HA-MRSA): MRSA infection occurring in people in hospitals or other health care facilities. (Chapter 3.5)

Human papillomavirus (hyū-măn pap-ĭ-lō-mă-VĪ-rŭs) (HPV): The most common sexually transmitted infection, causing genital warts and potentially leading to cervical, throat, and other cancers. (Chapter 3.5)

Hyperhidrosis (hī-pĕr-hī-DRŌ-sĭs): Abnormally excessive sweating. (Chapter 3.4)

Hypodermis (hī-pō-DUR-mĭs): Also known as subcutaneous tissue; the deeper subcutaneous tissue composed of fat and connective tissue. (Chapter 3.4)

Impetigo (ĭm-pĕ-TĪ-gō): A contagious bacterial skin infection forming pustules and yellow crusty sores, typically in children. (Chapter 3.5)

Incision & drainage (in-SIZH-ŏn and DRĀN-ij) (I&D): A minor surgical procedure to cut into a lesion or abscess to allow the escape of fluid. (Chapter 3.6)

Infection (ĭn-FĚK-shŏn): The invasion and multiplication of microorganisms such as bacteria, viruses, and parasites that are not normally present within the body. (Chapter 3.5)

Jaundice (JON-dĭs): A yellowing of the skin and eyes due to a buildup of bilirubin in the blood. (Chapter 3.5)

Keloid (KĒ-loyd): An area of irregular fibrous tissue formed at the site of a scar or injury. (Chapter 3.5)

Keratin (KĚR-ă-tĭn): A protein found in the skin, hair, and nails, providing strength and protection. (Chapter 3.4)

Laceration (lăs-ĕ-RĀ-shŏn): A deep cut or tear in skin or flesh. (Chapter 3.5)

Laser surgery (LĀ-zĕr SUR-jə-rē): A surgical technique that uses a laser to cut tissue instead of a scalpel. (Chapter 3.6)

Lesion (lĒ-zhŏn): A region in an organ or tissue that has suffered damage through injury or disease. (Chapter 3.5)

Leukoplakia (loo-kō-PLĀ-kē-ă): Thickened, white patches on the mucous membranes of the mouth, tongue, or cheek. (Chapter 3.5)

Lipoma (lī-PŌ-mă): A benign tumor made of fat tissue. (Chapter 3.5)

Lupus (LOO-pŭs): The common name for systemic lupus erythematosus; an autoimmune disease in which the immune system recognizes its own cell antigens as being “non-self” and mounts an immune response against them. (Chapter 3.5)

Lymphedema (lim-fĕ-DĒ-mă): A type of swelling that occurs when lymph fluid builds up in the body’s soft tissues, often in the arms or legs, typically due to damage to the lymph system. (Chapter 3.5)

Macule (MAK-ūl): A flat, discolored spot on the skin. (Chapter 3.5)

Melanocytes (mĕl-ĀN-ō-sītz): Cells located in the epidermis that produce melanin, the pigment responsible for skin color. (Chapter 3.4)

Melanoma (mel-ă-NŌ-mă): A serious form of skin cancer that arises from the pigment-producing cells in the skin called melanocytes. (Chapter 3.5)

Metastasize (mĕ-TĂS-tă-sīz): The process by which cancer cells spread from the place where they first formed to another part of the body. (Chapter 3.5)

Methicillin-resistant Staphylococcus aureus (měth-ĭ-SĬL-ĭn rĕ-zĭs-tănt STĂF-ə-lō-KŌK-ŭs OWR-ē-ŭs) (MRSA): A strain of staph bacteria that’s

resistant to the antibiotics commonly used to treat staph infections. (Chapter 3.5)

Mohs surgery (MŌZ SŬR-jĕr-ē): A precise surgical technique used to treat skin cancer, involving the progressive removal and examination of layers of cancer-containing skin until only cancer-free tissue remains. (Chapter 3.5)

Mole (MŌL): A small skin growth that is usually brown or black; formed due to a cluster of pigmented cells. (Chapter 3.5)

Necrosis (nĕ-KRŌ-sĭs): The death of most or all of the cells in an organ or tissue due to disease, injury, or failure of the blood supply causing the skin to turn black. (Chapter 3.5)

Nevus (NĒ-vŭs): A benign skin lesion, commonly known as a mole, that is often pigmented. (Chapter 3.5)

Nodule (NOJ-ool): A small lump or growth on or under the skin, often a sign of an underlying condition or disease. (Chapter 3.5)

Onycholysis (ŏn-ĭ-KŌL-ĭ-sĭs): The painless detachment of the nail from the nail bed. (Chapter 3.4)

Onychomycosis (ŏn-ī-kō-mī-KŌ-sĭs): Fungal infections of the nails. (Chapter 3.5)

Onychophagia (ŏn-ĭ-kō-FĀ-jē-ă): The habit of biting the nails. (Chapter 3.4)

Pallor (PĂL-or): An unhealthy pale appearance. (Chapter 3.5)

Papule (PAP-ūl): A small, raised, solid bump on the skin. (Chapter 3.5)

Pathogens (PATH-ō-jĕns): Microorganisms that cause disease. (Chapter 3.5)

Pediculosis (pĕd-ĭ-kū-LŌ-sĭs): An infection with lice, typically affecting the head and resulting in itching and visible nits. (Chapter 3.5)

Petechiae (pĕ-TĒK-ē-ī): Small, pinpoint, nonblanching red or purple spots on the skin, often caused by minor hemorrhages or bleeding under the skin. (Chapter 3.5)

Pressure injuries: Damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other device due to unrelieved pressure. (Chapter 3.5)

Pruritus (proo-RĪT-ŭs): Severe itching; a common symptom in various skin conditions and diseases. (Chapter 3.5)

Psoriasis (sō-RĪ-ə-sĭs): A chronic autoimmune skin disease that speeds up

the growth cycle of skin cells, causing red, itchy, scaly patches on the body, most commonly on the elbows, knees, and scalp. (Chapter 3.5)

Purpura (PUR-pyŏŏ-ră): Larger areas of purple or red discolorations on the skin, often caused by bleeding underneath the skin. (Chapter 3.5)

Pus (PŬS): A thick fluid composed of leukocytes, bacteria, and dead tissues, typically associated with infection. (Chapter 3.5)

Pustule (PŬS-tūl): A small blister or pimple on the skin containing pus. (Chapter 3.5)

Rash: An area of redness and small spots on the skin due to allergy or illness. (Chapter 3.5)

Rhytidectomy (rĭt-ĭ-DEK-tə-mē): A cosmetic surgical procedure, commonly known as a facelift, to remove wrinkles and sagging skin. (Chapter 3.6)

Rickets (RIK-ĕts): A disease of children caused by vitamin D deficiency, characterized by imperfect calcification, softening, and distortion of the bones typically resulting in bowed legs. (Chapter 3.4)

Rosacea (rō-ZĀ-shē-ă): A chronic skin disorder characterized by facial redness, small, red, pus-filled bumps, and visible blood vessels, often on the nose and cheeks. (Chapter 3.5)

Rule of Nines: A method used in calculating body surface area affected by burns. (Chapter 3.5)

Scabies (SKĀ-bēz): An infection caused by tiny mites that burrow into the skin, leading to intense itching. (Chapter 3.5)

Scar (skăr): A mark left on the skin or within body tissue where a wound, burn, or sore has not healed completely, and fibrous connective tissue has developed. (Chapter 3.5)

Sebaceous gland (sĕ-BĀ-shŭs glănd): A small gland in the skin which secretes a lubricating oily matter (sebum) into the hair follicles to lubricate the skin and hair. (Chapter 3.4)

Second-degree burn: A burn marked by pain, blistering, and superficial destruction of dermis with edema and hyperemia of the tissues beneath the burn. (Chapter 3.5)

Shingles (SHING-gĭlz): A viral disease that causes painful rashes on the skin, caused by the varicella-zoster virus. (Chapter 3.5)

Skin ulcer (‘skin ŬL-sĕr): An open sore on an external or internal surface of

the body, caused by a break in the skin or mucous membrane that fails to heal. (Chapter 3.5)

Squamous cell carcinoma (SKWĀ-mŭs sel kar-sĭn-Ō-mă): A common form of skin cancer that originates in the squamous cells of the skin; often due to UV exposure and can metastasize if not treated. (Chapter 3.5)

Staphylococcus (stăf-ə-lō-KŌK-ŭs): A genus of gram-positive bacteria. (Chapter 3.5)

Streptococcus (strĕp-tō-KŌK-ŭs): A genus of coccus (spherical) bacteria belonging to the phylum Firmicutes and the lactic acid bacteria group. (Chapter 3.5)

Striae (STRĪ-ē): Commonly referred to as stretch marks; long, narrow streaks, stripes, or lines that develop on the skin, often due to rapid stretching of the skin. (Chapter 3.5)

Subcutaneous (sŭb-kū-TĀ-nē-ŭs): Also known as hypodermis tissue; the deeper tissue composed of fat and connective tissue. (Chapter 3.4)

Suturing (SOO-chər-ing): The act of sewing or stitching up a wound or incision. (Chapter 3.6)

Sympathetic nervous system (sĭm-pă-THĔT-ĭk NUR-vŭs SIS-tĕm): Part of the autonomic nervous system that serves to accelerate the heart rate, constrict blood vessels, and raise blood pressure. (Chapter 3.4)

Systemic lupus erythematosus (sis-TĔM-ik LOO-pŭs ĕr-i-thē-mă-TO-sŭs) (SLE): A chronic autoimmune disease that can cause inflammation and damage to various body tissues and organs, including the skin, joints, kidneys, brain, and heart. (Chapter 3.5)

Telangiectasia (tĕl-an-jē-ĕk-TĀ-zē-ă): Small, visible blood vessels near the surface of the skin; often appearing as red or purple lines. (Chapter 3.5)

Third-degree burn: A severe burn characterized by destruction of the skin through the depth of the dermis and possibly into underlying tissues, loss of fluid, and sometimes shock. (Chapter 3.5)

Tinea (TĪ-nē-ă): A group of skin infections caused by a fungus, including conditions like ringworm, athlete's foot, and jock itch. (Chapter 3.5)

Tinea capitis (TĪ-nē-ă KĂP-ĭ-tĭs): Scalp ringworm causing itchy, red patches on the head that can leave bald spots. (Chapter 3.5)

Tinea corporis (TĪ-nē-ă KŌR-pŏ-rĭs): Ringworm; a fungal rash on the body that typically looks like a red ring with a clear center. (Chapter 3.5)

Tinea cruris (TĪ-nē-ă KRŌŏ-rĭs): Jock itch; causes an itchy, burning rash in the groin area. (Chapter 3.5)

Tinea pedis (TĪ-nē-ă PĚD-ĭs): Athlete's foot, causing itching, burning, and cracked skin between the toes. (Chapter 3.5)

Urticaria (ur-tĭ-KĀR-ē-ă): Raised, itchy rashes on the skin, also known as hives. (Chapter 3.5)

Vascularized (VĂS-kū-lə-rīzd): Richly supplied with blood vessels. (Chapter 3.4)

Verruca (vĕr-ROO-kă): Another term for a wart; a benign growth on the skin caused by a virus. (Chapter 3.5)

Vesicle (VES-ĭ-kĭl): A small, fluid-filled sac or blister within or under the epidermis. (Chapter 3.5)

Virus (VĪ-rŭs): A microorganism that spreads infection by invading the body's cells and replicating. (Chapter 3.5)

Vitiligo (vĭt-ĭ-LĪ-gō): A disease that causes loss of skin color in blotches. (Chapter 3.5)

Wart (WART): A small, benign growth on the skin caused by a virus; also called verruca. (Chapter 3.5)

Wheal: An individual hive. (Chapter 3.4)

Xeroderma (zē-rō-DUR-mă): Excessively dry skin; often caused by environmental factors or certain skin conditions. (Chapter 3.5)

Yeast infections (YĒST ĭn-FĕK-shŭns): Infections commonly caused by the Candida fungus, leading to overgrowth and symptoms like itching and discharge. (Chapter 3.5)

PART IV

CHAPTER 4 RESPIRATORY SYSTEM TERMINOLOGY

4.1 Respiratory System Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to the respiratory system
- Identify meanings of key word components of the respiratory system
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to the respiratory system
- Use terms related to the respiratory system
- Use terms related to the diseases and disorders of the respiratory system

Introduction to the Respiratory System

The primary function of the respiratory system is to provide oxygen to body tissues and to remove carbon dioxide. This chapter will begin by reviewing common word components related to the respiratory system that can be used to build definitions of respiratory terminology. Other respiratory terms, whose definitions cannot be easily built from word components, will be described in context based on the anatomy and physiology of the respiratory system, as well as common respiratory diseases and disorders. Medical

specialists, diagnostic tests, procedures, and equipment related to the respiratory system will also be discussed.

View Figure 4.1[1] for an illustration of major anatomic structures of the respiratory system.

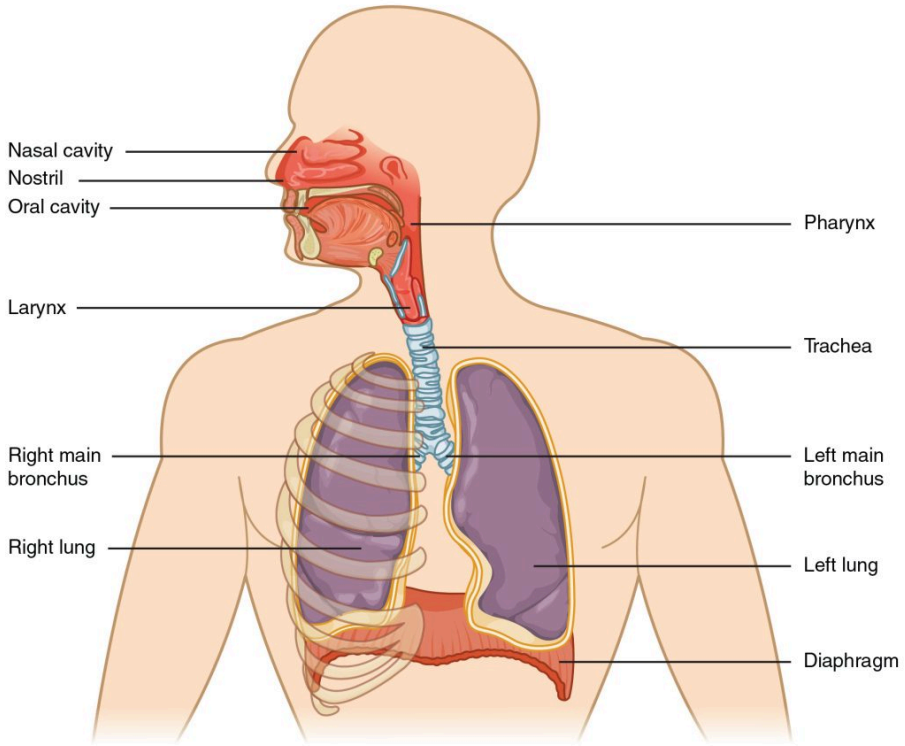

Figure 4.1 Major Respiratory Anatomic Structures

1. "2301 Major Respiratory Organs.jpg" by OpenStax College is licensed under CC BY 3.0

4.2 Word Components Related to the Respiratory System

This section will describe common word components related to the respiratory system. These word components can be used to build definitions for many medical terms related to the respiratory system. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO THE RESPIRATORY SYSTEM

- **a-**: Absence of, without
- **an-**: Absence of, without
- **brady-**: Slow
- **dys-**: Difficult, painful, abnormal, labored
- **endo-**: Within, in
- **eu-**: Normal, good
- **hyper-**: Above, excessive
- **hypo-**: Below, incomplete
- **intra-**: Within, in
- **poly-**: Many, much
- **tachy-**: Fast, rapid

COMMON WORD ROOTS WITH A COMBINING VOWEL RELATED TO THE RESPIRATORY SYSTEM

- **adenoid**/o: Adenoids
- **alveol**/o: Alveolus
- **atel**/o: Imperfect, incomplete
- **bronch**/o: Bronchus
- **bronchi**/o: Bronchus
- **capn**/o: Carbon dioxide
- **diaphragmat**/o: Diaphragm
- **epiglott**/o: Epiglottis
- **hem**/o: Blood
- **hemat**/o: Blood
- **laryng**/o: Larynx
- **lob**/o: Lobe
- **muc**/o: Mucus
- **nas**/o: Nose
- **orth**/o: Straight
- **ox**/i: Oxygen
- **pharyng**/o: Pharynx
- **phon**/o: Sound, voice
- **phren**/o: Diaphragm
- **pleur**/o: Pleura
- **pneum**/o: Lung, air
- **pneumat**/o: Lung
- **pneumon**/o: Lung, air
- **pulmon**/o: Lung
- **py**/o: Pus
- **radi**/o: X-rays, ionizing radiation
- **respir**/o: Breath, breathing
- **rhin**/o: Nose

- **sept**/o: Septum
- **sinus**/o: Sinus
- **somn**/o: Sleep
- **son**/o: Sound
- **spir**/o: Breathe, breathing
- **thorac**/o: Thorax, chest cavity
- **tom**/o: To cut, section, slice
- **tonsill**/o: Tonsil
- **trache**/o: Trachea

COMMON SUFFIXES RELATED TO THE RESPIRATORY SYSTEM

- **-algia**: Pain
- **-ar**: Pertaining to
- **-ary**: Pertaining to
- **-cele**: Hernia, protrusion
- **-centesis**: Surgical puncture to aspirate fluid
- **-eal**: Pertaining to
- **-ectasis**: Stretching out, dilation, expansion
- **-ectomy**: Excision, cut out
- **-emia**: In the blood
- **-genic**: Producing, originating, causing
- **-gram**: Record of, radiographic image
- **-graph**: Instrument used to record
- **-graphy**: Process of recording, radiographic imaging
- **-ia**: Condition, diseased state, abnormal state
- **-ic**: Pertaining to
- **-itis**: Inflammation
- **-logist**: Specialist who studies and treats
- **-logy**: Study of

- **-meter**: Instrument used to measure
- **-metry**: Measurement
- **-oid**: Resembling
- **-osis**: Abnormal condition
- **-pexy**: Surgical fixation, suspension
- **-plasty**: Surgical repair
- **-pnea**: Breathing
- **-ptysis**: Spitting, coughing
- **-rrhagia**: Rapid flow of blood, excessive bleeding
- **-scope**: Instrument used for visual examination
- **-scopic**: Pertaining to visual examination
- **-scopy**: Process of visually examining, visual examination
- **-spasm**: Sudden involuntary muscle contraction, spasmodic contraction
- **-stenosis**: Constriction, narrowing
- **-stomy**: Creation of an artificial opening
- **-thorax**: Chest, chest cavity
- **-tome**: Instrument used to cut
- **-tomy**: Cut into, incision

4.3 Examples of Respiratory Terms Easily Defined By Their Word Components

Here are examples of respiratory medical terms that can be easily defined by breaking them down into word components.

Pulmonologist

1. Break down the medical term into word components: **Pulmon/o/logist**
2. Label the word parts: **Pulmon** = WR; **o** = CV; **logist** = S
3. Define the word components: **Pulmon** = lung; **logist** = specialist who studies and treats disorders
4. Create a final definition of the medical term: **Specialist who treats diseases and disorders of the lungs**

Adenoidectomy

1. Break down the medical term into word components: **Adenoid/ectomy**
2. Label the word parts: **Adenoid** = WR; **ectomy** = suffix
3. Define the word components: **Adenoid** = adenoid; **ectomy** = excision (cut out)

4. Create a final definition of the medical term: **Excision of the adenoid**

Bronchoscopy

1. Break down the medical term into word components: **Bronch/o/scopy**
2. Label the word parts: **Bronch** = WR; **o** = CV; **scopy** = suffix
3. Define the word components: **Bronch** = bronchus; **scopy** = visual examination
4. Create a final definition of the medical term: **Visual examination of the bronchi**

Interactive Learning Activity: Practice defining and pronouncing respiratory system medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3078#h5p-95

You can also print this as a Chapter 4 Student Companion Worksheet and check your answers with this Answer Key.

4.4 Anatomy of the Respiratory System

This section will describe the major anatomic structures of the respiratory system, including the nose and adjacent structures, pharynx, larynx, trachea, bronchia, alveoli, and lungs. Common disorders affecting these structures will also be introduced.

NOSE, NASAL CAVITY, AND SINUSES

See Figure 4.2[1] for an illustration of anatomic structures of the upper respiratory system. The upper respiratory system refers to the nose, nasal cavities, sinuses, pharynx, and larynx. An **upper respiratory infection** (ŬP-er RES-pĭr-ă-tō-rē ĭn-FEK-shun) **(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. The word root for "nose" is *rhin*. For example, **rhinorrhagia** (rī-nō-RĀ-jē-ă) refers to bleeding from the nose, also called **epistaxis** (ĕp-ĭ-STĂK-sĭs). **Rhinitis** (rye-NYE-tis) 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** (SĔP-tŭm). The floor of the nasal

1. "Blausen_0872_UpperRespiratorySystem.png" by Blausen.com staff (2014) is licensed under CC BY 3.0

cavity is composed of the hard palate and the soft palate. The nasal cavities are lined with mucous membranes that produce **mucus** (MŪ-kŭs), a substance created for lubrication and protection. **Rhinorrhea** (rye-noh-REE-uh), commonly referred to as a "runny nose," is medical term for excess mucus production by the nasal cavity. 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. **Sinusitis** (sī-nŭ-SĪ-tĭs) refers to inflammation of the sinus cavities. Air moves from the nasal cavities and sinuses into the pharynx.[2]

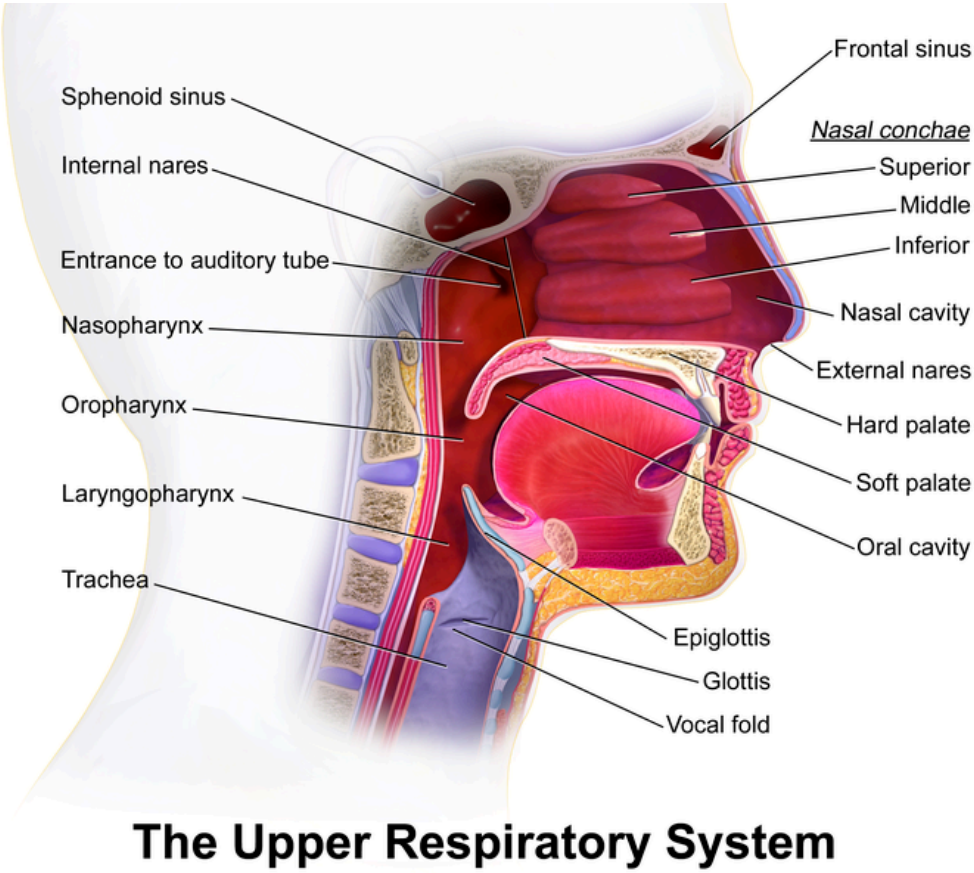

Figure 4.2 The Upper Respiratory System

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The **pharynx** (FĂR-ĭngks), commonly known as the throat, is divided into three major regions: the nasopharynx, the oropharynx, and the laryngopharynx. See Figure 4.3[3] for an illustration of the regions of the pharynx.

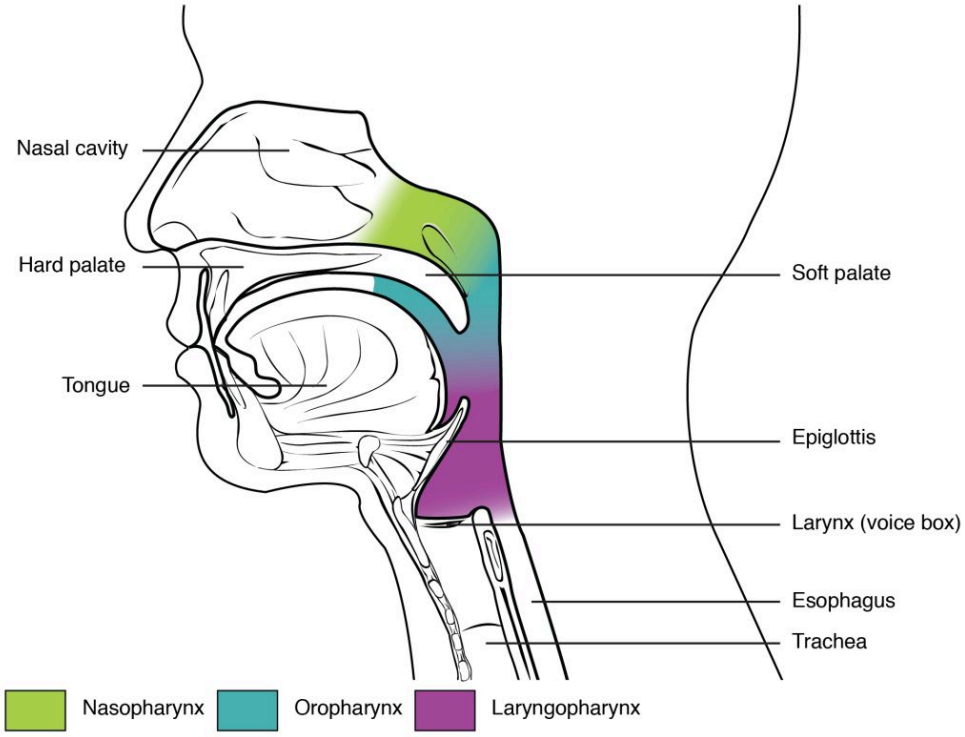

Figure 4.3 Regions of the Pharynx

At the top of the nasopharynx is the pharyngeal tonsil, also called adenoid, which is collection of lymphatic tissue found at the back of the nasal cavity in the nasopharynx. The function of the pharyngeal tonsil or **adenoid** (ĂD-ĕ-noyd) is to trap and destroy invading pathogens that enter the airway during inhalation. **Pharyngitis** (fă-RĬN-JĪ-tĭs) is inflammation of the pharynx. **Tonsillitis** (tŏn-sĭl-Ī-tĭs) refers to inflammation of the tonsils. **Adenoiditis** (ad-ĕ-

3. "2305_Divisions_of_the_Pharynx.jpg" by OpenStax College is licensed under CC BY 3.0

noyd-ĪT-is) refers to inflammation of the adenoids, a common medical condition in young children that can hinder speaking and breathing.[4]

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 colds can sometimes cause ear infections in children.[5]

The oropharynx is bordered superiorly by the nasopharynx and anteriorly by the oral cavity. The oropharynx contains two distinct sets of tonsils called the palatine tonsils and lingual tonsils that also trap and destroy pathogens entering the body through the oral or nasal cavities.[6]

The laryngopharynx is located just below the oropharynx. It is the part of the pharynx (throat) located behind (posterior) the larynx. The laryngopharynx separates into the trachea (the tube going to the larynx) and the esophagus (the tube going into the stomach). The epiglottis prevents food and fluid and food from entering the trachea while swallowing.[7]

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LARYNX

The structure of the **larynx** (LĀR-ĭngks) is formed by several pieces of cartilage, as shown in Figure 4.4.[8] Three large cartilage pieces form the major structure of the larynx called 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** (lă-rĭn-JĪ-tĭs) refers to inflammation of the larynx, specifically the vocal folds or cords, resulting in huskiness or loss of one's voice and a cough.[9]

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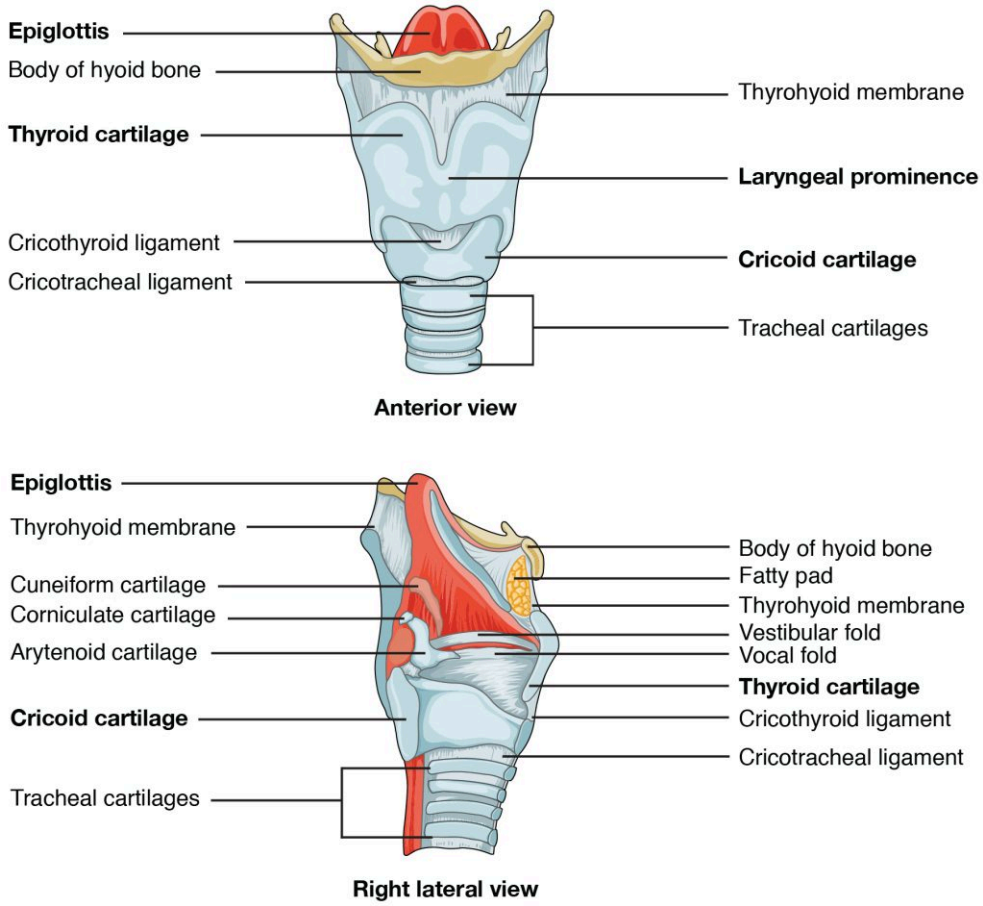

Figure 4.4 Larynx

The **epiglottis** (ĕ-pĭ-GLŎT-ĭs) is a flap of tissue that covers the trachea during swallowing to prevent **aspiration** (ăs-pĭ-RĀ-shŭn), 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.[10]

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

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cords are free, allowing oscillation as air passes through to produce sound for speaking. See Figure 4.5[11] for an illustration of vocal cords. The word root *phon* refers to sound or voice, so the medical term **dysphonia** (dis-FŌ-nē-ă) refers to the medical condition of difficulty speaking (i.e., voice).[12]

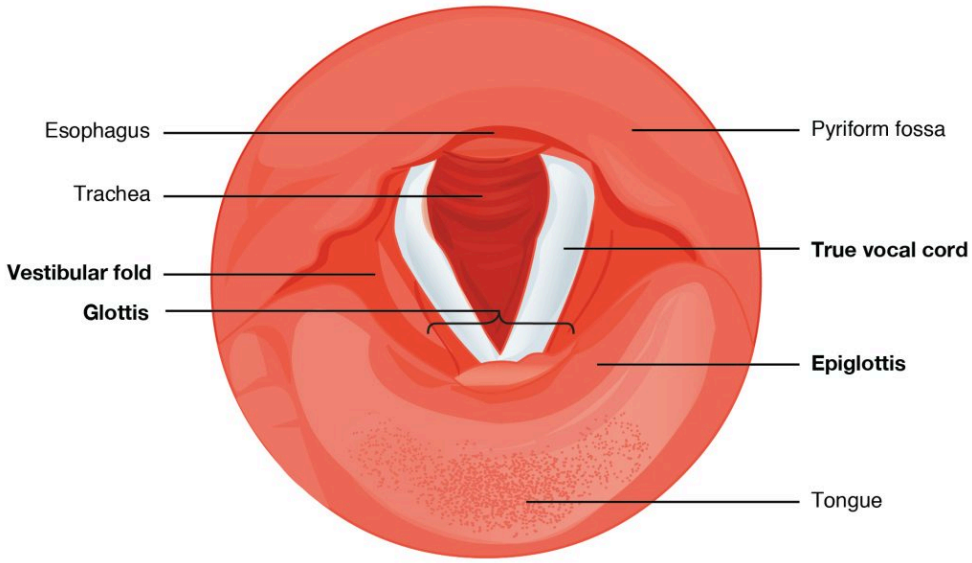

Figure 4.5 Vocal Cords

The lower respiratory tract consists of the trachea, bronchi, alveoli, and lungs.

The **trachea** (trā-KĒ-ă) is formed by stacked, C-shaped pieces of cartilage that are connected by dense connective tissue. See Figure 4.6[13] for an

11. "2307_Cartilages_of_the_Larynx.jpg" by OpenStax College is licensed under CC BY 3.0

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13. "2308a_The_Trachea.jpg" by OpenStax *Anatomy and Physiology* is licensed under CC BY 4.0

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.[14]

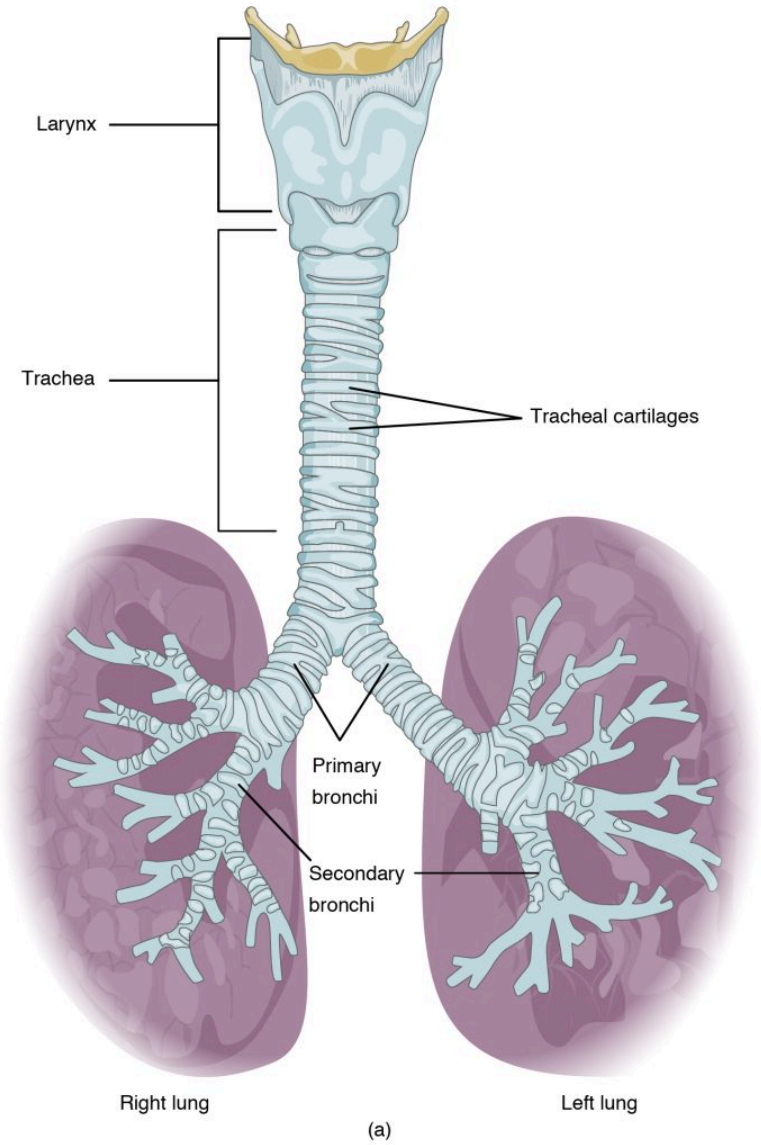

Figure 4.6 Trachea

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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. A **tracheostomy** (trā-kē-ŎS-tō-mē) is an incision created in the trachea to create an artificial opening to allow breathing when an obstruction is present.

BRONCHI AND BRONCHIOLES

Bronchi (brŏng-kī) 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.[15]

Bronchioles (brŏng-kē-ŏlz) are the smallest branches of the bronchi that lead to the alveolar sacs. See Figure 4.7[16] for an illustration of the terminal (very last) bronchioles leading 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 bronchia to increase or decrease airflow to the alveoli.[17]

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16. "2309_The_Respiratory_Zone.jpg" by OpenStax College is licensed under CC BY 3.0

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The word root *bronch* refers to the bronchi. **Bronchospasm** (brŏng-kō-spăz-ăm) is a symptom of many respiratory conditions that refers to a sudden constriction of the muscles in the walls of the bronchi. **Bronchitis** (brŏng-KĪ-tĭs) refers to inflammation of the bronchi. **Bronchoscopy** (brŏng-KŎS-kŏ-pē) is a procedure in which a tube is inserted by a medical specialist to visually examine the bronchi.[18]

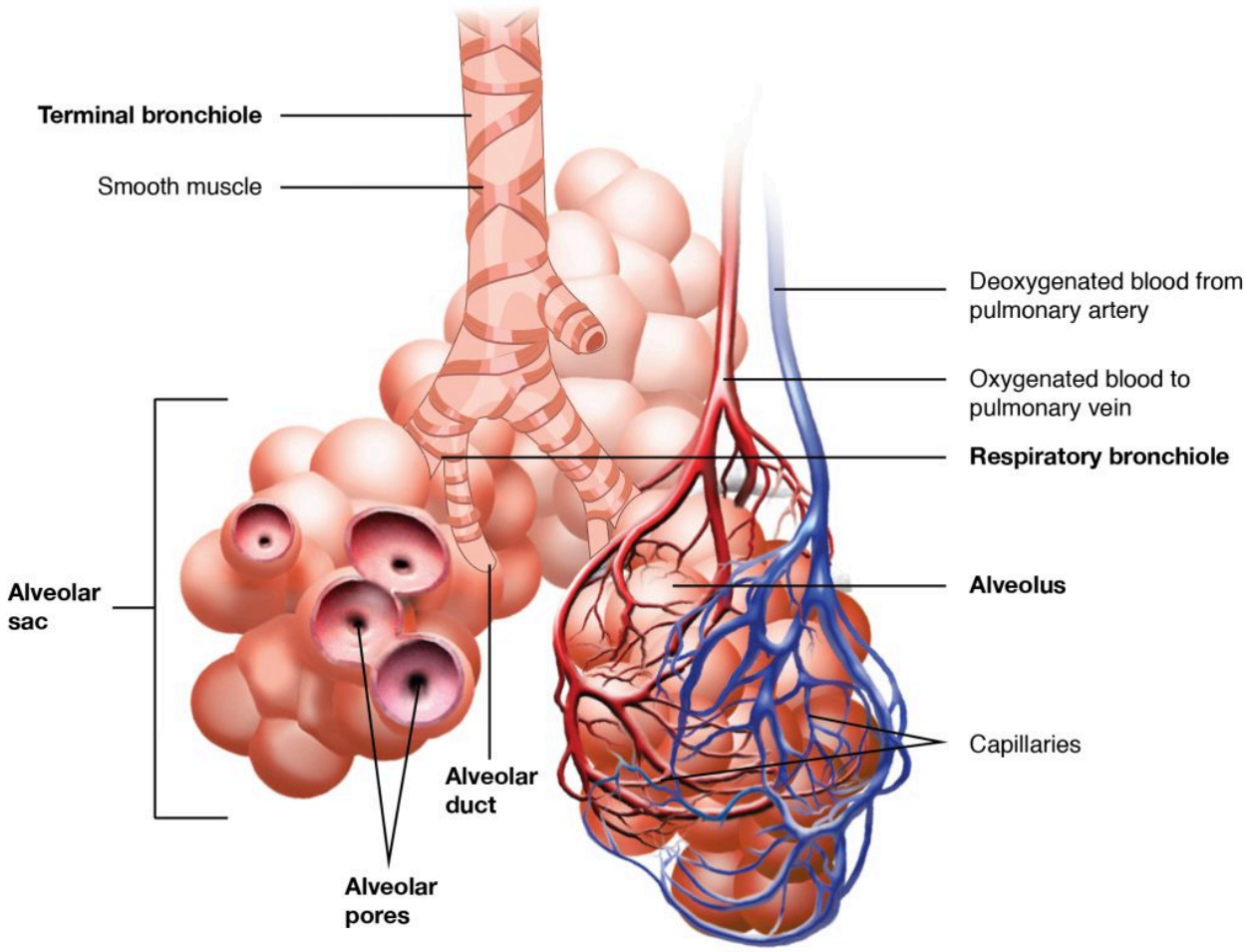

Figure 4.7 Alveoli

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The trachea, bronchi, and bronchioles are lined with mucous membranes that create mucous secretions that can be expelled through the mouth, also referred to as **sputum** (SPŪT-ŭm).

ALVEOLI

Alveoli (ăl-VĒ-ŏ-lī) are small, grapelike sacs where gas exchange occurs. 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** (SŬR-făk-tănt), a slippery substance that prevents the lungs from collapsing. **Atelectasis** (ă-tĕ-lĕk-TĀ-sĭs) 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.[19]

Alveol is the root word for alveolus, the singular form of alveoli. For example, the medical term **alveolar** (ăl-VĒ-ŏ-lăr) means pertaining to the alveolus.

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LUNGS

The **lungs** (lŭngz) are connected to the trachea by the main (primary) bronchi

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that branches to the right and left bronchi. See Figure 4.8[20] 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.[21]

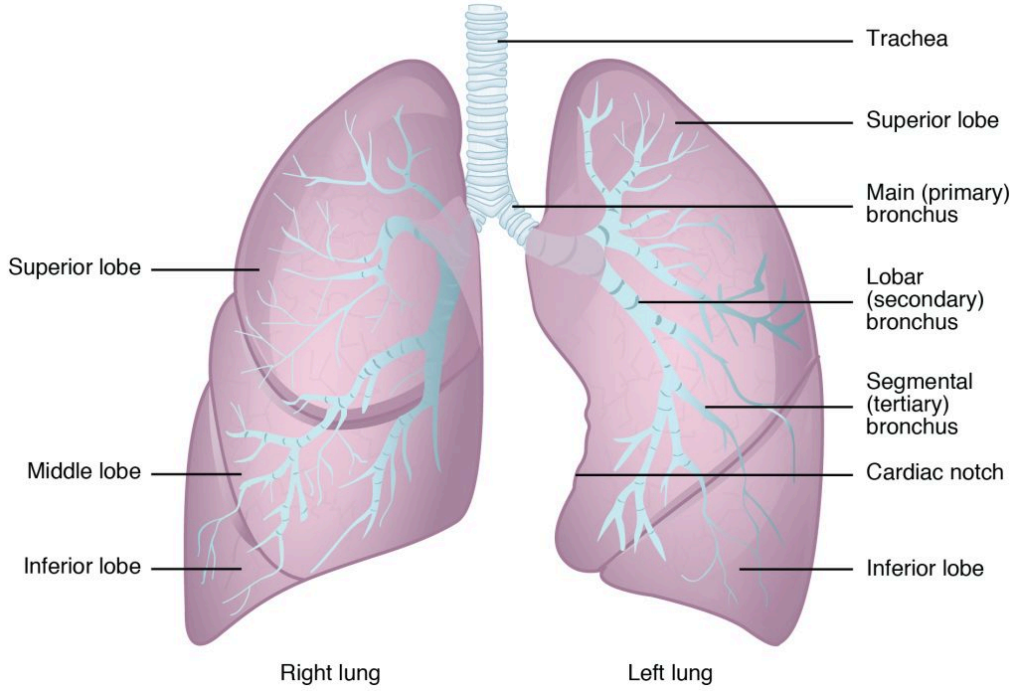

Figure 4.8 Lungs

Each lung is composed of smaller units called **lobes** (lōbz). 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

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with the heart. Each lobe receives its own large bronchus that has multiple branches. A **lobectomy** (lō-BĚK-tŭ-mē) refers to surgical removal of a lobe of the lung.[22]

The word roots for lungs and/or air are *pneum* or *pneumon*. For example, the medical term **pneumonia** (noo-MŌN-yă) refers to a diseased state of the lung.[23]

There are two pleural membranes in the lungs. The visceral pleura is a thin membrane on the surface of the lungs. The parietal pleural 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 keep them inflated. See Figure 4.9[24] for an illustration of the pleural membranes and the pleural cavity. *Pleur* is the word root for pleural membranes. For example, **pleural effusion** (PLOOR-ăl ĕ-FŪ-zhŭn) is a medical term that refers to excessive fluid between the pleural membranes caused by disease or trauma.[25]

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24. "2313_The_Lung_Pleurea.jpg" by OpenStax College is licensed under CC BY 3.0

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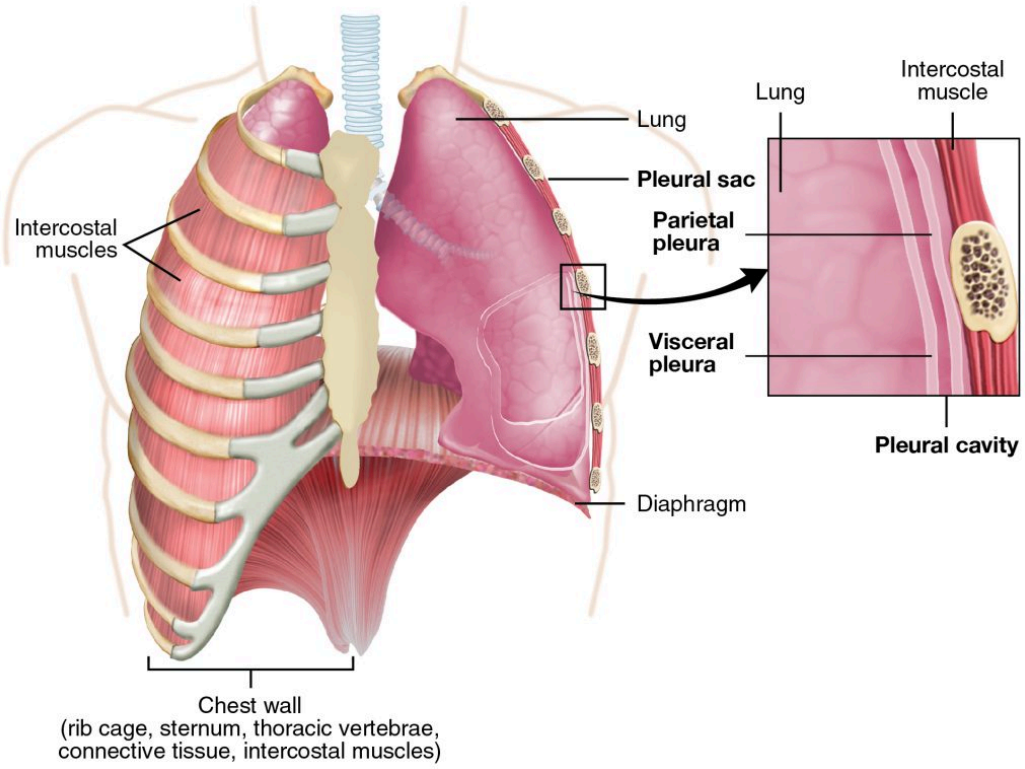

Figure 4.9 Pleural Cavity

View the following YouTube video[26] to visually review the anatomy of the respiratory system: Respiratory System Anatomy (v2.0)

26. Forciea, B. (2015, May 13). *Respiratory system anatomy* (v2.0) [Video]. YouTube. All rights reserved. Video used with permission. https://youtu.be/aqTwrdMS6CE

4.5 Physiology of the Respiratory System

The main function of the respiratory system is **gas exchange** (găs ĭk-SCHĀNJ), meaning providing 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** (vĕn-tĭ-LĀ-shŭn) (i.e., breathing).[1]

VENTILATION AND THE MECHANICS OF BREATHING

The lungs bring oxygen to the cells of our body through inhalation. **Inhalation** (i-hā-LĀ-shŭn), also called inspiration, is the act of breathing in. During inhalation, the diaphragm contracts and flattens, creating a larger lung cavity, which decreases the pressure in the lungs. At the same, the intercostal muscles (the muscles between the ribs) pull downward, also causing the thoracic cavity to expand. The **thoracic cavity** (thuh-RAS-ik KA-vah-tee) 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).

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During **exhalation** (ĕks-hā-LĀ-shŭn), also called expiration, 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.[2] See Figure 4.10[3] for an illustration of inhalation and exhalation.

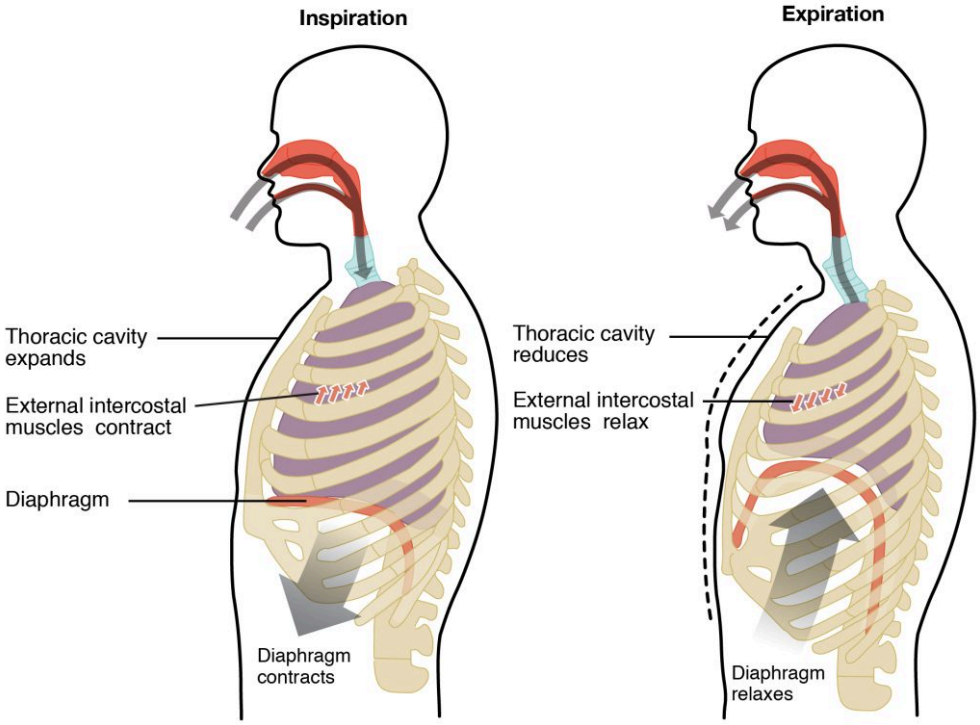

Figure 4.10 Inhalation and Exhalation

Health care professionals use an instrument called a **stethoscope** (STETH-ŏ-skōp) to listen tointernal body sounds like lung sounds. Lung sounds are

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3. "2316_Inspiration_and_Expiration.jpg" by OpenStax College is licensed under CC BY 3.0

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[4]:

- **Rhonchi** (rŏng-kahy), 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** (rāylz), also called fine crackles, are popping or crackling sounds heard on inspiration. They are associated with medical conditions, such as heart failure or pneumonia, that cause fluid accumulation within the alveolar and interstitial spaces. The sound is similar to that produced by rubbing strands of hair together close to your ear.
- **Wheezes** (wēz-ĕz) are whistling noises produced when air is forced through airways narrowed by bronchoconstriction or mucosal edema. For example, patients with asthma commonly have wheezing.
- **Stridor** (strī-door) is heard only on inspiration. It is associated with obstruction of the trachea/upper airway.
- **Pleural rub** (plur-uhl ruhb) 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.

View the following YouTube video[5] to review the

4. This work is a derivative of Open RN *Nursing Skills 2e* by Chippewa Valley Technical College with CC BY 4.0 licensing.

5. Chandra, S. (2017, November 1). *Mechanics of breathing AIDA*

mechanics of breathing: Mechanics of Breathing AIDA Freediving

Forced breathing, also known as **hyperpnea** (hī-pĕrp-NĒ-ă), is a type of breathing that can occur during exercise or actions that require the active manipulation of breathing, such as singing. During forced breathing, muscle contractions of accessory muscles, in addition to the diaphragm, are used for inspiration and expiration. These additional muscle contractions during inspiration also occur during **labored breathing** (LĀ-bŏrd BRĒ-thĭng), a symptom of many respiratory disorders.[6]

The word root *pnea* refers to breathe. Therefore, **tachypnea** (tak-ip-NĒ-ă) refers to rapid breathing, **bradypnea** (brăd-ĬP-nē-ă) refers to slow breathing, **hypopnea** (hī-POP-ne-ă) refers to deficient breathing, and **apnea** (AP-nē-ă) refers to the absence of breathing. **Dyspnea** (disp-NĒ-ă) is a common symptom of respiratory disorders and refers to difficulty breathing.

CONTROL OF BREATHING

Respiratory rate (RES-pĭr-ă-tō-rē rāt) is the number of breaths taken per minute. The normal respiratory rate for adults is 12-20 breaths per minute. A

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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 10 years old, the normal rate is closer to 18 to 30. Respiratory rate can be an important indicator of a respiratory disorder because the rate may increase or decrease during illness or disease.[7]

The respiratory rate is controlled by the respiratory center located within the medulla oblongata and the 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 surprisingly not **hypoxemia** (hī-pŏk-SĒ-mē-ă), low levels of oxygen in the blood, rather the concentration of carbon dioxide. Carbon dioxide is a waste product of cellular respiration and is toxic at high levels in the blood, referred to as **hypercapnia** (hī-pĕr-KAP-nē-ă). As carbon dioxide levels in the blood increase, the central chemoreceptors stimulate the contraction of the diaphragm and intercostal muscles (i.e., the muscles between the ribs), and the rate and depth of respiration increase to help rid the body of carbon dioxide. **Hyperventilation** (hī-pĕr-vĕn-tĭ-LĀ-shŭn) refers to rapid and deep breathing. In contrast, low levels of carbon dioxide in the blood stimulate shallow, slow breathing to help the body retain carbon dioxide. **Hypoventilation** (hī-pō-vĕn-tĭ-LĀ-shŭn) refers to slow and shallow breathing.[8]

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GAS EXCHANGE

Ventilation (i.e., the mechanics of breathing) provides air to the alveoli in the lungs for gas exchange. **Respiration** (rĕs-pĭ-RĀ-shŏn) 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.[9]

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 into the surrounding cells and 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.[10]

Asphyxia (ăs-FIK-sē-ă) refers to deprivation of oxygen to the tissues, commonly referred to as suffocation.

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PERFUSION

In addition to adequate ventilation, the second important aspect of gas exchange is perfusion. **Perfusion** (pĕr-FYŪ-zhŭn) refers to the flow of blood. In the lungs, perfusion occurs in the **pulmonary circulation** (PŬL-mŭ-năr-ē sĕr-kyŏŏ-LĀ-shŭn), as it moves from the heart to the lungs and then back to the heart for distribution to the body. The **pulmonary arteries** (PŬL-mō-nĕ-rē ăr-tĕ-rēs) 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.[11]

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** (HĒ-mō-glō-bĭn) within red blood cells (erythrocytes). The more oxygen the hemoglobin in 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.[12]

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HYPOXIA

Diseases and disorders affecting the respiratory system can cause **hypoxia** (hī-PŎK-sē-ă), low levels of oxygen in the tissues. A patient's oxygenation status is routinely assessed by health care professionals using pulse oximetry. **Pulse oximetry** (pŭls ŏk-SĬM-ĭ-trē) is an estimated oxygenation level based on the saturation of hemoglobin measured by a pulse oximeter. Because the majority of oxygen carried in the blood is attached to hemoglobin within the red blood cells, pulse oximetry estimates how much hemoglobin is "saturated" with oxygen. The normal range for pulse oximetry is 94-100%.[13]

Hypoxia can occur due to inadequate ventilation or impaired perfusion. For example, a medical condition called **pulmonary edema** (PŬL-mō-nĕ-rē ĕ-DĒ-mă) refers to fluid accumulation in alveoli, often caused by heart failure or kidney failure. As a result of the fluid, 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 carbon dioxide) may occur, requiring urgent medical interventions to sustain life by decreasing carbon dioxide levels and increasing oxygen levels.[14]

View supplementary YouTube videos for additional review of the respiratory system:

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Respiratory System[15]
Overview of the Respiratory System, Animation[16]
Respiratory System, Part 1: Crash Course A&P #31[17]

15. Amoeba Sisters. (2022, February 28). *Respiratory system* [Video]. YouTube. All rights reserved. https://www.youtube.com/watch?v=v_j-LD2YEqg

16. Alila Medical Media. (2019, April 15). *Overview of the respiratory system, animation* [Video]. YouTube. All rights reserved. https://youtu.be/03qvN5pjCTU?si=LJRgMq6RwLiUhcXF

17. CrashCourse. (2015, August 24). Respiratory system, Part 1: Crash Course Anatomy & Physiology #31 *[Video]. YouTube. All rights reserved. https://youtu.be/bHZsvBdUC2I*

4.6 Diseases and Disorders of the Respiratory System

This section provides an overview of common respiratory disorders and diseases.

ALLERGIES

Allergies (ĂL-ĕr-jēz) occur when a person's immune system reacts to a substance and makes antibodies that identify that substance as harmful. Substances identified as allergens can cause inflammation of the skin, sinuses, nasal passages, airways, or digestive system. The severity of allergies varies from person to person and can range from minor irritation to a potentially life-threatening emergency called **anaphylaxis** (ăn-ă-fĭ-LĂK-sĭs). While most allergies can't be cured, allergy medications can help relieve symptoms.[1]

There are many types of allergies. Allergic rhinitis, commonly referred to as "hay fever," can cause sneezing; **pruritus** (PRŪ-rī-tŭs), itching of the skin, as well as itching of the nose, eyes, or roof of the mouth; rhinorrhea; and watery, red, or swollen eyes. A food allergy can cause tingling in the mouth; swelling of the lips, tongue, face, or throat; hives; and anaphylaxis. Read more information about anaphylaxis in the following subsection. An insect sting allergy can cause swelling at the sting site, itching or hives all over the body, cough, chest tightness, wheezing, shortness of breath, and anaphylaxis. A

1. Mayo Clinic Staff. (2022, August 5). *Allergies*. https://www.mayoclinic.org/diseases-conditions/allergies/symptoms-causes/syc-20351497

drug allergy can cause hives, pruritus, rash, swelling in the respiratory tract, and anaphylaxis.

ANAPHYLAXIS

Severe allergies, including allergies to foods, insect stings, medications, and blood transfusions, can trigger a severe reaction known as anaphylaxis. As a life-threatening medical emergency, anaphylaxis can cause a patient to go into anaphylactic shock, a potentially fatal condition. Signs and symptoms of anaphylaxis are as follows[2]:

- Loss of consciousness
- Drop in blood pressure
- Severe shortness of breath
- Skin rash
- Light-headedness
- Rapid, weak pulse
- Nausea and vomiting

Treatment of anaphylaxis often requires injection of a medication called epinephrine to rapidly reduce the body's allergic response and restore adequate respiratory status.

2. Mayo Clinic. (2021). *Anaphylaxis*. https://www.mayoclinic.org/diseases-conditions/anaphylaxis/symptoms-causes/syc-20351468

ASTHMA

Asthma (AZ-muh) is a common chronic respiratory condition that can affect all age groups. Asthma is characterized by episodes of inflammation and edema of the airways and bronchospasms that prevent air from entering the lungs. Excessive mucus secretion can also occur, which further contributes to blockage of the airway and shortness of breath. Bronchospasms can lead to **asthma attacks** (ĂZ-mă ă-TĂKS) that can range from mild to severe and can be life-threatening. An asthma attack may be triggered by environmental factors such as dust, pollen, pet hair, or dander; changes in the weather; mold; tobacco smoke; respiratory infections; or by exercise and stress.[3] Between episodes of asthma attacks, many individuals with asthma are asymptomatic.

See Figure 4.11[4] for an illustration of how asthma affects the airways.

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4. "Asthma_attack-illustration_NIH.jpg" by United States-National Institute of Health: National Heart, Lung, Blood Institute is in the Public Domain

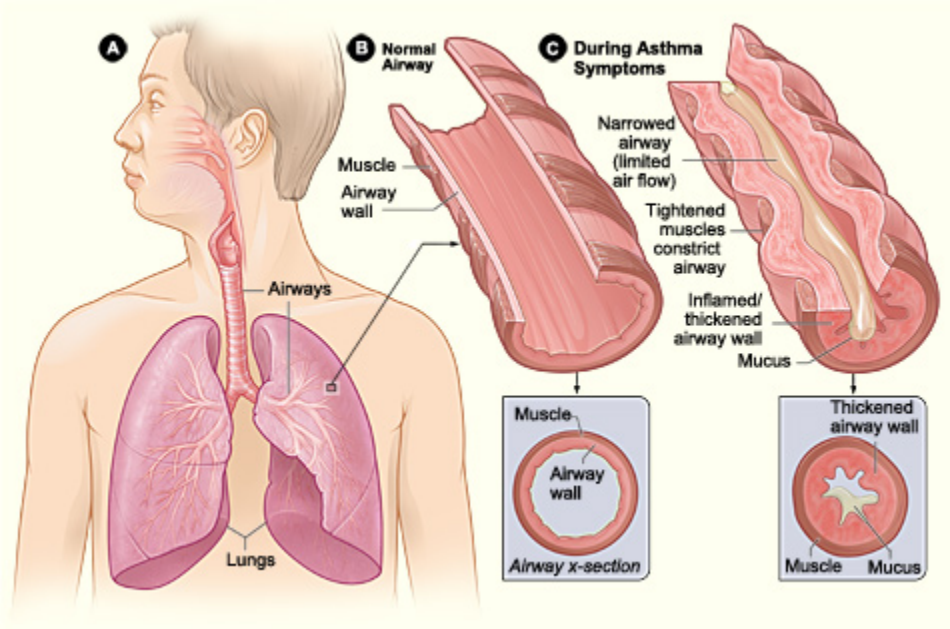

Figure 4.11 How Asthma Affects the Airways

Symptoms of an asthma attack involve coughing, dyspnea (shortness of breath), wheezing, and tightness of the chest. Severe asthma attacks can be fatal and require immediate medical attention. Symptoms of a severe asthma attack include worsening dyspnea that can cause **cyanotic** (sī-ă-NŎT-ĭk) or blue lips or fingertips, worsening wheezing, confusion, drowsiness, a rapid pulse, sweating, and severe anxiety.[5]

Chronic asthma is typically diagnosed by health care providers by using pulmonary function tests. Read more about pulmonary function tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System" section of this chapter. Individuals with asthma are often prescribed a **peak flow meter** (pēk flō mē-tĕr), a portable instrument used to measure air flow during forced exhalation, to help manage their symptoms.

Asthma is treated by respiratory medications given via an inhaler and/or

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nebulizer (NEB-yŭ-lī-zĕr). A nebulizer is a medical device that creates a mist for delivering respiratory medication. Inhalers may be referred to as dry powder inhalers (DPI) or metered dose inhalers (MDI). The severity of the condition, frequency of attacks, and identified triggers influence the type of medication that an individual may require. Long-term treatments for patients with severe asthma include oral and/or injectable medications.[6] See Figures 4.12,[7] 4.13,[8] and 4.14[9] for images of an albuterol inhaler, respiratory medication used in a nebulizer, and a nebulizer.

Figure 4.12 Albuterol Inhaler

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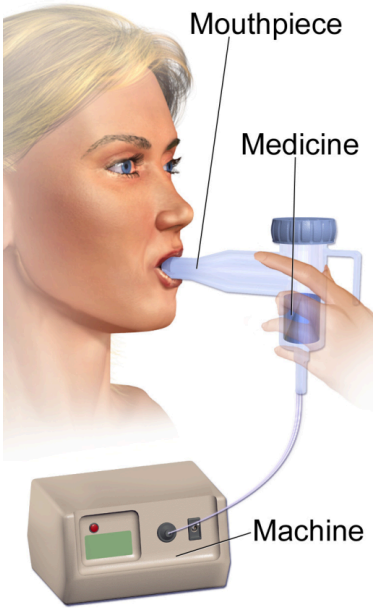
7. "Ventolin® HFA (Albuterol Sulfate) Inhaler.jpg" by MisterNarwhal is licensed under CC BY SA 4.0

8. "Albuterol 2.jpg" by Mark Oniffrey is licensed under CC BY SA 4.0

9. "Nebulizer_Mouthpiece.png" by BruceBlaus is licensed under CC BY-SA 4.0

Figure 4.13 Medication Used in a Nebulizer



Using a Nebulizer with a Mouthpiece

Figure 4.14 Nebulizer

To learn more about asthma, visit the Centers for Disease Control and Prevention (CDC) web page on asthma.

View the following YouTube video[10] for additional information about asthma: How Does Asthma Work? – Christopher E. Gaw

BRONCHITIS

Bronchitis is an inflammation of the lining of the bronchial tubes, which carry air to and from the lungs. People who have bronchitis often cough up thickened mucus, which can be discolored. Bronchitis may be either acute or chronic.

Often developing from a cold or other respiratory infection, acute bronchitis is very common. Acute bronchitis, also called a chest cold, usually improves within a week to ten days without lasting effects, although the cough may linger for weeks.

Chronic bronchitis (KRŎN-ĭk brŏng-KĪ-tĭs), a more serious condition, is a constant irritation or inflammation of the lining of the bronchial tubes, often due to smoking. Chronic bronchitis is one of the conditions included in

10. TED-Ed. (2017, May 11). *How does asthma work? – Christopher E. Gaw* [Video]. YouTube. https://youtu.be/PzfLDi-sL3w

chronic obstructive pulmonary disease (COPD).[11] Read more about COPD in the following subsection.

Symptoms for either acute bronchitis or chronic bronchitis may include the following:

- Cough
- Production of mucus (sputum), which can be clear, white, yellowish-gray, or green in color — rarely, it may be streaked with blood
- Fatigue
- Shortness of breath
- Slight fever and chills
- Chest discomfort

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Chronic obstructive pulmonary disease (KRŎN-ĭk ŏb-STRŬK-tĭv PŬL-mō-nĕ-rē dĭ-ZĒZ) **(COPD)** is an inflammatory lung disease that causes obstructed airflow out of the lungs. COPD is a chronic condition with most symptoms appearing in people in their middle 50s. COPD is most often caused by smoking but can also be caused by long-term exposure to irritating gases or dust. People with COPD are at increased risk of developing heart disease, lung cancer, and a variety of other conditions.

Emphysema and chronic bronchitis are the two types of COPD that often occur together. **Emphysema** (ĕm-fŭ-SĒ-mă) is a disorder affecting the alveoli where they become abnormally inflated, damaging their walls and making it harder to breathe. Chronic bronchitis is inflammation of the lining of the

11. Mayo Clinic Staff. (2017, April 11). *Bronchitis*. https://www.mayoclinic.org/diseases-conditions/bronchitis/symptoms-causes/syc-20355566

bronchial tubes and characterized by chronic cough and mucus (sputum) production. See Figure 4.15 for an illustration of normal lungs compared to lungs with COPD.[12]

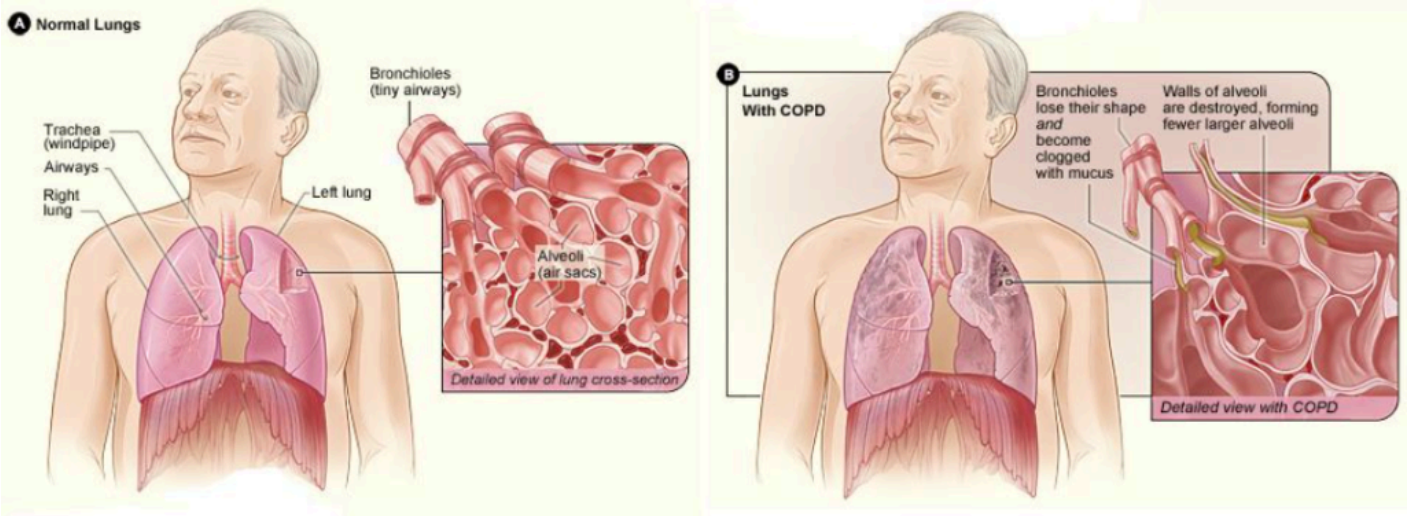


Figure 4.15 Normal Lungs Compared to Lungs in a Person With COPD

COPD symptoms often don't appear until significant lung damage has occurred, and they usually worsen over time, particularly if smoke exposure continues. Common signs and symptoms of COPD include the following:

- Dyspnea (shortness of breath), especially during physical activities
- **Wheezing** (HWĒ-zĭng) (breathing with a whistling or rattling sound in the chest)
- Chronic cough
- Excessive sputum (mucus from the respiratory tract) that may be clear, white, yellow, or greenish
- Frequent respiratory infections
- Lack of energy

12. "Copd 2010Side.JPG" by National Heart, Lung, and Blood Institute is licensed in the Public Domain.

- Barrel chest (enlarged, rounded chest)
- Unintended weight loss (in later stages)

Signs and symptoms of COPD worsen during **exacerbations** (ĕg-ză-sĕr-BĀ-shŭns) or flare-ups and can result in hospitalization. Symptoms of COPD exacerbation may include worsening dyspnea, green or brown mucus, fever, **cyanosis** (sī-ă-NŌ-sĭs) or blue lips or fingers caused by lack of oxygenation of tissues, and increased fatigue.

COPD is diagnosed by health care providers using spirometry. Spirometry is further described in pulmonary function tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System" section of this chapter.

COPD is progressive disease that is treatable but not curable. Shortness of breath may be controlled with a medication called a **bronchodilator** (brŏng-kō-dī-LĀ-tŭr), a drug that relaxes and expands the bronchi. The best way to avoid exacerbations is to avoid triggers, avoid people who are sick, get the annual flu shot, and reduce exposure to cigarette smoke and pollution.[13] The majority of cases of COPD are caused by cigarette smoking, and the best way to prevent COPD is to never smoke or stop smoking.[14]

To learn more about COPD, visit the Centers for Disease Control and Prevention's web page on COPD.

13. Centers for Disease Control and Prevention. (2023, June 30). *What is COPD?* https://www.cdc.gov/copd/index.html

14. Mayo Clinic Staff. (2020, April 15). *COPD*. https://www.mayoclinic.org/diseases-conditions/copd/symptoms-causes/syc-20353679

The Effects of Second-Hand Tobacco Smoke

The burning of a tobacco cigarette creates multiple chemical compounds that are released through mainstream smoke, which is inhaled by the smoker, and through sidestream smoke, which is the smoke that is given off by the burning cigarette. Second-hand smoke, which is a combination of sidestream smoke and the mainstream smoke that is exhaled by the smoker, has been demonstrated by numerous scientific studies to cause disease. At least 40 chemicals in sidestream smoke have been identified that negatively impact human health, leading to the development of COPD, cancer, or other conditions, such as immune system dysfunction, liver toxicity, cardiac arrhythmias, pulmonary edema, and neurological dysfunction. Furthermore, second-hand smoke has been found to harbor at least 250 compounds that are known to be toxic, carcinogenic, or both. Some major classes of carcinogens in second-hand smoke are polyaromatic hydrocarbons (PAHs), N-nitrosamines, aromatic amines, formaldehyde, and acetaldehyde.

Tobacco and second-hand smoke are considered to be carcinogenic. Exposure to second-hand smoke can cause lung cancer in individuals who are not tobacco users themselves. It is estimated that the risk of developing lung cancer is increased by up to 30 percent in nonsmokers who live with an individual who smokes in the house, as compared to nonsmokers who are not regularly exposed to second-hand smoke. Children are especially affected by second-hand smoke. Children who live with an individual who smokes inside the home have a larger number of lower respiratory infections, which are associated with hospitalizations, and higher risk of sudden infant death syndrome (SIDS). Second-hand smoke in the home has also

been linked to a greater number of ear infections in children, as well as worsening symptoms of asthma.[15]

COMMON COLD

The common cold, also known as an upper respiratory infection (URI) is a viral infection of the upper respiratory tract. Many types of viruses can cause a common cold. Children younger than six are at greatest risk of colds, but healthy adults can also expect to have two or three colds annually. Most people recover from a common cold within a week to ten days. Symptoms might last longer in people who smoke.

Symptoms of a common cold usually appear one to three days after exposure to a cold-causing virus. Signs and symptoms, which can vary from person to person, are as follows[16]:

- Runny or stuffy nose
- Sore throat
- Cough
- Congestion
- Slight body aches or a mild headache
- Sneezing

15. This work is a derivative of Anatomy and Physiology by OpenStax licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

16. Mayo Clinic Staff. (2023, May 24). *Common cold.* https://www.mayoclinic.org/diseases-conditions/common-cold/symptoms-causes/syc-20351605

- Low-grade fever
- Generally feeling unwell (malaise)

CORONAVIRUS (COVID-19)

Influenza and COVID-19 are both highly contagious respiratory illnesses, but they are caused by different viruses. COVID-19 is caused by infection with a coronavirus named SARS-CoV-2. You cannot tell the difference between the common cold, influenza, and COVID-19 by symptoms alone because all have similar symptoms. Individuals with symptoms should get tested for both influenza and COVID-19 and take appropriate precautions to prevent the spread of infection.[17]

> To read current information about COVID-19 symptoms and treatment, go to the Centers for Disease Control and Prevention (CDC) website on COVID-19.

CYSTIC FIBROSIS

Cystic fibrosis (SĬS-tĭk fī-BRŌ-sĭs) is a genetic disease that causes problems with breathing and digestion. People with cystic fibrosis have thick, sticky mucus that builds up in the lungs and digestive tract and other areas of the

17. Centers for Disease Control and Prevention. (n.d.). *COVID-19*. https://www.cdc.gov/coronavirus/2019-ncov/

body. This excessive mucus blocks airways, traps germs, makes respiratory infections more likely, and leads to lung damage. It also affects the pancreas, with the increased secretions preventing digestive enzymes from reaching the intestines, which decreases the body's ability to absorb nutrients from food.[18]

INFLUENZA

Influenza (in-floo-EN-ză), commonly referred to as the "flu," is a highly contagious viral infection affecting the respiratory tract. Symptoms of influenza include fever, cough, sore throat, rhinorrhea (runny nose), muscle aches, headache, and fatigue (severe tiredness). Most people who get influenza will recover in less than two weeks, but some people develop complications (such as pneumonia) that can be life-threatening. Anyone can get influenza, even healthy people, and serious problems related to the flu can happen to anyone at any age, but some people are at higher risk of developing serious flu-related complications if they get sick. This includes people 65 years and older, people of any age with certain chronic medical conditions (such as asthma, diabetes, or heart disease), pregnant women, and children younger than five years old. Everyone aged six months and older should get an annual flu vaccine, ideally by the end of October, to prevent influenza and its potential complications.[19]

18. Centers for Disease Control and Prevention. (2022, May 9). *Cystic fibrosis*. https://www.cdc.gov/genomics/disease/cystic_fibrosis.htm

19. Centers for Disease Control and Prevention. (2022, October 3). *Flu symptoms & complications*. https://www.cdc.gov/flu/symptoms/symptoms.htm

LUNG CANCER

Cancer (KĂN-sŏr) is a disease in which cells in the body grow out of control. When cancer begins in the lungs, it is called **lung cancer** (lŭng KĂN-sŏr), although it may spread to lymph nodes or other organs in the body, such as the brain. Cancer from other organs also may spread to the lungs. When cancer cells spread from one organ to another, they are called **metastases** (mĕ-TĂS-tă-sēz).[20]

Cigarette smoking is the number one risk factor for lung cancer. In the United States, cigarette smoking is linked to about 80% to 90% of lung cancer deaths. People who quit smoking at any age have a lower risk of lung cancer than if they had continued to smoke, but their risk is higher than the risk for people who never smoked.[21]

After smoking, radon is the second leading cause of lung cancer in the United States. Radon is a naturally occurring gas that forms in rocks, soil, and water. It cannot be seen, tasted, or smelled. When radon gets into homes or buildings through cracks or holes, it can get trapped and build up in the air inside. People who live or work in these homes and buildings breathe in high radon levels. Over long periods of time, radon can cause lung cancer.[22]

Most people with lung cancer don't have symptoms until the cancer is

20. Centers for Disease Control and Prevention. (2023, July 31). *What is lung cancer?* https://www.cdc.gov/cancer/lung/basic_info/what-is-lung-cancer.htm

21. Centers for Disease Control and Prevention. (2023, July 31). *What is lung cancer?* https://www.cdc.gov/cancer/lung/basic_info/what-is-lung-cancer.htm

22. Centers for Disease Control and Prevention. (2023, July 31). *What are the risk factors for lung cancer?* https://www.cdc.gov/cancer/lung/basic_info/risk_factors.htm

advanced and has metastasized. Lung cancer symptoms may include the following[23]:

- Coughing that gets worse or doesn't go away
- Chest pain
- Shortness of breath
- Wheezing
- **Hemoptysis** (hē-MŎP-tĭ-sĭs) (coughing up blood)
- Fatigue (feeling very tired all the time)
- Weight loss with no known cause
- Repeated episodes of pneumonia
- Swollen or enlarged lymph nodes inside the chest in the area between the lungs

Lung cancer may initially be suspected after routine tests like **chest X-rays** (chĕst ĕks-rās), also referred to as **radiographs** (RĀ-dē-ŏ-grăfs). Additional diagnostic testing is performed if lung cancer is suspected. Read more about diagnostic tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System" section of this chapter.

Treatments for lung cancer may include surgery, chemotherapy, targeted therapy, immunotherapy, and radiation therapy.

23. Centers for Disease Control and Prevention. (2023, July 31). *What are the symptoms of lung cancer?* https://www.cdc.gov/cancer/lung/basic_info/symptoms.htm

OBSTRUCTIVE SLEEP APNEA

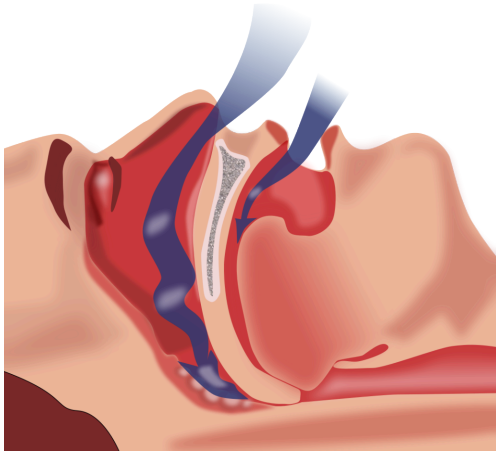


Figure 4.16 Obstructive Sleep Apnea

Obstructive sleep apnea (ŏb-STRŬK-tĭv slēp ăp-NĒ-ă) is a chronic disorder that can occur in children and adults. It is characterized by periods of no breathing during sleep. These episodes may last for several seconds or several minutes and may differ in the frequency with which they are experienced. Sleep apnea leads to poor sleep. Symptoms of sleep apnea include fatigue, evening napping, irritability, memory problems, morning headaches, and excessive snoring. A diagnosis of sleep apnea is usually done during a sleep study, where the patient is monitored in a sleep laboratory or with home testing. Treatment of sleep apnea commonly includes the use of a device called a **continuous positive airway pressure device** (kŏn-TĬN-yū-ŭs POZ-ĭ-tĭv AIR-wā PRESS-ŭr dĭ-VĪS) **(CPAP)** during sleep. The CPAP machine has a mask that covers the nose, or the nose and mouth, and forces air into the airway at regular intervals. This pressurized air can help to gently force the airway to remain open, allowing for more normal ventilation to occur.[24] Read more

24. Slowik, J. M., Sankari, A., & Collen, J. F. (2022). *Obstructive sleep apnea.*

about a CPAP device in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System" section. See Figure 4.16[25] for an illustration of obstructive sleep apnea. As soft tissue falls to the back of the throat, it impedes the passage of air (blue arrows) through the trachea and is characterized by repeated episodes of complete or partial obstructions of the upper airway during sleep.

Figure 4.16 Obstructive Sleep Apnea

PNEUMONIA

Pneumonia is an infection of the alveoli of the lungs caused by microorganisms like bacteria, viruses, or fungi that can cause mild to severe illness in people of all ages.

Symptoms of pneumonia are as follows[26]:

- Cough, which may produce greenish or yellow mucus (often called purulent sputum)
- Fever and shaking chills
- Dyspnea (shortness of breath)
- Rapid, shallow breathing

[Updated 2022 Dec 11]. In: StatPearls [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK459252/

25. "Obstruction ventilation apnée sommeil.svg" by Habib M'henni is in the Public Domain.

26. American Lung Association. (2023, August 3). *Pneumonia symptoms and diagnosis.* https://www.lung.org/lung-health-diseases/lung-disease-lookup/pneumonia/symptoms-and-diagnosis

- Sharp or stabbing chest pain that gets worse when breathing deeply or coughing
- Loss of appetite, low energy, and fatigue

See Figure 4.17[27] for an image of purulent sputum.

Figure 4.17 Purulent Sputum

Common diagnostic tests for pneumonia include sputum cultures and chest X-rays. Read more about these diagnostic tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System" section of this chapter.

There are several categories of pneumonia that are treated with different types of antibiotics[28]:

- **Aspiration pneumonia:** Pneumonia that occurs when food or liquid is

27. "Sputum.JPG" by Zhangmoon618 is licensed under CC0

28. Centers for Disease Control and Prevention. (2022, September 30). *Causes of pneumonia*. https://www.cdc.gov/pneumonia/causes.html

breathed into the airways or lungs, instead of being swallowed.

- **Community-acquired pneumonia:** Pneumonia that is diagnosed in someone in the community (not in a hospital).
- **Healthcare-associated pneumonia:** Pneumonia that is diagnosed in someone during or following a stay in a health care setting.
- **Ventilator-associated pneumonia:** Pneumonia that is diagnosed in someone who has been on a ventilator.

Incentive Spirometry

Patients who have undergone surgery are at risk for developing atelectasis and pneumonia. Atelectasis means the alveoli have become deflated, which can cause a partial or complete collapsed lung and/or lead to pneumonia. An incentive spirometer is a medical device often prescribed as a preventative measure after surgery or for patients with atelectasis. While sitting upright, the patient should breathe in slowly and deeply through the tubing with the goal of raising the piston to a specified level. See Figure 4.18[29] for an image of a patient using an incentive spirometer. The patient should attempt to hold their breath for five seconds, or as long as tolerated, and then rest for a few seconds. This technique should be repeated by the patient ten times every hour while awake.[30]

29. "Incentive Spirometer.pngsommeil.svg" by BruceBlaus is licensed under CC BY-SA 4.0

30. [31]

31. [16]

Figure 4.18 Using an Incentive Spirometer

PULMONARY EDEMA

Pulmonary edema is the accumulation of fluid in the alveoli causing decreased gas exchange, resulting in increased levels of carbon dioxide and decreased levels of oxygen in the blood. Pulmonary edema can be caused by several medical conditions, such as pneumonia, heart failure, kidney failure, and liver failure. It is treated with medications that help eliminate excess fluid from the body, called diuretics.

PULMONARY EMBOLISM

A **pulmonary embolism** (PULL-muh-nair-ee EM-boh-liz-uhm) **(PE)** is a blood clot or other substance, such as fat or an air bubble, that has traveled through the bloodstream and lodged in a smaller vessel within the pulmonary circulation in the lungs and obstructed blood flow. This blockage causes lack

of oxygen delivery to the tissues supplied by that blood vessel. A PE is medical emergency that requires rapid treatment to prevent severe damage to the lungs or heart and death. Symptoms of a PE may include sudden, severe dyspnea; sharp pain in the chest or arm; and pale, clammy skin. Treatment includes medications to dissolve the clot or procedures to remove the clot in order to quickly restore adequate pulmonary circulation.[32]

RESPIRATORY SYNCYTIAL VIRUS

Respiratory syncytial virus (rĕs-pĭ-RĂ-tōr-ē SĬN-sĭ-shē-ăl VĪ-rŭs) **(RSV)** is a very common respiratory virus that usually causes mild, cold-like symptoms. Most people recover in a week or two, but RSV can be very serious in infants and older adults. RSV is a common cause of pneumonia and bronchiolitis. **Bronchiolitis** (brŏng-kē-ŎL-ĭ-tĭs) refers to inflammation of the small airways in the lung. Older adults and infants younger than six months of age with RSV may require hospitalization if they have problems breathing or become dehydrated. Severe cases may require endotracheal intubation and mechanical ventilation.[33]

TUBERCULOSIS

Tuberculosis (tū-bĕr-kyŭ-LŌ-sĭs) **(TB)** is a serious infectious disease that

32. Cleveland Clinic. (2022). *Pulmonary embolism*. https://my.clevelandclinic.org/health/diseases/17400-pulmonary-embolism

33. Centers for Disease Control and Prevention. (2023). *Respiratory syncytial virus*. https://www.cdc.gov/rsv/about/symptoms.html

affects the lungs. It is caused by bacteria that can be spread through the air from person to person. Symptoms include a chronic cough, **hemoptysis** (hē-MŎP-tĭ-sĭs) or coughing up blood, weight loss, night sweats, and fever. Patients with TB require a long course of treatment involving multiple antibiotics.[34]

View a supplementary YouTube video[35] on tuberculosis:

CDC Tuberculosis (TB) Tansmission and Pathogenesis Video

34. Centers for Disease Control and Prevention. (2023). Tuberculosis. https://www.cdc.gov/tb/default.htm

35. Centers for Disease Control and Prevention. (2020, May 6). *CDC tuberculosis (TB) transmission and pathogenesis video* [Video]. YouTube. All rights reserved. https://youtube.com/watch?v=UKV8Zn7x0wM

4.7 Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System

SPECIALISTS

Pulmonologist

Respiratory medicine is concerned with the diagnosis and treatment of diseases related to the respiratory system. Respiratory medicine requires in-depth knowledge of internal medicine. A physician who specializes in diagnosing and treating respiratory system disease is called a **pulmonologist** (pŭl-mŏn-ŎL-ŏ-jĭst).[1]

> For more information, visit the American Lung Association's page on pulmonologists.

1. American Lung Association. (2019, May 14). *Know your providers – What does a pulmonologist do?* https://www.lung.org/blog/know-your-providers-pulmonologist

Respiratory Therapist

Respiratory therapists (rĕ-spĭr-ă-tōr-ē THĔR-ă-pĭsts) **(RTs)** are health care professionals that monitor, assess, and treat people who are having problems breathing. RTs are licensed in the state in which they practice. RTs are trained in ventilation and airway management, cardiopulmonary resuscitation, and oxygen and aerosol therapy. They provide care for patients undergoing cardiac stress-testing, pulmonary function testing, smoking cessation, high-risk births, rehabilitation, and surgery. They also assist in treating patients with asthma, COPD, heart failure, and pneumonia.[2]

> For more information, visit the American Association for Respiratory Care's What is an RT? web page.

Thoracic Surgeon

A **thoracic surgeon** (thō-RĂS-ĭk SŬR-jŏn) refers to a surgeon who has specialized in either thoracic (chest) surgery or cardiothoracic (heart and chest) surgery. They perform surgery for patients with serious conditions of the heart, lungs, and other structures in the chest cavity.[3]

> To learn more about thoracic surgeons, visit WebMD's What is a Thoracic Surgeon? web page.

2. American Association for Respiratory Care. (n.d.). *What is an RT?* https://www.aarc.org/careers/what-is-an-rt/

3. WebMD. (2023, July 8). *What is a thoracic surgeon?* https://www.webmd.com/a-to-z-guides/what-is-a-thoracic-surgeon

DIAGNOSTIC TESTING AND PROCEDURES

Arterial Blood Gas

Arterial blood gas (ar-TĬR-ē-ăl blŭd găs) **(ABG)** is a measurement of dissolved oxygen and carbon dioxide levels in blood taken from an artery. ABG is often obtained for patients who have deteriorating or unstable respiratory status requiring urgent and/or emergency treatment. An ABG is typically drawn in the forearm from the radial artery by a respiratory therapist, emergency or critical care nurse, or other health care provider.

Bronchoscopy

A **bronchoscopy** (bron-KOS-kŏ-pē) is a procedure used to visualize the bronchi with a **bronchoscope** (BRŎNG-kŏ-skōp), a thin, flexible tube with a light and a lens or small video camera on the end. The tube is inserted into the patient's nose or mouth, down the throat, into the trachea (windpipe), and into the airways (bronchi and bronchioles) of the lungs. It is typically performed by a physician. See Figure 4.19[4] for an image of a bronchoscopy.

4. "Bronchoskopie_Bronchoalveoläre_Lavage.jpg" by User:MrArifnajafov is licensed under CC BY-SA 3.0

Figure 4.19 Bronchoscopy

A bronchoscopy is performed to look for the causes of problems in the airways of the lungs or to further examine an abnormal area seen on an imaging test (such as a chest X-ray or CT scan).[5] Any abnormal areas in the airways that are seen with the bronchoscope can be biopsied to determine the cause of the abnormal finding. A biopsy is performed by passing long, thin instruments down the bronchoscope, such as small forceps (tweezers), needles, or brushes to collect the samples. Sterile salt water can also be flushed down the bronchoscope to rinse the airways and then suctioned up, which is referred to as a **bronchial washing** (BRŎNG-kē-ăl WŎSH-ing). The biopsy samples are visually examined under a microscope in a pathology lab.[6]

5. American Cancer Society. (2019, January 14). *Bronchoscopy*. https://www.cancer.org/cancer/diagnosis-staging/tests/endoscopy/bronchoscopy.html

6. American Cancer Society. (2019, January 14). *Bronchoscopy*. https://www.cancer.org/cancer/diagnosis-staging/tests/endoscopy/bronchoscopy.html

Chest X-Ray

As discussed earlier, a chest x-ray (CXR) is also referred to as a radiograph. Using a controlled beam of radiation, a CXR produces shadow-like images of organs and tissues like the bones, lungs, heart, and the diaphragm. After passing through the body, the beam hits a piece of film or a special detector. Tissues in the body absorb or block the radiation to varying degrees. Dense tissues, such as bones, block most radiation and appear white on the CXR. Soft tissues, like fat or muscle, block less radiation and show up in shades of gray. Organs that are mostly air (such as the lungs) appear black. Tumors are usually denser than the tissue around them, so they often show up as lighter shades of gray.[7] See Figure 4.20[8] for an image of a CXR. A CXR is used to diagnose a variety of respiratory conditions, such as pneumonia, pulmonary edema, and cancer.

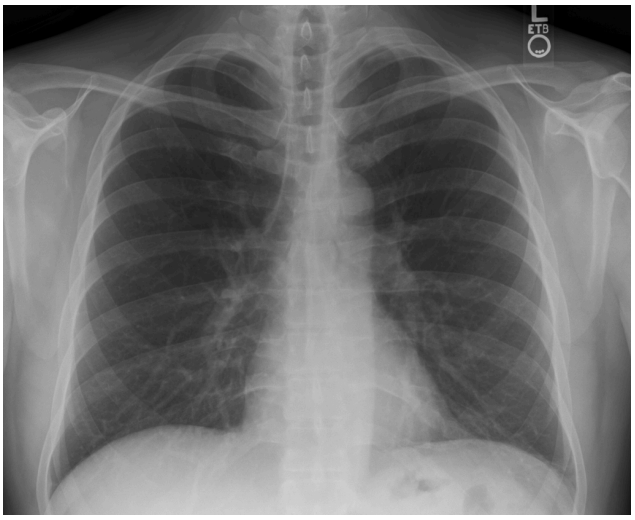


Figure 4.20 Chest X-ray

7. American Cancer Society. (2022, August 15). *Tests for lung cancer*. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

8. "Chest Xray PA 3-8-2010.png" by Stillwaterising is licensed under CC0

Computed Tomography (CT) Scan

A **computed tomography scan** (kŏm-PYŌŌ-tĕd tŏ-mŎG-ră-fē skăn) **(CT)** uses X-rays to make detailed cross-sectional images of a person's body. Instead of taking one or two pictures like a regular X-ray, a CT scanner takes many pictures and then a computer combines them to create detailed images in slices of the part of the body being studied. See Figure 4.21[9] for an image of a CT scanner.

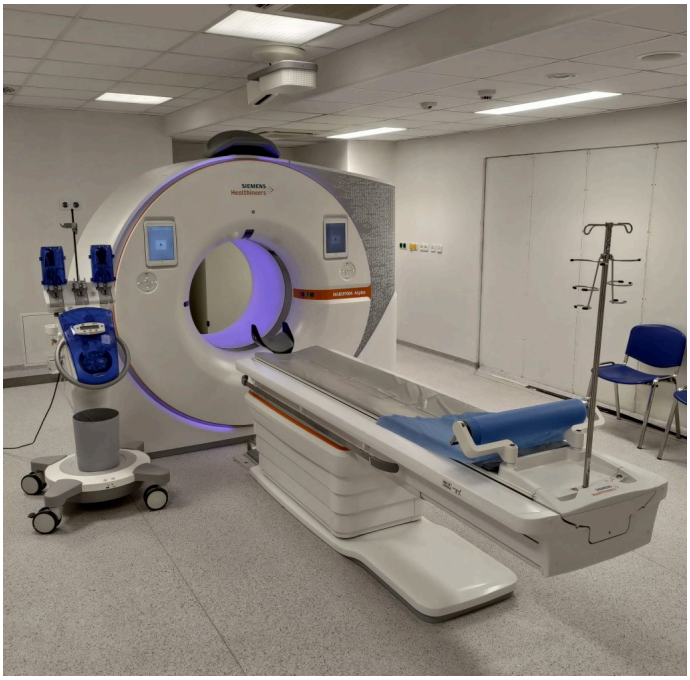


Figure 4.21 CT Scanner

A CT scan is more likely to show lung tumors than routine chest X-rays. It can also show the size, shape, and position of any lung tumor and can help visualize enlarged lymph nodes that might contain cancer that has spread. A

9. "Moderní_výpočetní_tomografie_s_přímo_digitální_detekcí_rentgenového_záření.jpg" by Tomáš Vendiš is licensed under CC BY-SA 4.0

CT scan can also be used to look for masses in the liver, brain, and other organs that can occur if the cancer has metastasized.[10]

If a suspected area of cancer is deep within the body, a CT scan can be used to guide a biopsy needle into this area to obtain a tissue sample to biopsy for cancer. This procedure is referred to as a **CT-guided needle biopsy** (sē-tē GĪ-dĕd NĒ-dŭl BĪ-ŏp-sē).[11] See Figure 4.22[12] for an image of a CT-guided needle biopsy of the lung.

10. American Cancer Society. (2022, August 15). *Tests for lung cancer*. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

11. American Cancer Society. (2022, August 15). *Tests for lung cancer*. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

12. "Biopsie_Lunge_Computertomographie_BC.png" by Hellerhoff is licensed under CC BY-SA 3.0

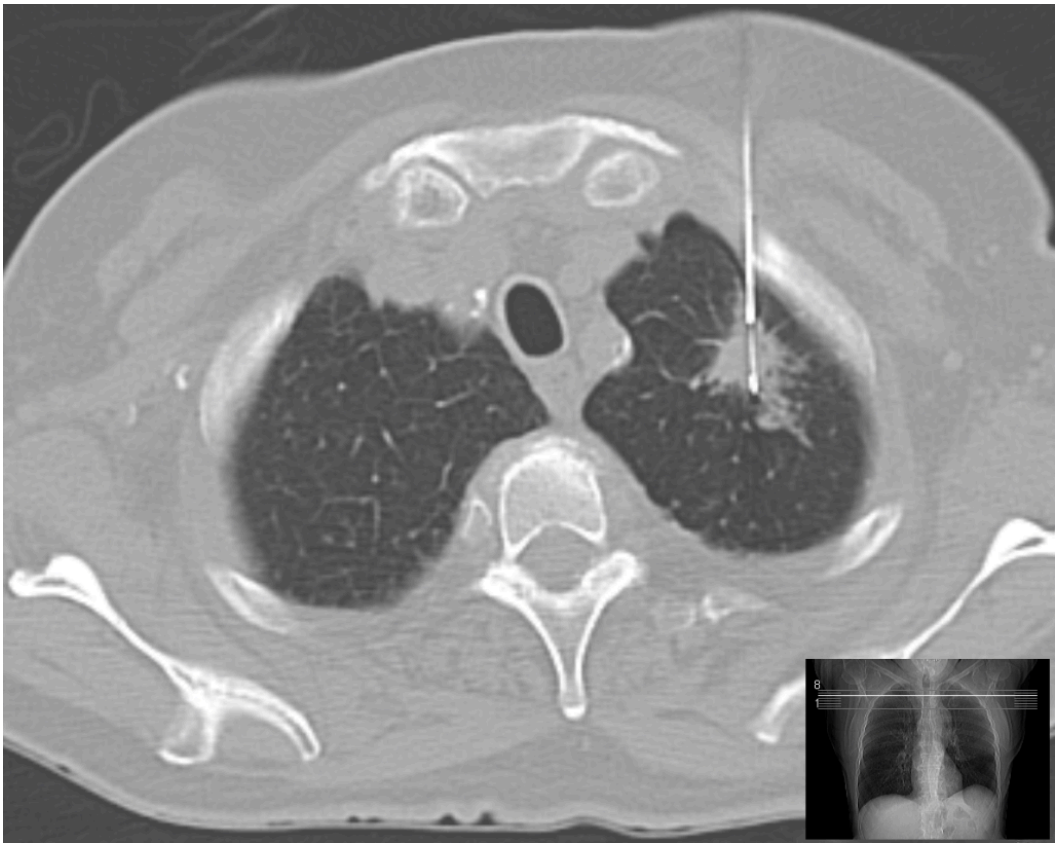


Figure 4.22 CT-Guided Needle Biopsy

Endotracheal Intubation

When a patient is experiencing respiratory failure or receiving general anesthesia during surgery, an **endotracheal tube** (ĕn-dō-TRĀ-kē-ăl tūb) **(ET tube)** is inserted to maintain a patent airway by health care professionals with advanced training, such as a respiratory therapist, paramedic, anesthesiologist, or physician. The ET tube is sealed within the trachea with an inflatable cuff, and oxygen is supplied via a bag valve mask or via mechanical ventilation. See Figure 4.23[13] for an image of a cuffed endotracheal tube.

13. "Sondeintubation.jpg" by bigomar2 is licensed under CC BY-SA 3.0

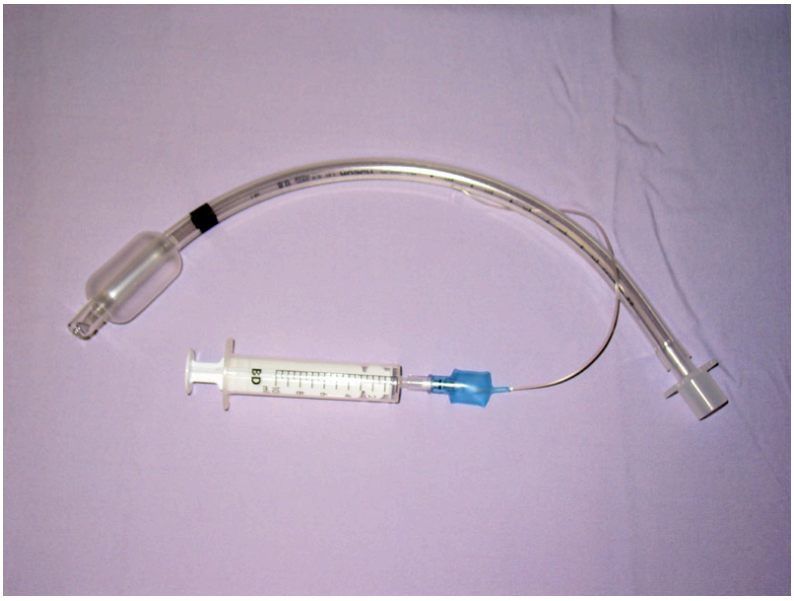


Figure 4.23 An Endotracheal Tube

Magnetic Resonance Imaging (MRI)

Similar to CT scans, **magnetic resonance imaging** (măg-NĚT-ĭk rĕz-ŏ-năns ĬM-ă-jing) **(MRI)** scans show detailed images of soft tissues in the body. However, MRI scans use radio waves and strong magnets instead of radiation. MRI scans are used to diagnose many medical conditions, such as soft tissue abnormalities, tears in ligaments, joint abnormalities, and tumors. They are also used to evaluate for metastasis of cancer to other areas of the body, such as the brain, liver, lungs, and bones.[14]

Mechanical Ventilation

A **mechanical ventilator** (mĕ-kăn-Ĭ-kăl vĕn-tĬ-lā-tŏr) is a machine attached to an endotracheal tube to assist or replace spontaneous breathing. Mechanical ventilation is termed invasive because it requires placement of an

14. American Cancer Society. (2022, August 15). *Tests for lung cance*r. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

endotracheal tube in the trachea. Mechanical ventilators are typically managed by respiratory therapists. See Figure 4.24[15] for an image of a simulated patient who is intubated with an endotracheal tube that is attached to a mechanical ventilator.

Figure 4.24 Simulated Intubated Patient on a Mechanical Ventilator

Needle Biopsy

During a **needle biopsy** (NĒ-dŭl BĪ-ŏp-sē), doctors use a needle to obtain a small sample of cells from a suspicious area (mass) to examine under a microscope. An advantage of needle biopsies is that they don't require a surgical incision. There are a variety of types of needle biopsies. One type of needle biopsy is a **fine needle aspiration biopsy** (fīn NĒ-dŭl ăs-pĭ-RĀ-shŭn BĪ-ŏp-sē) **(FNA)**. During this procedure, a syringe with a very thin, needle is used

15. "Simulated intubated patient on a mechanical ventilator" by Chippewa Valley Technical College is licensed under CC BY 4.0

to **aspirate** (ĂS-pĭ-rāt) or withdraw cells and small fragments of tissue. An FNA biopsy is often used to check for cancer in lymph nodes.[16]

Positron Emission Tomography Scan

During a **positron emission tomography scan** (pŏz-Ĭ-trŏn ĭ-MĬSH-ən tŏ-mŏG-ră-fē skăn) **(PET)**, a slightly radioactive substance is injected into the patient's blood. If cancer cells are present in the body, they have a higher uptake of this radioactive substance and appear as a highlighted area on the scan. Often a PET scan is combined with a CT scan so the highlighted areas on the PET scan can be easily visualized with the corresponding image on the CT scan. PET/CT scans are useful to determine if cancer has spread to other parts of the body.[17] See Figure 4.25[18] for an image of a PET/CT scan showing a red highlighted area of radioactive substance, indicating cancer cells have spread to this area of the body.

16. American Cancer Society. (2022, August 15). *Tests for lung cancer*. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

17. American Cancer Society. (2022, August 15). *Tests for lung cancer*. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

18. "Anterior_Pancoast_tumor_PET.jpg" by Soichi Oka, Kenji Ono, Kenta Kajiyam, and Katsuma Yoshimatsu is licensed under CC BY-SA 4.0

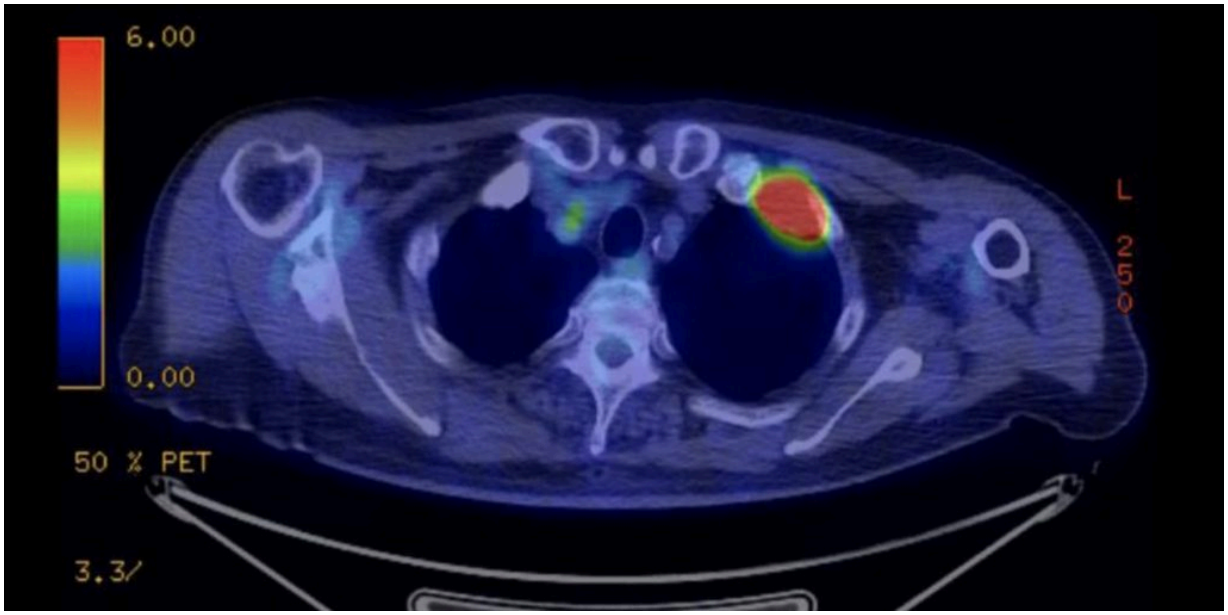


Figure 4.25 PET-CT Scan

Pulmonary Function Tests

Pulmonary function tests (PŬL-mŏ-nā-rē fŭnk-shŭn tĕsts) **(PFTs)** allow physicians and respiratory therapists to evaluate the respiratory function of patients with various types of lung disease. PFTs do not provide a specific diagnosis, but the results are combined with other assessment data to reach a diagnosis. PFTs also help determine the severity of pulmonary disease, assess the patient's response to treatment, and monitor for possible disease progression over time.[19]

Spirometry (spī-RŎM-ĕ-trē) is a common PFT that measures the patient's ability to inhale and exhale air relative to time using a device called a spirometer. Spirometry is used for diagnosis and therapeutic management of common respiratory disorders, such as asthma and chronic obstructive pulmonary disease (COPD). The primary measurements during spirometry testing are forced vital capacity (FVC), forced expiratory volume exhaled in the

19. This work is a derivative of StatPearls by Ponce, Sankari, & Sharma and is licensed under CC BY 4.0

first second (FEV1), and the FEV1/FVC ratio. The spirometry procedure has three phases that include maximal inspiration, a “blast” of exhalation, and a complete exhalation.[20] View an illustration of spirometry in Figure 4.26.[21]

Figure 4.26 Spirometry

View the following YouTube video[22] for more information

20. This work is a derivative of StatPearls by Ponce, Sankari, & Sharma and is licensed under CC BY 4.0

21. “Spirometry_Part_1.png” by BruceBlaus is licensed under CC BY-SA 4.0

22. BMJ Learning. (2020, July 1). *How to do a spirometry test and interpret the results* [Video]. YouTube. All rights reserved. https://youtu.be/jSkwBoed6Tw?si=AQxyjWNULZLAgC2t

about spirometry: How To Do a Spirometry Test and Interpret the Results

Sputum Culture

A **sputum culture** (SPYŌŌ-tŭm KŬL-chŭr) is a diagnostic test that evaluates the type and number of bacteria present in mucus from the respiratory tract. The patient is asked to cough deeply and spit any mucus that comes up into a sterile specimen container. Care must be taken to ensure the specimen only contains mucus and not saliva. The sample is sent to a lab where it is placed in a special dish and examined for two to three days or longer to see if bacteria or other disease-causing pathogens grow. See Figure 4.27[23] for an image of a sputum culture.

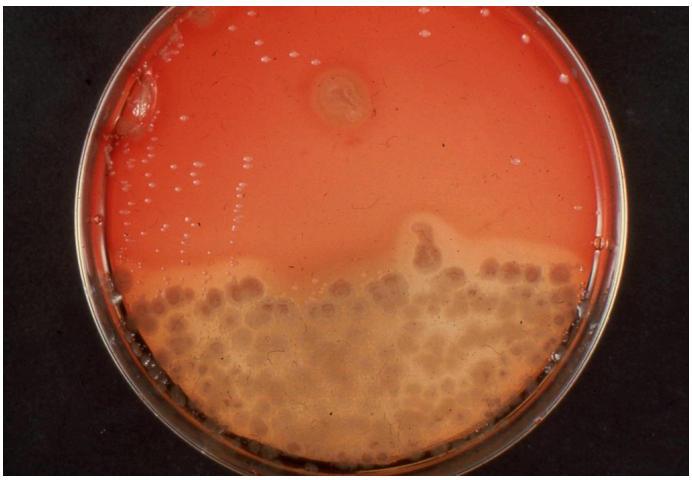


Figure 4.27 Sputum Culture

23. "m241-8 Blood agar culture of sputum from patient with pneumonia. Comprimised host. Colonies of Candida albicans and pseudomonas aeruginosa (LeBeau)" by Microbe World is licensed under CC BY-NC-SA 2.0

Thoracentesis

If fluid has collected in the pleural space around the lungs (called a pleural effusion), health care providers perform a procedure called a **thoracentesis** (thor-uh-sen-TEE-sis) to remove the fluid. Pleural effusion is typically caused by a medical condition, such as pneumonia, heart failure, infection, or lung cancer.

During a thoracentesis, the patient's skin is numbed, and a needle is inserted between the ribs to aspirate (i.e., suction) the fluid for examination in the lab. If recurrent pleural effusions cause the patient to have trouble breathing, thoracentesis may be repeated to remove additional fluid to help the patient breathe better.[24] See Figure 4.28[25] for an illustration of removal of fluid during a thoracentesis.

24. American Cancer Society. (2022, August 15). *Tests for lung cancer*. https://www.cancer.org/cancer/types/lung-cancer/detection-diagnosis-staging/how-diagnosed.html

25. "Thoracentesis.jpg" by National Heart, Lung and Blood Institute is licensed in the Public Domain.

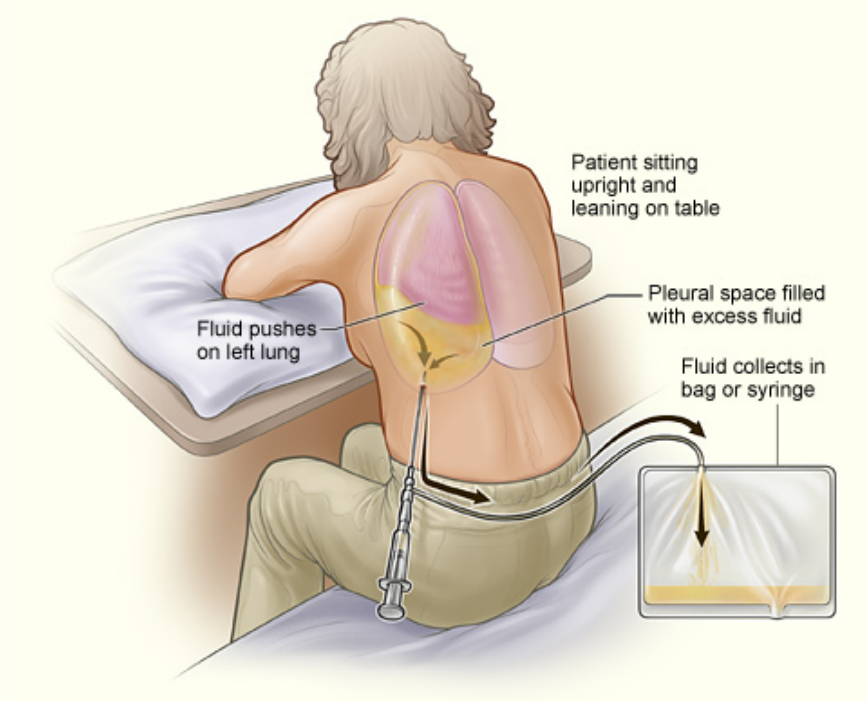


Figure 4.28 Thoracentesis

Tracheostomy

A **tracheostomy** (trā-kē-ŎS-tŏ-mē) is a surgically created opening, called a stoma, that goes from the front of the patient's neck into the trachea. A tracheostomy tube is placed through the stoma into the trachea to maintain a patent (open) airway and to administer oxygen. A tracheostomy may be an emergent procedure performed due to an airway obstruction or a planned procedure to manage a disease process. See Figure 4.29[26] for an illustration of a patient with a tracheostomy tube in place.

26. "Tracheostomy NIH.jpg" by National Heart, Lung, and Blood Institute is in the Public Domain.

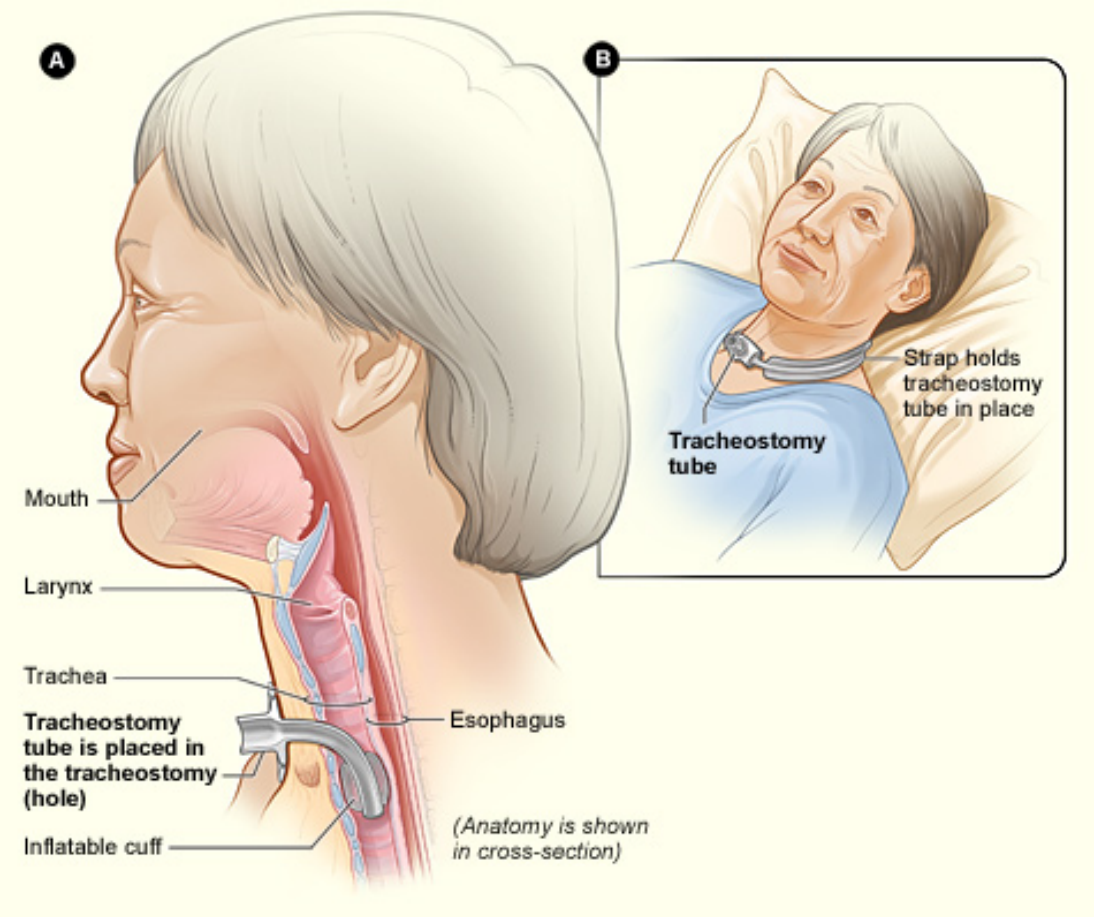


Figure 4.29 Patient With Tracheostomy Tube

RESPIRATORY EQUIPMENT

There are various types of medical devices related to the respiratory system.

Continuous Positive Airway Pressure (CPAP)

A **continuous positive airway pressure device** (kŏn-TĬN-yū-ŭs POZ-ĭ-tĭv AIR-wā PRESS-ŭr dĭ-VĪS) **(CPAP)** is used for people who are able to breathe spontaneously on their own but need help in keeping their airway unobstructed, such as those with obstructive sleep apnea. The CPAP device consists of a special mask that covers the patient's nose, or nose and mouth, and is attached to a machine that continuously applies mild air pressure to

keep the patient's airways from collapsing. See Figure 4.30[27] for an illustration of a patient wearing a CPAP device while sleeping.

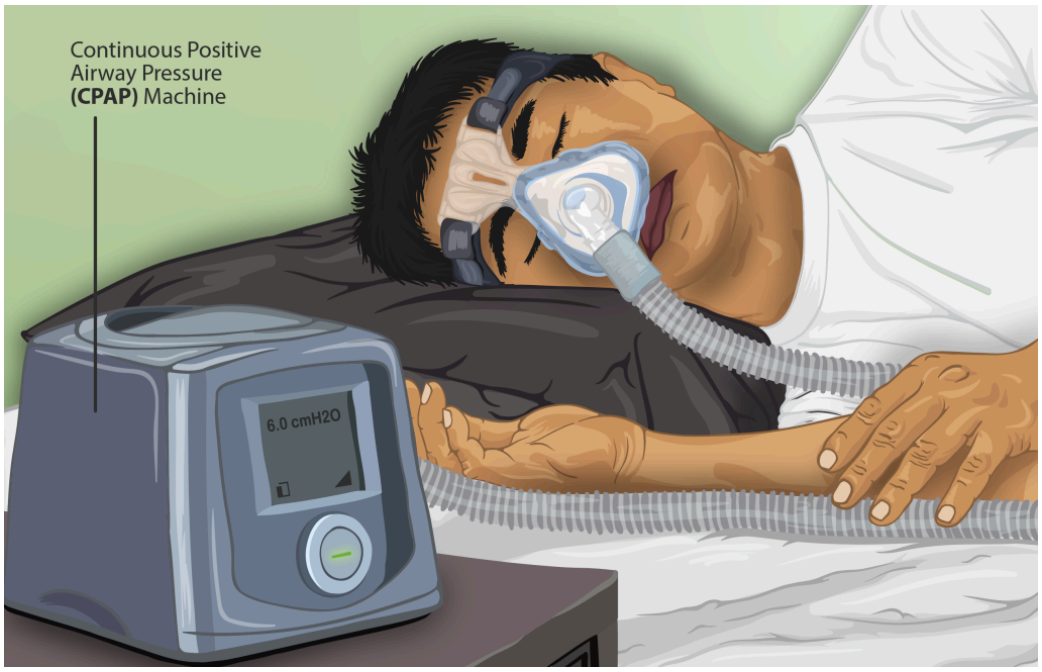


Figure 4.30 CPAP Machine

Bilevel Positive Airway Pressure (BiPAP)

A **bilevel positive airway pressure** (BĪ-lĕv-ĕl PŎZ-ĭ-tĭv ĀR-wā PRĔSH-ŭr) **(BiPAP)** device is similar to a CPAP device in that it is used to prevent airways from collapsing, but BiPAP devices have two pressure settings. One setting occurs during inhalation, and a lower pressure setting is used during exhalation. Patients using BiPAP devices in their home environment for obstructive sleep apnea often find these two pressures more tolerable because they don't have to exhale against continuous pressure. In acute care settings, BiPAP devices are also used for patients in acute respiratory distress

27. "Depiction of a sleep apnea patient using a CPAP machine" by https://www.myupchar.com/en is licensed under CC BY 4.0

as a noninvasive alternative to intubation and mechanical ventilation and are managed by respiratory therapists. See Figure 4.31[28] for an image of a simulated patient wearing a BiPAP mask in a hospital setting.

Figure 4.31 Simulated Patient Wearing a BiPAP Mask

Nasal Cannula

A **nasal cannula** (NĀ-zăl KĂN-yū-lă) is the simplest and most commonly used oxygenation device. It consists of oxygen tubing connected to two short

28. "Simulated patient wearing a BiPAP mask" by Chippewa Valley Technical College is licensed under CC BY 4.0

prongs that are inserted into the patient's nares (nostrils). See Figure 4.32[29] for an image of a nasal cannula. Nasal cannulas are used for short- and long-term therapy and are best used with stable patients who require low amounts of oxygen, such as patients with COPD.

Figure 4.32 Nasal Cannula

Read more information about additional oxygenation devices such as a high-flow nasal cannula, non-rebreather mask, partial rebreather mask, Venturi mask, oxymask, and oxymizer in the "Oxygenation Equipment" section of the "Oxygen Therapy" chapter of Open RN *Nursing Skills, 2e*.

29. "Image00011.jpg" by British Columbia Institute of Technology is licensed under CC BY 4.0. Access for free at https://opentextbc.ca/clinicalskills/chapter/5-5-oxygen-therapy-systems/

Pulse Oximeter

A **pulse oximeter** (pŭls ŏk-SĬM-ĭ-tŏr) is a commonly used portable device used to obtain a patient's oxygen saturation level, often referred to as a pulse oximetry reading. The pulse oximeter analyzes light produced by the probe as it passes through the finger to determine the saturation level of hemoglobin with oxygen while also analyzing the pulse rate See Figure 4.33[30] for an image of a portable pulse oximeter. The normal range for a pulse oximetry reading for an adult without an underlying respiratory condition is 94-100%.

Figure 4.33 Portable Pulse Oximeter

30. "OxyWatch_C20_Pulse_Oximeter.png" by Thinkpaul is licensed under CC BY-SA 3.0

4.8 Respiratory System Learning Activities

Interactive Learning Activity: Label the anatomy of the respiratory system using this drag and drop activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-154

Interactive Learning Activity: Study terms discussed in this chapter using these flashcards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-173

Interactive Learning Activity: Test your comprehension of respiratory system terms and concepts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-104

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-99

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-101

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-102

Interactive Learning Activity: Practice identifying and defining word parts for terms discussed in this chapter:

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3086#h5p-195

You can also print this as a Chapter 4 Practice Worksheet and check your answers with this Answer Key PDF.

4.9 Glossary

Adenoid (ĂD-ĕ-noyd): Lymphatic tissue between the back of the nasal cavity and the pharynx. (Chapter 4.4)

Adenoiditis (ad-ĕ-noyd-ĪT-is): Inflammation of the adenoids. (Chapter 4.4)

Allergies (ĂL-ĕr-jēz): A condition in which the immune system reacts abnormally to a foreign substance. (Chapter 4.6)

Alveolar (ăl-VĒ-ŏ-lăr): Pertaining to the alveoli, the small air sacs in the lungs responsible for gas exchange. (Chapter 4.4)

Alveoli (ăl-VĒ-ō-lī): Tiny air sacs in the lungs where the exchange of oxygen and carbon dioxide takes place. (Chapter 4.4)

Anaphylaxis (ăn-ă-fĭ-LĂK-sĭs): A severe, potentially life-threatening allergic reaction. (Chapter 4.6)

Apnea (ĂP-nē-ă): Absence of breathing. (Chapter 4.5)

Arterial blood gas (ar-TĬR-ē-ăl blŭd găs): A test that measures the amounts of oxygen and carbon dioxide in the blood from an artery. It is used to check how well the lungs are able to move oxygen into the blood and remove carbon dioxide from the blood. (Chapter 4.7)

Asphyxia (ăs-FĬK-sē-ă): A condition arising when the body is deprived of oxygen, causing unconsciousness or death; suffocation. (Chapter 4.5)

Aspirate (ĂS-pĭ-rāt): To draw in or out using a sucking motion, typically refers to the process of drawing fluid or tissue samples from the body. (Chapter 4.7)

Aspiration (ăs-pĭ-RĀ-shŭn): The inhalation of food, liquid, or other material into the respiratory tract. (Chapter 4.4)

Asthma (ĂZ-mă): A condition in which a person's airways become inflamed, narrow, and swell, producing extra mucus, which makes it difficult to breathe. (Chapter 4.6)

Asthma attacks (ĂZ-mă ă-TĂKS): Episodes of severe asthma symptoms, such as coughing, wheezing, and shortness of breath. (Chapter 4.6)

Atelectasis (ăt-ĕ-lĔK-tă-sĭs): The collapse of part or all of a lung, often

caused by a blockage of the air passages or by pressure on the outside of the lung. (Chapter 4.4)

Bilevel positive airway pressure (BĪ-lĕv-ĕl PŎZ-ĭ-tĭv ĀR-wā PRĔSH-ŭr) (BiPAP): A form of noninvasive ventilation that provides two levels of air pressure, one for inhalation and a lower one for exhalation, used in the treatment of sleep apnea and other respiratory problems. (Chapter 4.7)

Bradypnea (brăd-ĬP-nē-ă): Abnormally slow breathing. (Chapter 4.5)

Bronchi (BRŎNG-kī): The main passageways into the lungs. (Chapter 4.4)

Bronchial washing (BRŎNG-kē-ăl WŎSH-ing): A procedure during bronchoscopy where saline is squirted into a part of the lung and then recollected for examination. It's used to collect cells from the bronchial tubes. (Chapter 4.7)

Bronchioles (BRŎNG-kē-ōlz): Small branches of the bronchi that lead to the alveoli in the lungs. (Chapter 4.4)

Bronchiolitis (brŏng-kē-ŎL-ĭ-tĭs): An inflammation of the small airways in the lungs, known as bronchioles, usually due to a viral infection. It is most common in infants and young children, particularly during the winter months, and can cause symptoms like wheezing, coughing, and difficulty breathing. (Chapter 4.6)

Bronchitis (brŏng-KĪ-tĭs): Inflammation of the bronchial tubes, often resulting from infection or environmental factors like smoking. (Chapter 4.4)

Bronchodilator (brŏng-kō-DĪ-lā-tŏr): A drug that relaxes bronchial muscle resulting in expansion of the bronchial air passages, used in conditions like asthma. (Chapter 4.6)

Bronchoscope (BRŎNG-kŏ-skōp): A medical instrument with a light and camera used for examining the inside of the trachea, bronchi, and lungs. (Chapter 4.7)

Bronchoscopy (brŏng-KŎS-kŏ-pē): A procedure that allows a doctor to look at the airway through a thin viewing instrument called a bronchoscope. (Chapter 4.4)

Bronchospasm (BRŎNG-kō-spăz-ŭm): The sudden constriction of the muscles in the bronchial walls. (Chapter 4.4)

Cancer (KĂN-sŏr): A disease in which abnormal cells divide uncontrollably and destroy body tissue. (Chapter 4.6)

Chest X-rays (chĕst ĕks-rāz) (CXR): An imaging test that uses small amounts of radiation to produce pictures of the organs, bones, and tissues in the chest area; also called radiographs. (Chapter 4.6)

Chronic bronchitis (KRŎN-ĭk brŏng-KĪ-tĭs): A form of bronchitis characterized by chronic cough and mucus production for at least three months in two consecutive years. (Chapter 4.6)

Chronic obstructive pulmonary disease (KRŎN-ĭk ŏb-STRŬK-tĭv PŬL-mō-nĕ-rē dĭ-ZĒZ) (COPD): A group of lung diseases that block airflow and make it difficult to breathe. (Chapter 4.6)

Computed tomography scan (kŏm-PYŌŌ-tĕd tŏ-mŎG-ră-fē skăn) (CT): A medical imaging technique used to create detailed images of internal body structures, particularly useful for diagnosing diseases or conditions in the lungs and other thoracic structures. (Chapter 4.7)

Continuous positive airway pressure device (kŏn-TĬN-yū-ŭs POZ-ĭ-tĭv AIR-wā PRESS-ŭr dĭ-VĪS) (CPAP): A type of therapy used in sleep apnea, in which air is supplied through a mask to keep airways open during sleep. (Chapter 4.6)

CT-guided needle biopsy (sē-tē Gī-dĕd NĒ-dŭl BĪ-ŏp-sē): A procedure where a needle biopsy is performed with the guidance of computed tomography (CT) imaging to obtain a tissue sample from the lung or other internal organs. (Chapter 4.7)

Cyanosis (sī-ă-NŌ-sĭs): A bluish discoloration of the skin and mucous membranes resulting from poor circulation or inadequate oxygenation of the blood. (Chapter 4.6)

Cyanotic (sī-ă-NŎT-ĭk): Pertaining to cyanosis; a bluish or purplish discoloration of the skin due to deficient oxygenation of the blood. (Chapter 4.6)

Cystic fibrosis (SĬS-tĭk fī-BRŌ-sĭs): A genetic disorder affecting the lungs and digestive system, characterized by thick, sticky mucus that can clog airways and lead to respiratory and digestive problems. (Chapter 4.6)

Dysphonia (dis-FŌ-nē-ă): Difficulty in speaking due to a problem with the voice. (Chapter 4.4)

Dyspnea (dĭs-PNĒ-ă): Difficulty or discomfort in breathing; shortness of breath. (Chapter 4.5)

Emphysema (ĕm-fĭ-ZĒ-mă): A chronic respiratory disease where there is overinflation of the air sacs (alveoli) in the lungs, leading to a decrease in lung function and breathlessness. (Chapter 4.6)

Endotracheal tube (ĕn-dō-TRĀ-kē-ăl tūb) (ET tube): A flexible plastic tube that is put in the mouth and then down into the trachea to help a patient breathe. (Chapter 4.7)

Epiglottis (ĕ-pĭ-GLŎT-ĭs): A flap of tissue that covers the trachea during swallowing to prevent aspiration. (Chapter 4.4)

Epistaxis (ĕp-ĭ-STĂK-sĭs): Bleeding from the nose; also called rhinorrhagia. (Chapter 4.4)

Exacerbations (ĕg-ză-sĕr-BĀ-shŭns): Episodes where symptoms of a disease become worse or more severe. (Chapter 4.6)

Exhalation (ĕks-hă-LĀ-shŭn): The process of breathing out air. (Chapter 4.5)

Fine needle aspiration biopsy (fīn NĒ-dŭl ăs-pĭ-RĀ-shŭn BĪ-ŏp-sē) (FNA): A diagnostic procedure used to investigate lumps or masses. In this technique, a thin needle is used to extract sample cells from the body. (Chapter 4.7)

Gas exchange (găs ĭk-SCHĀNJ): The process in the lungs where oxygen is taken up by the blood and carbon dioxide is released from the blood. (Chapter 4.5)

Hemoglobin (HĒ-mō-glō-bĭn): A protein in red blood cells that carries oxygen from the lungs to the rest of the body and returns carbon dioxide from the body to the lungs. (Chapter 4.5)

Hemoptysis (hē-MŎP-tĭ-sĭs): Coughing up blood from the respiratory tract. (Chapter 4.6)

Hypercapnia (hī-pĕr-KĂP-nē-ă): Excess carbon dioxide in the bloodstream, typically caused by inadequate respiration. (Chapter 4.5)

Hyperpnea (hī-PŬR-pnē-ă): Excessively deep or rapid breathing; forced breathing. (Chapter 4.5)

Hyperventilation (hī-pĕr-vĕn-tĭ-LĀ-shŭn): Breathing that is deeper and more rapid than normal. (Chapter 4.5)

Hypopnea (hī-pŎP-nē-ă): Deficient shallow or slow breathing. (Chapter 4.5)

Hypoventilation (hī-pō-vĕn-tĭ-LĀ-shŭn): Reduced rate and/or depth of air movement into the lungs, leading to increased carbon dioxide levels in the blood. (Chapter 4.5)

Hypoxemia (hī-pŏk-SĒ-mē-ă): Low levels of oxygen in the blood. (Chapter 4.5)

Hypoxia (hī-PŎK-sē-ă): A condition in which the body or a region of the body is deprived of adequate oxygen supply at the tissue level. (Chapter 4.5)

Influenza (ĭn-flōō-ĕn-ză): A highly contagious viral infection affecting the respiratory tract, commonly referred to as the flu, with symptoms like fever, cough, sore throat, and muscle aches. (Chapter 4.6)

Inhalation (ĭn-hă-lĀ-shŭn): The process of breathing in air. (Chapter 4.5)

Labored breathing (LĀ-bŏrd BRĒ-thĭng): Breathing that requires more effort than normal; often a sign of distress or illness. (Chapter 4.5)

Laryngitis (lă-rĭn-JĪ-tĭs): Inflammation of the larynx, typically resulting in huskiness or loss of voice. (Chapter 4.4)

Larynx (LĀR-ĭngks): The organ forming an air passage to the lungs and holding the vocal cords; the voice box. (Chapter 4.4)

Lobectomy (lō-BĔK-tŏ-mē): Surgical removal of a lobe of an organ, such as a lobe of the lung. (Chapter 4.4)

Lobes (lōbz): Divisions of the lungs; the right lung has three lobes, and the left lung has two. (Chapter 4.4)

Lung cancer (lŭng KĂN-sŏr): A type of cancer that begins in the lungs and may spread to lymph nodes or other organs in the body. (Chapter 4.6)

Lungs (lŭngz): The main organs of the respiratory system, responsible for the exchange of oxygen and carbon dioxide. (Chapter 4.4)

Magnetic resonance imaging (măg-NĚT-ĭk rĕz-ŏ-năns ĬM-ă-jing) (MRI): A medical imaging technique used in radiology to form pictures of the anatomy and the physiological processes of the body. (Chapter 4.7)

Mechanical ventilator (mĕ-kăn-Ĭ-kăl vĕn-tĬ-lā-tŏr): A machine that provides respiratory support for patients who are unable to breathe effectively on their own. (Chapter 4.7)

Metastases (mĕ-TĂS-tă-sēz): The spread of cancer from one part of the body to another. (Chapter 4.6)

Mucus (MŪ-kŭs): A slippery secretion produced by, and covering, mucous membranes for lubrication and protection. (Chapter 4.4)

Nasal cannula (NĀ-zăl KĂN-yū-lă): A device used to deliver supplemental

oxygen or increased airflow to a patient in need of respiratory help. (Chapter 4.7)

Nebulizer (NĒB-yū-lī-zĕr): A device for converting a drug into mist and delivering it to the lungs, often used in treating asthma and other respiratory conditions. (Chapter 4.6)

Needle biopsy (NĒ-dŭl BĪ-ŏp-sē): A procedure to obtain a sample of cells from the body for laboratory testing, often used to diagnose diseases such as cancer. (Chapter 4.7)

Obstructive sleep apnea (ŏb-STRŬK-tĭv slēp ăp-NĒ-ă) (OSA): A sleep disorder characterized by pauses in breathing or periods of shallow breathing during sleep. (Chapter 4.6)

Peak flow meter (pēk flō mē-tĕr): A small, hand-held device used to measure the ability to push air out of the lungs. (Chapter 4.6)

Perfusion (pĕr-FYŪ-zhŭn): The passage of fluid through the circulatory system or lymphatic system to an organ or a tissue. (Chapter 4.5)

Pharyngitis (fă-RĬN-JĪ-tĭs): Inflammation of the pharynx, often resulting in a sore throat. (Chapter 4.4)

Pharynx (FĂR-ĭngks): Commonly known as the throat; a part of the neck and throat that is situated posteriorly to the mouth and nasal cavity and cranially to the esophagus and larynx. (Chapter 4.4)

Pleural effusion (PLŪR-ăl ĕ-FYŪ-zhŭn): A condition where fluid accumulates in the pleural space, the area between the layers of tissue that line the lungs and chest cavity. (Chapter 4.4)

Pleural rub (plur-uhl ruhb): An abnormal lung sound that is caused by inflammation of the pleura membranes that results in friction as the surfaces rub against each other. (Chapter 4.5)

Pneumonia (nū-MŌ-nē-ă): An infection that inflames the air sacs in one or both lungs, which may fill with fluid or pus. (Chapter 4.4)

Positron emission tomography scan (pŏz-Ĭ-trŏn ĭ-MĬSH-ən tŏ-mŏG-ră-fē skăn) (PET): A diagnostic imaging test using a radioactive substance to look for disease in the body, often used for detecting cancer. (Chapter 4.7)

Pruritus (PRŪ-rī-tŭs): Itching or an uncomfortable irritation of the skin. (Chapter 4.6)

Pulmonary arteries (PŬL-mō-nĕ-rē ăr-tĕ-rēs): The arteries carrying blood

from the right ventricle of the heart to the lungs for oxygenation. (Chapter 4.5)

Pulmonary circulation (PŬL-mō-nĕ-rē sĭr-kyū-LĀ-shŭn): The part of the circulatory system which carries blood from the heart to the lungs and back to the heart. (Chapter 4.5)

Pulmonary edema (PŬL-mŏn-ăr-ē ĕ-DĒ-mă): Fluid accumulation in the alveoli of the lungs, often caused by heart or kidney failure. (Chapter 4.5)

Pulmonary embolism (PŬL-mŏ-nā-rē ĕm-BŌ-lĭ-zŭm) (PE): A blockage in one of the pulmonary arteries in the lungs, usually caused by blood clots that travel to the lungs from the legs or other parts of the body. (Chapter 4.6)

Pulmonary function tests (PŬL-mŏ-nā-rē fŭnk-shŭn tĕsts) (PFTs): A group of tests that measure how well the lungs take in and release air and how well they move gases such as oxygen from the atmosphere into the body's circulation. (Chapter 4.7)

Pulmonologist (pŭl-mŏn-ŎL-ŏ-jĭst): A physician who specializes in the diagnosis and treatment of diseases and disorders related to the respiratory system. (Chapter 4.7)

Pulse oximeter (pŭls ŏk-SĬM-ĭ-tŏr): A small, clip-like device that attaches to a body part, like toes or an earlobe, but most commonly to a finger, to measure the oxygen saturation of arterial blood. (Chapter 4.5)

Radiographs (RĀ-dē-ŏ-grăf): Images produced on a sensitive plate or film by X-rays, gamma rays, or similar radiation, and used in medical examinations. (Chapter 4.6)

Rales (rāylz): An abnormal lung sound, also called fine crackles, that sound like popping or crackling sounds on inspiration. Rales are associated with medical conditions that cause fluid accumulation within the alveolar and interstitial spaces, such as heart failure or pneumonia. (Chapter 4.5)

Respiration (rĕs-pĭ-RĀ-shŏn): The process of inhaling oxygen from the air and exhaling carbon dioxide out of the body. It is a vital function for the survival of humans and many other organisms, facilitating the exchange of gases in the lungs and tissues. (Chapter 4.5)

Respiratory rate (RES-pĭr-ă-tō-rē rāt): The number of breaths a person takes per minute. (Chapter 4.5)

Respiratory syncytial virus (rĕs-pĭ-RĂ-tōr-ē SĬN-sĭ-shē-ăl VĪ-rŭs) (RSV): A

common and highly contagious virus that causes infections of the respiratory tract. It can lead to mild, cold-like symptoms in adults and older children but can be severe in infants, young children, and older adults, especially those with underlying health conditions. (Chapter 4.6)

Respiratory therapists (rĕ-spĭr-ă-tōr-ē THĔR-ă-pĭsts): Health care professionals who specialize in providing care for patients with breathing or other cardiopulmonary disorders. (Chapter 4.7)

Rhinitis (rye-NYE-tis): Inflammation of the nasal mucosa. (Chapter 4.4)

Rhinorrhagia (rī-nō-RĀ-jē-ă): Bleeding from the nose, also known as epistaxis. (Chapter 4.4)

Rhinorrhea (rye-noh-REE-uh): Excess mucous production by the nasal cavities, commonly referred to as a "runny nose." (Chapter 4.4)

Rhonchi (rŏng-kahy): An abnormal lung sounds, also referred to as coarse crackles, that are are low-pitched, continuous sounds heard on expiration that are a sign of turbulent airflow through mucus in the large airways. (Chapter 4.5)

Septum (SĔP-tŭm): The structure separating the left and right airways in the nose, dividing the two nostrils. (Chapter 4.4)

Sinusitis (sī-nŭ-SĪ-tĭs): Inflammation of the sinus cavities. (Chapter 4.4)

Spirometry (spī-RŎM-ĕ-trē): A common office test used to assess how well the lungs work by measuring how much air is inhaled, how much is exhaled, and how quickly it is exhaled. (Chapter 4.7)

Sputum (SPŪT-ŭm): Mucous secretions from the respiratory tract that can be expelled through the mouth. (Chapter 4.4)

Sputum culture (SPYŌŌ-tŭm KŬL-chŭr): A test to detect and identify bacteria or fungi that are infecting the lungs or breathing passages. (Chapter 4.7)

Stethoscope (STĔTH-ō-skōp): A medical instrument used for listening to the internal sounds of an organism, typically used for heart and lung sounds. (Chapter 4.5)

Stridor (strī-door): An abnormal lungs sound heard during inspiration that is associated with obstruction of the trachea/upper airway. (Chapter 4.5)

Surfactant (SŬR-făk-tănt): A substance that reduces the surface tension of fluid in the lungs and helps make the alveoli more stable. (Chapter 4.4)

Tachypnea (tăk-ĬP-nē-ă): Rapid breathing. (Chapter 4.5)

Thoracentesis (thŏr-ă-sĕn-TĒ-sĭs): A procedure to remove fluid from the space between the lining of the outside of the lungs (pleura) and the wall of the chest. (Chapter 4.7)

Thoracic cavity (thō-RĂS-ĭk KĂV-ĭ-tē): The area of the body located between the neck and the diaphragm, housing the lungs and heart. (Chapter 4.5)

Thoracic surgeon (thō-RĂS-ĭk SŬR-jŏn): A surgeon who specializes in surgical procedures of the chest, including the heart, lungs, esophagus, and other organs in the chest. (Chapter 4.7)

Tonsillitis (tŏn-sĭl-Ī-tĭs): Inflammation of the tonsils. (Chapter 4.4)

Trachea (TRĀ-kē-ă): The windpipe; a tube that connects the larynx to the bronchi, providing a pathway for air to enter the lungs. (Chapter 4.4)

Tracheostomy (trā-kē-ŎS-tŏ-mē): A surgical procedure to create an opening through the neck into the trachea (windpipe) to allow direct access to the breathing tube. (Chapter 4.4)

Tuberculosis (tū-bĕr-kyū-lō-sĭs) (TB): A serious infectious disease that mainly affects the lungs, caused by the bacterium *Mycobacterium* tuberculosis. (Chapter 4.6)

Upper respiratory infection (ŬP-er RES-pĭr-ă-tō-rē ĭn-FEK-shun) (URI): A viral infection of one or more structures of the upper respiratory system, including the nose, nasal cavities, sinuses, pharynx, and larynx. (Chapter 4.4)

Ventilation (vĕn-tĭ-LĀ-shŭn): The movement of air in and out of the lungs. (Chapter 4.5)

Wheezing (HWĒ-zĭng): A high-pitched whistling sound made while breathing, typically heard when exhaling, often associated with asthma or lung diseases. (Chapter 4.6)

PART V

CHAPTER 5 URINARY SYSTEM TERMINOLOGY

5.1 Urinary System Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to the urinary system
- Identify meanings of key word components of the urinary system
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to the urinary system
- Use terms related to the urinary system
- Use terms related to the diseases and disorders of the urinary system

Introduction to the Urinary System

The urinary system filters waste products from the blood and produces urine. It also performs several additional physiological processes, such as regulating fluid volume and electrolyte levels, releasing hormones to control blood pressure and red blood cell production, and helping with bone health by controlling calcium and phosphorus levels.

This chapter will review common word components related to the urinary system to assist students in learning how to analyze, build, and define terms. Other urinary terms, whose definitions cannot be easily built from word

components, will be described in context based on the anatomy and physiology of the urinary system and common diseases and disorders. Medical specialists, diagnostic tests, and procedures related to the urinary system will also be discussed.

View the following YouTube video[1] on the urinary system:

Urinary System, Part 1: Crash Course Anatomy & Physiology #38

1. CrashCourse. (2015, October 12). *Urinary system, Part 1: Crash Course Anatomy & Physiology #38* [Video]. YouTube. All rights reserved. https://youtu.be/l128tW1H5a8?si=qJRaF8EPQrVMMkqQ

5.2 Word Components Related to the Urinary System

This section will describe common word components related to the urinary system. These word components can be used to build definitions for many medical terms related to the urinary system. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO THE URINARY SYSTEM

- **a-**: Absence of, without
- **an-**: Absence of, without
- **dia-**: Through, complete
- **dys-**: Painful, abnormal, difficult, labored
- **poly-**: Many, much

COMMON WORD ROOTS WITH A COMBING VOWEL RELATED TO THE URINARY SYSTEM

- **albumin**/o: Albumin
- **azot**/o: Urea, nitrogen
- **blast**/o: Developing cell, germ cell
- **cyst**/o: Bladder, sac
- **glomerul**/o: Glomerulus
- **glyc**/o: Sugar
- **glycos**/o: Sugar
- **hydr**/o: Water
- **lith**/o: Stone, calculus
- **meat**/o: Meatus
- **nephr**/o: Kidney
- **noct**/i: Night
- **olig**/o: Few, scanty
- **py**/o: Pus
- **pyel**/o: Renal pelvis
- **ren**/o: Kidney
- **ur**/o: Urine, urinary tract
- **ureter**/o: Ureter
- **urethr**/o: Urethra
- **urin**/o: Urine, urinary tract
- **vesic**/o: Bladder, sac

COMMON SUFFIXES RELATED TO THE URINARY SYSTEM

- **-al**: Pertaining to
- **-ary**: Pertaining to
- **-cele**: Hernia, protrusion
- **-emia**: In the blood
- **-esis**: Condition
- **-gram**: The recorded radiographic image
- **-graph**: Instrument used to record
- **-graphy**: Process of recording, radiographic imaging
- **-iasis**: Condition
- **-itis**: Inflammation
- **-lith**: Stone
- **-lysis**: Loosening, dissolution, separating
- **-megaly**: Enlarged, enlargement
- **-oma**: Tumor, swelling
- **-osis**: Abnormal condition
- **-pexy**: Surgical fixation, suspension
- **-ptosis**: Drooping, sagging, prolapse
- **-rrhaphy**: Suturing, repairing
- **-scope**: Instrument used for visual examination
- **-scopic**: Pertaining to visual examination
- **-scopy**: Visual examination
- **-stomy**: Creation of an artificial opening
- **-tomy**: Cut into, incision
- **-tripsy**: Surgical crushing
- **-uria**: Urine, urination

5.3 Examples of Urinary Terms Easily Defined By Their Word Components

Here are examples of urinary medical terms that can be easily defined by breaking them into word components.

Cystoscopy

1. Break down the medical term into word components: **Cyst/o/scopy**
2. Label the word parts: **Cyst** = WR; **o** = CV; **scopy** = S
3. Define the word components: **Cyst** = bladder; **scopy** = visual examination
4. Create a final definition of the medical term: **Visual examination of the bladder**

Dysuria

1. Break down the medical term into word components: **Dys/ur/ia**
2. Label the word components: **Dys** = P; **ur** = WR; **ia** = S
3. Define the word components: **Dys** = painful or difficult; **ur** = urine; **ia** = condition of

4. Create a final definition of the medical term: **Condition of difficult or painful urination**

Nephritis

1. Break down the medical term into word components: **Nephr**/**itis**
2. Label the word components: **Nephr** = WR; **itis** = S
3. Define the word components: **Nephr** = kidney; **itis** = inflammation
4. Create a final definition of the medical term: **Inflammation of the kidney**

Interactive Learning Activity: Practice defining and pronouncing additional urinary system medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3446#h5p-136

You can also print this as a Chapter 5 Student Companion Worksheet and check your answers with this Answer Key.

5.4 Anatomy of the Urinary System

The **urinary** (YŪR-ĭ-nĕr-ē) system, also referred to as the **renal** (RĒ-năl) system or **urinary tract** (YŪR-ĭ-nĕr-ē trăkt), consists of the kidneys, ureters, bladder, and urethra. The kidneys form urine and perform other functions attributed to the urinary system. 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 the outside the body during urination.[1] See Figure 5.1[2] for an illustration of the male urinary system.

1. National Institute of Diabetes and Digestive and Kidney Diseases. (2020, June). *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

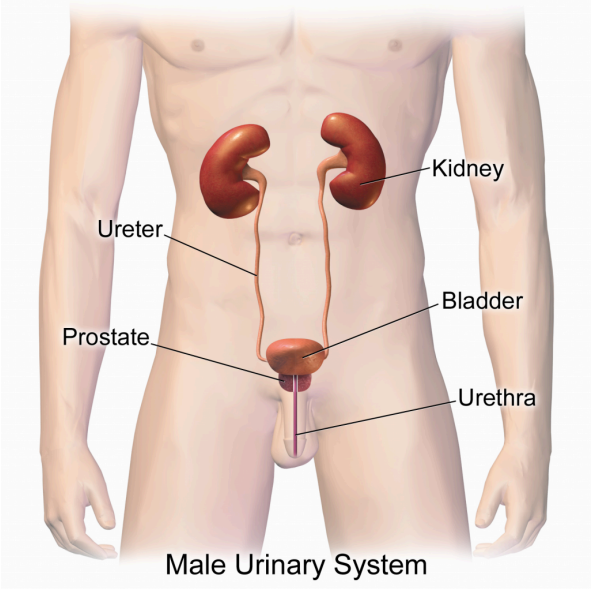


Figure 5.1 Male Urinary System

KIDNEYS

The **kidneys** (KĬD-nēz) are a pair of organs 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. They are roughly the size of your fist. The male kidneys are typically a bit larger than the female kidneys. The kidneys are well-vascularized, receiving about 25 percent of the blood pumped out of the heart with each heartbeat.[3] Figure 5.2[4] shows the location of the kidneys.

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4. "2608_Kidney_Position_in_Abdomen.jpg" by OpenStax College is licensed under CC BY 3.0

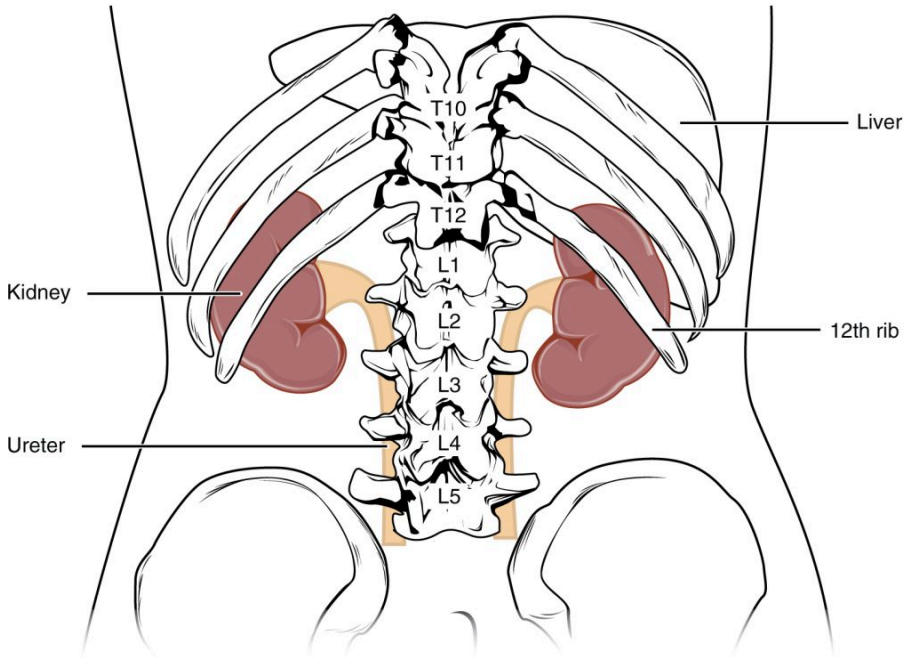

Figure 5.2 Kidneys

The outer region of the kidney is called the renal cortex, and the inner region is called the renal medulla. See Figure 5.3[5] 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 cleansed blood to the inferior vena cava.[6]

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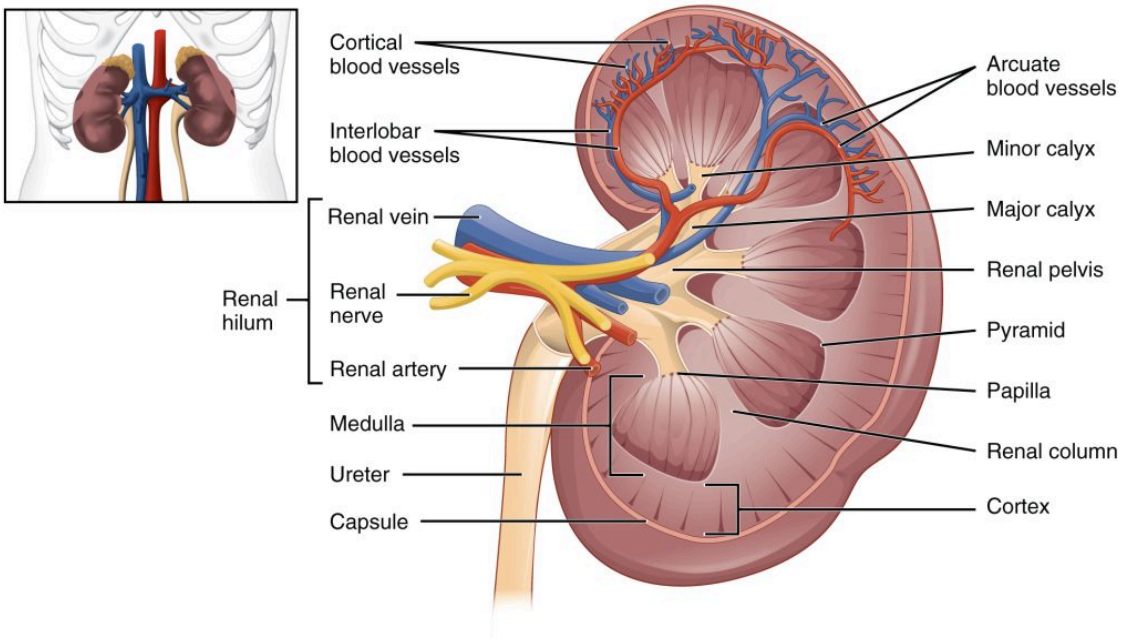

Figure 5.3 Internal Structures of the Kidney

Arterioles and Nephrons

The renal artery branches into small arteries called afferent arterioles that bring blood to the nephron. See Figure 5.4[7] for an illustration of blood flow from the renal artery to the afferent arterioles to a nephron. The **nephron** (NĔF-rŏn) is the functional unit of the kidney and filters the blood, removes wastes, and balances fluid and electrolyte levels. Afferent arterioles service about 1.3 million nephrons in each kidney.[8]

7. "2612_Blood_Flow_in_the_Kidneys.jpg" by OpenStax College is licensed under CC BY 3.0

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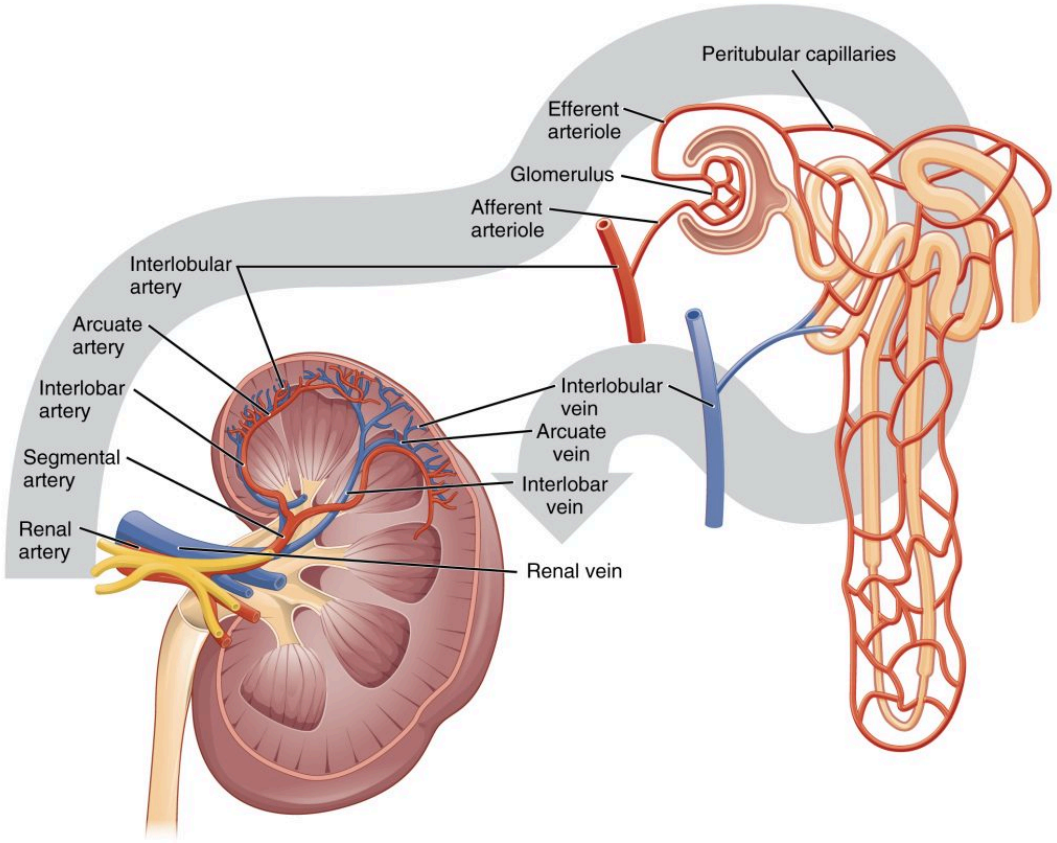

Figure 5.4 Blood Flow in the Kidneys

A nephron has two main sections called a renal corpuscle and a renal tubule. The renal corpuscle consists of a cluster of high-pressure capillaries, called the **glomerulus** (glō-MĚR-ū-lŭs), surrounded by a glomerular capsule. See Figure 5.5[9] for an illustration of blood flow through the nephron. The capillaries in the glomerulus initially filter the blood to create a filtrate, which is mostly water, amino acids, glucose, and ions. The filtrate then flows through the renal tubule beginning with the proximal tubule, a long loop-like structure called the nephron loop (or 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

9. "2611_Blood_Flow_in_the_Nephron.jpg" by OpenStax College is licensed under CC BY 3.0

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.[10]

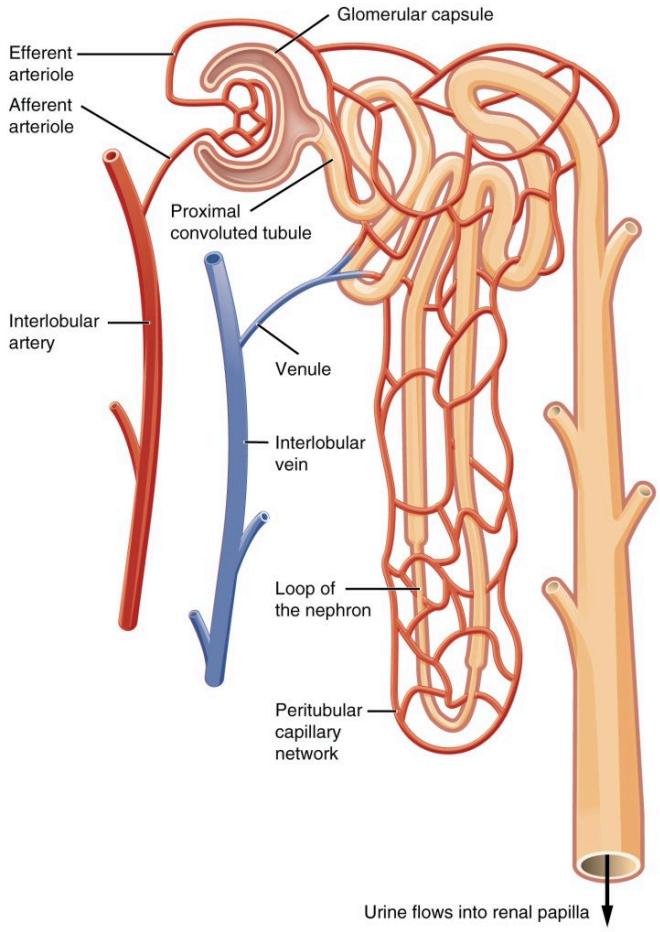

Figure 5.5 Blood Flow in the Nephron

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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** (YŪR-ĕ-tĕr). As urine passes through the ureter, it does not passively drain into the bladder but rather is propelled by wave-like contractions called peristalsis. The ureters are approximately 30 cm long.[11]

BLADDER

The **bladder** (blăd-ĕr) collects urine from both ureters. View Figure 5.6[12] 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, bladder 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 can project into the abdomen when it becomes **distended** (dis-TEN-ded) or stretched out with urine.[13]

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12. "2605_The_Bladder.jpg" by OpenStax College is licensed under CC BY 3.0

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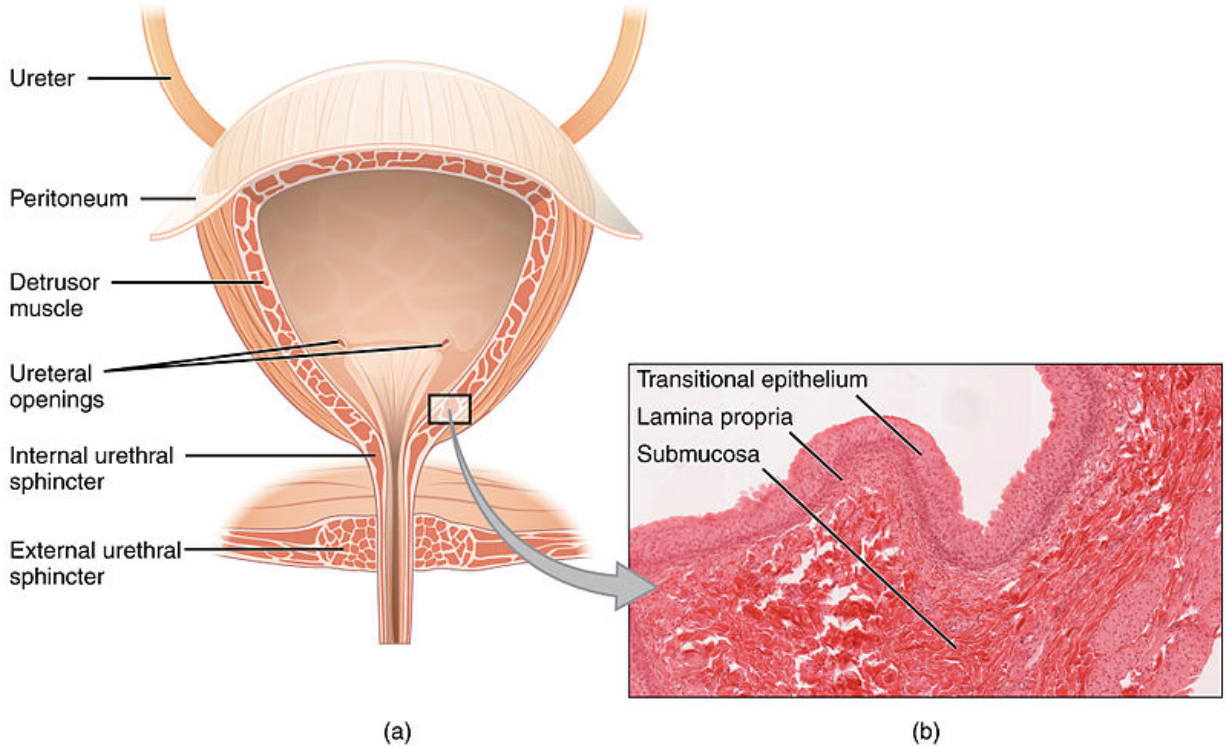

Figure 5.6 Bladder

URETHRA

The **urethra** (yū-RĒ-thră) 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, which causes an

increased risk for urinary tract infections.[14] See Figure 5.7[15] for a comparison of the female and male urinary systems.

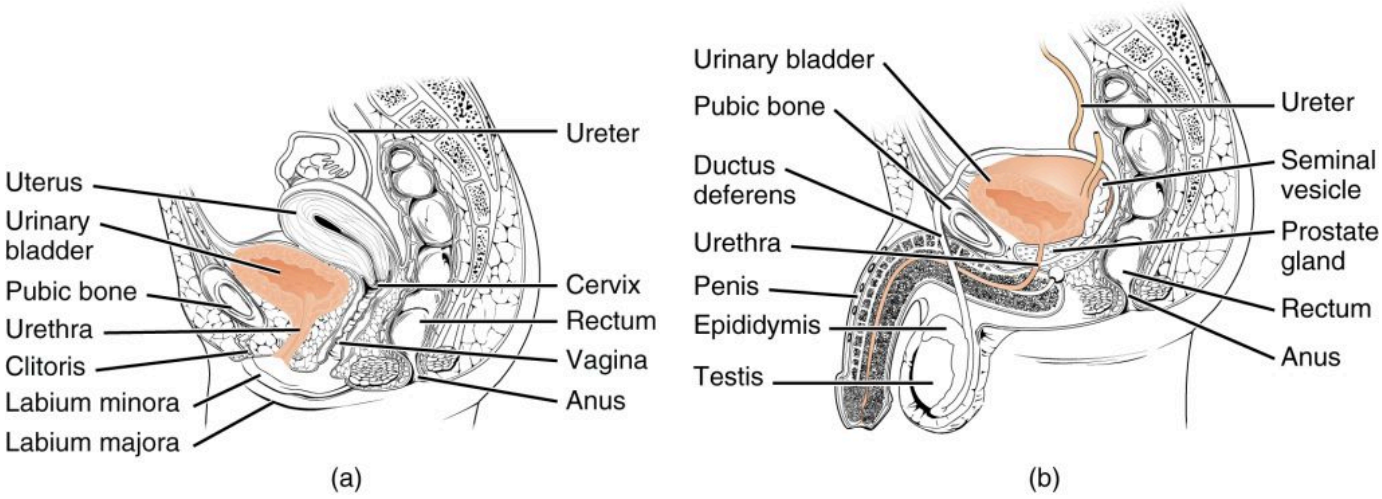

Figure 5.7 Female and Male Urinary Systems

URINATION

Urinate (YŪR-ĭ-nāt) means to pass urine, also referred to as **void** (voyd) or **micturate** (MĬK-tū-rāt). A healthy adult with normal functioning kidneys produces an average of 800-2,000 mL of urine per day, depending on their

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15. "Female_and_Male_Urethra.jpg" by OpexStax College is licensed under CC BY 4.0 Access for free at https://openstax.org/books/anatomy-and-physiology-2e/pages/1-introduction

fluid intake and other physiological processes. The adult bladder typically holds about 360-480 mL of urine.[16]

Urination is regulated by the internal and external urinary **sphincters** (SFĬNK-tĕrz), circular muscles constricting an orifice (opening). As the bladder fills to 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 until the brain sends signals it is time to urinate. As the bladder continues to fill, subsequent urges become harder to ignore. If voluntary voiding does not occur and the bladder overfills, voluntary control fails, resulting in urinary **incontinence** (ĭn-KŎN-tĭ-nĕns).[17]

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 with little to no odor. However, some foods (like asparagus) or medications (such as antibiotics) may change the smell or color of urine.[18]

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").[19]

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18. National Institute of Diabetes and Digestive and Kidney Diseases. (2020, June). *The urinary tract & how it works*. National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-tract-how-it-works

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5.5 Physiology of the Urinary System

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 keep bones healthy.[1]

FILTRATION, REABSORPTION, AND SECRETION

As previously discussed in "Anatomy of the Urinary System," 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 absorbing calcium.[2]

The initial filtering of the blood takes place in the glomerulus, a cluster of capillaries surrounded by the glomerular capsule within the nephron. The

1. Centers for Disease Control and Prevention. (2022, February 28). *Chronic kidney disease basics*. https://www.cdc.gov/kidneydisease/basics.html
2. National Institute of Diabetes and Digestive and Kidney Diseases. (2020, June). *The urinary tract & how it works*. National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-tract-how-it-works

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.[3]

Glomerular Filtration

The first step in urine production is **glomerular filtration** (glō-MER-yū-lăr fĭl-TRĀ-shŭn). 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.[4]

The volume of filtrate formed by both kidneys per minute is called the **glomerular filtration rate** (glō-MER-yū-lăr fĭl-TRĀ-shŭn rāt) **(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.[5]

GFR is influenced by hydrostatic pressure, osmotic pressure, and oncotic pressures. **Hydrostatic** (hī-drō-STAT-ik) pressure refers to the pressure produced by a fluid against a surface. Glomerular filtration occurs as

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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.[6] See Figure 5.8[7] for an illustration of hydrostatic pressure in a capillary.

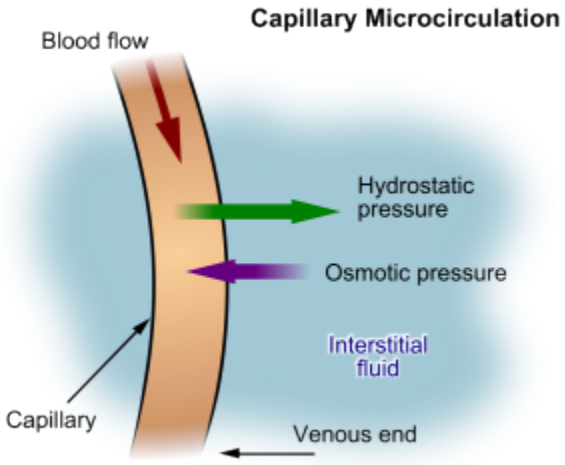

Figure 5.8 Hydrostatic and Osmotic Pressures in Capillaries

Another force, called osmotic pressure, also controls the movement of water. **Osmosis** (ŏz-MŌ-sĭs) 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

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7. "Capillary_microcirculation.jpg" by Kes47 is in the Public Domain

important in maintaining osmotic pressure in the glomerulus, as well as systemically throughout the body.[8]

A third force, called **oncotic pressure** (ŏn-KŎT-ĭk PRĚSH-ŭr), is created by the protein content of the blood that helps holds 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** (ĭ-DĒ-mă) or puffy, swollen tissue due to accumulation of fluid.[9]

Tubular Reabsorption and Secretion

After glomerular filtration, the filtrate continues to undergo modification through secretion and reabsorption in the renal tubules before urine is 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,

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and returns them to the body via the renal vein. The remaining fluid and wastes in the tubule become urine.[10]

See Figure 5.9[11] for an illustration of nephron structure. 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.[12]

10. This work is a derivative of Anatomy and Physiology by OpenStax licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

11. "Figure 41 03 04.jpg" by CNX OpenStax is licensed under CC BY 4.0

12. McCuistion, L., Vuljoin-DiMaggio, K., Winton, M., & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 443-454. Elsevier.

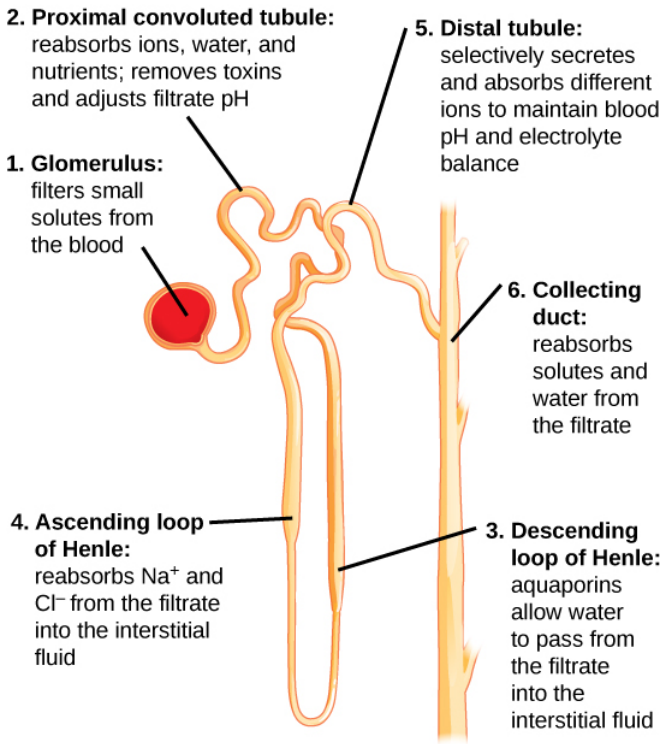

Figure 5.9 Nephron Structure

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. Two common symptoms of kidney disease include fluid retention (causing edema) and **hyperkalemia** (hī-pĕr-kă-LĒM-ē-ă) or increased levels of potassium in the blood due to a reduced inability to reabsorb these substances.

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.[13]

Urine color and odor are affected by many conditions and even the food the person has eaten. For example, a urinary tract infection or kidney stone may cause bleeding, resulting in pink or even bright red urine. Dehydration produces darker, concentrated urine. See Figure 5.10[14] for an illustration of the color of urine based on the patient'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]

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14. "2601_Urine_Color_Chart.jpg" by OpenStax College is licensed under CC BY 3.0

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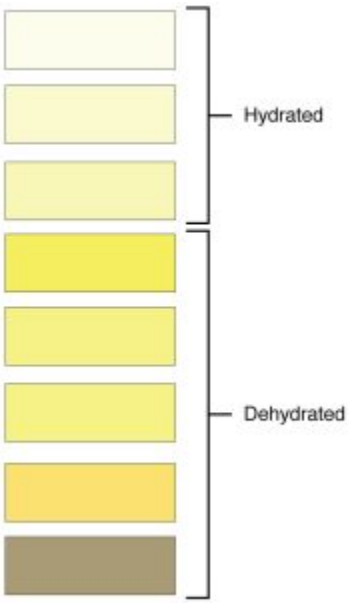

Figure 5.10 Urine Color Based on Hydration Status

Urea

Urea (yū-RĒ-ă) nitrogen is a waste product made when the liver breaks down protein into amino acids, and then **deamination** (dē-am-ĭ-NĀ-shŏn) 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 filtered out less efficiently, and a buildup of urea in the blood can occur.[16] For this reason, a diagnostic test called blood urea nitrogen (BUN) provides important information about kidney function and is further discussed in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section.

Most of the ammonia produced from the breakdown of protein in the body

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is converted into urea by the liver, so the odor of ammonia is rarely detected in fresh urine. The strong ammonia odor that can sometimes be detected in bathrooms is due to the breakdown of urea into ammonia by bacteria in the environment.[17]

Diuretics

A **diuretic** (dī-ū-RĒT-ĭk) 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 individuals with high blood pressure to reduce blood volume and, thereby, reduce blood pressure.[18]

Other Terms Related to Urine and Urination

Terms commonly used to document urine and urination are as follows:

- **Anuria** (ă-NOOR-ē-ă)**:** Absence of urine output, typically found during kidney failure, defined as less than 50 mL of urine over a 24-hour period.
- **Diuresis** (dī-ū-RĒ-sĭs)**:** Increased production of urine.
- **Dysuria** (dĭs-ŪR-ē-ă)**:** Painful or difficult urination.
- **Enuresis** (en-ū-RĒ-sĭs)**:** Involuntary urination, especially by children at night.
- **Frequency** (FRĒ-kwĕn-sē)**:** The need to urinate several times during the

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18. This work is a derivative of Anatomy and Physiology by OpenStax licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

day or at night (nocturia) in normal or less-than-normal volumes. It may be accompanied by a feeling of urgency.[19]

- **Hematuria** (hē-mă-TŪR-ē-ă)**:** Blood in the urine, either visualized or found during microscopic analysis.
- **Oliguria** (ŏ-lĭ-GŪR-ē-ă)**:** Decreased urine output, defined as less than 500 mL of urine in adults in a 24-hour period.
- **Nocturia** (nŏk-TŪR-ē-ă)**:** 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.[20]
- **Polyuria** (pŏl-ē-ŪR-ē-ă)**:** Greater than 2.5 liters of urine output over 24 hours, also referred to as diuresis.[21] New polyuria should be reported to the health care provider because it can be a sign of many medical conditions.
- **Pyuria** (pī-ŪR-ē-ă)**:** White blood cells in a urine sample indicating infection. In severe infections, pus may be visible in the urine.[22] See Figure 5.11[23] for an image of pyuria.
- **Urgency** (ŬR-jĕn-sē)**:** A sensation of an urgent need to void.[24] Urgency can

19. Maddukuri, G. (2021, January). *Urinary frequency*. Merck Manual Professional Version. https://www.merckmanuals.com/professional/genitourinary-disorders/symptoms-of-genitourinary-disorders/urinary-frequency

20. This work is a derivative of StatPearls by Leslie, Sajjad, & Singh and is licensed under CC BY 4.0

21. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2021. Urination – excessive amount; [updated 2021, Feb 8; cited 2021, Feb 16]. https://medlineplus.gov/ency/article/003146.htm

22. Cherney, K. (2018, August 30). *Everything you should know about pyuria*. Healthline. https://www.healthline.com/health/pyuria

23. "Pyuria2011.JPG" by James Heilman, MD is licensed under CC BY-SA 3.0

24. Maddukuri, G. (2021, January). *Urinary frequency*. Merck Manual Professional

cause urge incontinence if the patient is not able to reach the bathroom quickly.

- **Urinal** (Ū-rĭn-ăl)**:** A receptacle used for urine collection in health care facilities.

Figure 5.11 Pyuria

View the following YouTube video about the urinary system: Urinary System, Part 2: Crash Course Anatomy & Physiology #39[25]

Version. https://www.merckmanuals.com/professional/genitourinary-disorders/symptoms-of-genitourinary-disorders/urinary-frequency

25. CrashCourse. (2015, October 19).Urinary system, Part 2: Crash Course Anatomy & Physiology #39 [Video]. YouTube. All rights reserved. https://youtu.be/DlqyyyvTI3k?si=Pf8-IEPgHQJTLHAa

5.6 Diseases and Disorders of the Urinary System

ACUTE KIDNEY FAILURE

Acute kidney failure (ā-kūt kĭd-nē fāl-yŭr) is the rapid (less than two days) loss of kidney function. There are many possible causes of acute kidney failure. They include the following[1]:

- Acute tubular necrosis (damage to the renal tubules)
- Autoimmune kidney disease
- Decreased blood flow to the kidneys due to very low blood pressure, which can result from dehydration, hemorrhage, serious illness or injury, or surgery
- Disorders that cause clotting within the kidney's blood vessels
- Infections that directly injure the kidney, such as acute pyelonephritis (severe infection of the kidneys)
- Pregnancy complications, including placental abruption (separation of the placenta from the uterine wall) or placenta previa (placenta blocking the cervix)
- Urinary tract blockage
- Illicit drugs such as cocaine and heroin
- Medicines including nonsteroidal anti-inflammatory drugs (NSAIDs), certain antibiotics and blood pressure medicines, intravenous contrast

1. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. Acute Kidney Failure; [reviewed 2022, April 11]. https://medlineplus.gov/ency/article/000501.htm

(dye), HIV medications, and some types of cancer

Acute kidney failure is diagnosed through blood and urine tests that measure creatinine, urea nitrogen, and protein levels in the blood and urine. Read more information about these diagnostic tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section.

Acute kidney failure is typically treated with dialysis and medications. Read more information about dialysis in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section.

CHRONIC KIDNEY DISEASE

Kidney disease is a leading cause of death in the United States. More than one in seven American adults have **chronic kidney disease** (KRŎN-ĭk kĭd-nē dĭ-ZĒZ) **(CKD)** where the kidneys are damaged and cannot filter blood as well as they should. Because of the decreased kidney function, excess fluid and waste products remain in the body and cause other health problems. CKD has varying levels of seriousness and usually gets worse over time, although treatment has been shown to slow its progression. If left untreated, CKD can progress to kidney failure. Kidney failure is also called **end-stage renal disease** (ĕnd-stāj rē-năl dĭ-ZĒZ).[2]

Risk factors for developing CKD include diabetes mellitus type 1 and type 2, high blood pressure, heart disease, family history of CKD, and obesity. People with CKD may not feel ill or notice any symptoms. The only way to diagnose CKD is through blood and urine tests that measure creatinine, urea nitrogen, and protein levels. Read more information about these diagnostic tests in the

2. Centers for Disease Control and Prevention. (2022, February 28). *Chronic kidney disease basics*. https://www.cdc.gov/kidneydisease/basics.html

"Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section.

CKD is treated by carefully managing blood pressure and diabetes to prevent further damage to the nephrons. If the kidneys stop working, dialysis or a kidney transplant is needed for survival.[3] Read more information about dialysis and kidney transplantation in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section.

GLOMERULONEPHRITIS

Glomerulonephritis (glō-měr-ū-lō-nĕ-FRĪ-tĭs) involves inflammation of the glomerular capillaries. Glomerulonephritis can be caused by immune system problems, cancer, or infections such as strep infections, viruses, heart infections, or abscesses. It can develop quickly and lead to kidney failure, or it can become a chronic disease. Damage to the glomeruli affects their ability to filter correctly, and blood and protein can be lost in the urine. Common symptoms of glomerulonephritis include blood in the urine (hematuria), foamy urine (due to excess protein in the urine), and swelling (edema) of the face, eyes, ankles, feet, legs, or abdomen due to decreased protein (and osmotic pressure) in the bloodstream. Many diagnostic tests may be performed, but the diagnosis is typically confirmed by a kidney biopsy. Treatment depends upon the cause, but controlling high blood pressure with medications is usually the most important part of treatment. Drugs that suppress the immune system may also be prescribed.[4]

3. Centers for Disease Control and Prevention. (2022, February 28). *Chronic kidney disease basics*. https://www.cdc.gov/kidneydisease/basics.html

4. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. Glomerulonephritis; [reviewed 2021, July 27]. https://medlineplus.gov/ency/article/000484.htm

HYDRONEPHROSIS

Hydronephrosis (hī-drō-nĕ-FRŌ-sĭs) is the swelling of one or both kidneys because of urine backflow into the kidney. Several conditions can cause hydronephrosis, such as a kidney stone or other blockage in the ureters or back flow of urine from the bladder to the kidney, which is called **vesicoureteral reflux** (vĕs-ĭ-kō-yū-RĒT-ĕr-ăl rē-FLŬKS). Symptoms include back/side pain, an abdominal mass, nausea and vomiting, urinary tract infection (UTI), fever, dysuria (painful urination), and increased urinary frequency or urgency. Many diagnostic tests may be performed, such as an intravenous pyelogram. An intravenous pyelogram (IVP) is discussed in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section. Treatment is performed to treat the cause and may include placing a stent (tube) through the bladder and ureter to allow urine to flow from the kidney into the bladder, placing a tube into the kidney through the skin to allow the blocked urine to drain out of the body into a drainage bag, removing a stone causing the blockage, or performing surgery to correct the blockage or reflux.[5]

NEPHROLITHIASIS

Nephrolithiasis (nĕf-rō-lĭ-THĪ-ă-sĭs), commonly referred to as kidney stones, is solid pieces of material that form in the kidney from substances in the urine, such as calcium or uric acid. A kidney stone, also called **renal calculus** (RĒ-năl KĂL-kŭ-lŭs), may be as small as a grain of sand or as large as a pearl. See

5. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. Hydronephrosis of One Kidney; [reviewed 2021, July 1]. https://medlineplus.gov/ency/article/000506.htm

Figure 5.12[6] for an image of various sizes of kidney stones. Most kidney stones pass out of the body without medical intervention, but some get stuck in the urinary tract, block the flow of urine, and cause severe pain. Pain is typically located in the back or side. People with kidney stones may have hematuria (blood in the urine), fever and chills, vomiting, foul-smelling urine that may appear cloudy, or dysuria (painful urination).[7]

Figure 5.12 Kidney Stones

Extracorporeal shock wave **lithotripsy** (LĬTH-ō-trĭp-sē) or commonly called ESWL is a procedure for treating stones in the kidney and ureter that does not require surgery. Instead, high-energy shock waves are passed through the

6. "Kidney_stones_%28_renal_calculi_%29,_Бубрежни_камења_15.jpg" by Jakupica is licensed under CC BY-SA 4.0
7. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2016, Dec 8]. Kidney Stones; [cited 2023, Oct 12]. https://medlineplus.gov/kidneystones.html

body and used to break stones into pieces as small as grains of sand. Because of their small size, these pieces can then pass out the body with the urine.[8]

Nephrolithotomy (nĕf-rō-lĭ-THŎT-ŏ-mē) may be performed for patients who have large (two centimeters) or irregularly shaped kidney stones, stones that have not been broken up successfully by extracorporeal shock wave lithotripsy, or those who are not candidates for ureteroscopy. During this procedure, the surgeon enters the kidney through a small incision in the back and then threads a **nephroscope** (NĔF-rŏ-skōp), a miniature fiberoptic camera and then other small instruments, through the incision to remove the stone.[9]

POLYCYSTIC KIDNEY DISEASE

Polycystic kidney disease (pŏl-ē-SĬS-tĭk KĬD-nē dĭ-ZĒZ) **(PKD)** is an inherited genetic mutation that affects the kidneys and other organs. It is an inherited disorder that is passed down through families genetically. Clusters of fluid-filled sacs, called cysts, develop in the kidneys and interfere with their ability to filter waste products from the blood. See Figure 5.13[10] for an illustration of PKD. The growth of cysts causes the kidneys to become enlarged and can lead to chronic kidney disease (CKD). As CKD worsens, treatments for end-stage kidney disease may include dialysis or a kidney transplant. Cysts may also develop in other organs, particularly the liver. Cysts that are painful,

8. National Kidney Foundation. (n.d.). *Lithotripsy*. https://www.kidney.org/atoz/content/lithotripsy

9. National Kidney Foundation. (n.d.). *Percutaneous nephrolithotomy/ nephrolithrotripsy.* https://www.kidney.org/atoz/content/kidneystones_PNN

10. "Polycystic_kidneys,_gross_pathology_CDC_PHIL.png" by CDC/ Dr. Edwin P. Ewing, Jr. is licensed in the Public Domain.

infected, bleeding, or causing a blockage may need to be drained. There are usually too many cysts to make it practical to remove each cyst, so surgery to remove one or both kidneys may be needed.[11]

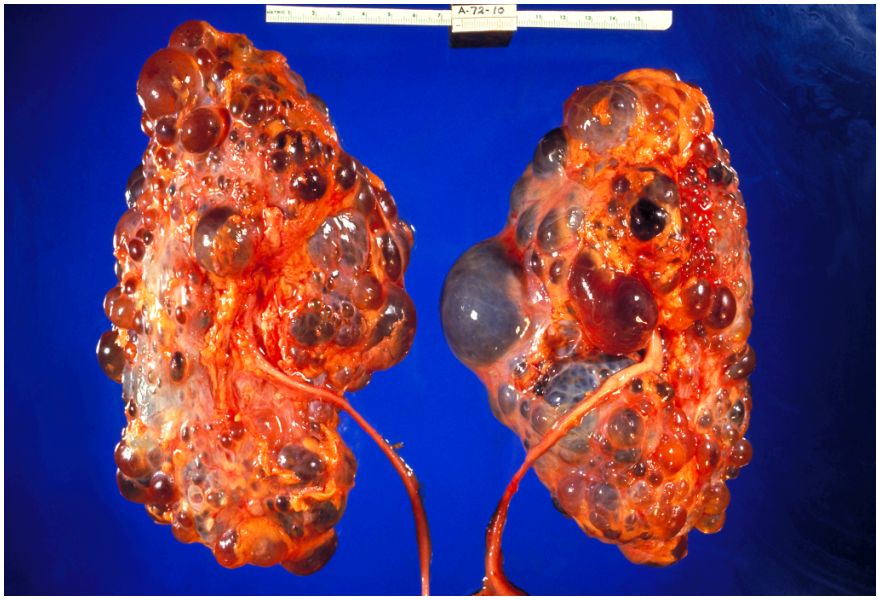

Figure 5.13 Polycystic Kidney Disease

RENAL CELL CANCER

Renal cell cancer (also called renal cell carcinoma) is the most common type of kidney cancer. Cancer occurs in tubules in the kidneys where urine is produced and collected. There are many types of treatments for renal cell cancer, including surgery, radiation therapy, chemotherapy, immunotherapy, and targeted therapy. The types of surgery that may be used are as follows[12]:

11. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. Polycystic Kidney Disease; [reviewed 2021, July 27]. https://medlineplus.gov/ency/article/000502.htm

12. National Cancer Institute. (2023, July 21). *Renal cell cancer – PDQ patient*

- **Partial nephrectomy** (nĕf-RĔK-tŏ-mē)**:** A surgical procedure to remove the cancer within the kidney and some of the tissue around it.
- **Simple nephrectomy** (sĭm-pĭl nĕf-RĔK-tŏ-mē)**:** A surgical procedure to remove the kidney.
- **Radical nephrectomy** (răd-ĭ-kăl nĕf-RĔK-tŏ-mē)**:** A surgical procedure to remove the kidney, the adrenal gland, surrounding tissue, and, usually, nearby lymph nodes.

URINARY INCONTINENCE

Urinary incontinence (YŪR-ĭ-nĕr-ē ĭn-KŎN-tĭ-nĕns) is the involuntary loss of urine. It is a common symptom that can seriously affect the physical, psychological, and social well-being of affected individuals.

There are many types and causes of urinary incontinence. A common type of incontinence is **stress urinary incontinence** (strĕs YŪR-ĭ-nĕr-ē ĭn-KŎN-tĭ-nĕns), a leakage of urine during moments of physical activity that increases abdominal pressure, such as coughing, sneezing, laughing, or exercise.[13] Overactive bladder is another type of incontinence where there is a frequent and sudden urge to urinate that can result in the individual not being able to make it to the restroom in time.

Diagnostic testing may be performed, such as a urinalysis to check for a urinary tract infection or urodynamic flow testing to evaluate bladder

version. National Institutes of Health. https://www.cancer.gov/types/kidney/patient/kidney-treatment-pdq#_1

13. McClurg, D., Pollock, A., Campbell, P., Hazelton, C., Elders, A., Hagen, S., & Hill, D. C. (2016). Conservative interventions for urinary incontinence in women: An overview of Cochrane systematic reviews. *The Cochrane Database of Systematic Reviews, 2016*(9). https://doi.org/10.1002/14651858.CD012337

function, including filling, urine storage, and emptying.[14] Treatment of incontinence is based on the cause of incontinence and may include pelvic floor exercises, medications, or surgery.

URINARY RETENTION

Urinary retention (YŪR-ĭ-nĕr-ē rĭ-TĔN-shŭn) is a condition that occurs when the patient cannot empty all of the urine from the bladder. Urinary retention can be acute (i.e., the sudden inability to urinate after receiving anesthesia during surgery) or chronic (i.e., a gradual inability to completely empty the bladder due to enlargement of the prostate gland in males). Urinary retention is caused by a blockage that prevents the flow of urine or the bladder not being able to create a strong enough force to expel all the urine. In addition to causing discomfort, urinary retention increases the patient's risk for developing a urinary tract infection (UTI) or other complications. See Figure 5.14[15] for an image of an enlarged prostate gland blocking the flow of urine from the bladder into the urethra.

14. Tso, C. (2018, January 10). Postmenopausal women and urinary incontinence. *American Nurse*. https://www.myamericannurse.com/postmenopausal-women-urinary-incontinence/

15. "Normal-vs-enlarged-prostate.jpg" by Akcmdu9 is licensed under CC BY-SA 3.0

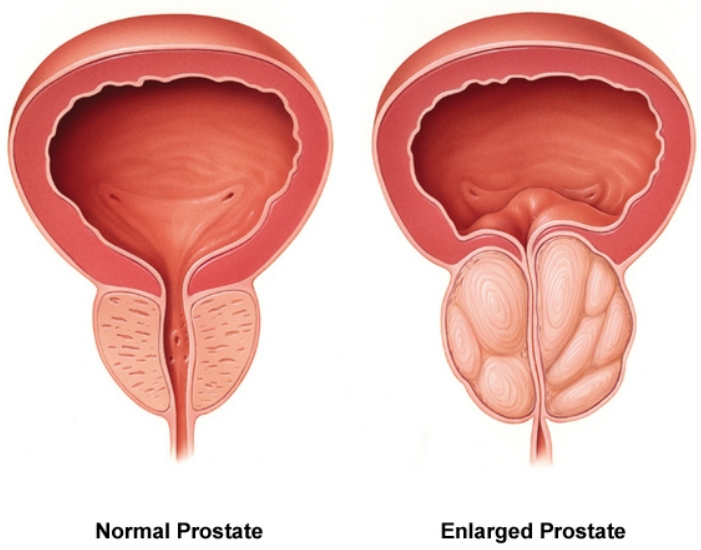

Figure 5.14 Enlarged Prostate Gland

Symptoms of urinary retention can range from no symptoms to severe abdominal pain.[16] Health care providers use a patient's medical history, physical exam findings, and diagnostic tests to determine the cause of urinary retention. **Post-void residual** (pōst voyd rĭ-ZĬD-ū-ăl) measurements can be taken when urinary retention is suspected by using a bladder scanner or inserting a catheter to determine how much urine is left in the bladder.[17]

Treatment for urinary retention depends on the cause. It may include urinary catheterization to drain the bladder, bladder training therapy,

16. National Institute of Diabetes and Digestive and Kidney Diseases. (n.d.). *Urinary retention.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-retention

17. National Institute of Diabetes and Digestive and Kidney Diseases. (n.d.). *Urinary retention.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-retention

medications, or surgery.[18] A surgery called **transurethral resection of the prostate** (trăns-yū-RĒ-thrăl rĭ-SĔK-shŭn ăv thĕ PRŌS-tāt) **(TURP)** may be performed in males to treat urinary retention caused by an enlarged prostate that is not responsive to medication.

URINARY TRACT INFECTION

A **urinary tract infection** (YŪR-ĭ-nĕr-ē trăkt ĭn-FĔK-shŭn) **(UTI)** is a common infection that occurs when bacteria, typically from the rectum, enter the urethra and infect the urinary tract. Infections can affect several parts of the urinary tract, but the most common type is a bladder infection, referred to as **cystitis** (sĭs-TĪ-tĭs). Kidney infections, referred to as **pyelonephritis** (pī-ĕl-ō-nĕ-FRĪ-tĭs), are more serious infections because they can have long-lasting effects on the kidneys.[19]

Some people are at higher risk of getting a UTI. UTIs are more common in females because their urethras are shorter and closer to the rectum, which makes it easier for bacteria to enter the urinary tract. Other factors that can increase the risk of UTIs include the following[20]:

18. National Institute of Diabetes and Digestive and Kidney Diseases. (n.d.). *Urinary retention.* National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/urinary-retention

19. Centers for Disease Control and Prevention. (2021, October 6). *Urinary tract infection.* https://www.cdc.gov/antibiotic-use/community/for-patients/common-illnesses/uti.html

20. Centers for Disease Control and Prevention. (2021, October 6). *Urinary tract infection.* https://www.cdc.gov/antibiotic-use/community/for-patients/common-illnesses/uti.html

- A previous UTI
- Sexual activity, especially with a new sexual partner
- Pregnancy
- Age (Older adults and young children are at higher risk.)
- Structural problems in the urinary tract, such as prostate enlargement
- Dehydration
- Uncontrolled diabetes

Symptoms of a UTI include the following[21]:

- Pain or burning while urinating (dysuria)
- Frequent urination (frequency)
- Urgency with small amounts of urine (oliguria)
- Bloody urine (hematuria)
- Pressure or cramping in the groin or lower abdomen
- Confusion or altered mental status in older adults

Symptoms of pyelonephritis include fever above 101 degrees F (38.3 degrees C), shaking chills, lower back pain or flank pain (i.e., on the sides of the back), and nausea or vomiting.[22] Older adults with a UTI may not exhibit these symptoms but often demonstrate an increased level of confusion. In some cases, UTIs can spread to the blood, leading to life-threatening infection called sepsis. **Sepsis** (SĔP-sĭs) occurs when the body's infection-fighting processes work improperly and damage the organs. Sepsis may progress to septic shock, a dramatic drop in blood pressure that can damage the lungs, kidneys,

21. Centers for Disease Control and Prevention. (2021, October 6). *Urinary tract infection*. https://www.cdc.gov/antibiotic-use/community/for-patients/common-illnesses/uti.html

22. Centers for Disease Control and Prevention. (2021, October 6). *Urinary tract infection*. https://www.cdc.gov/antibiotic-use/community/for-patients/common-illnesses/uti.html

liver, and other organs. When the damage is severe, it can lead to death. Early treatment of sepsis improves chances for survival.[23]

When a patient presents with symptoms of a UTI, the health care provider orders diagnostic tests that may include a urine dip, urinalysis, or urine culture & sensitivity. Read more about diagnostic tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section. Antibiotics are prescribed for urinary tract infections, and health teaching is provided to prevent future UTIs. Patients are also encouraged to drink extra fluids to help flush bacteria from the urinary tract.

23. Mayo Clinic. (2023). *Sepsis*. https://www.mayoclinic.org/diseases-conditions/sepsis/symptoms-causes/syc-20351214

5.7 Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System

MEDICAL SPECIALISTS

Nephrology (nĕf-RŎL-ŏ-jē) is the study of kidney diseases. A **nephrologist** (nĕf-RŎL-ŏ-jĭst) is a physician who specializes in diagnosing and treating kidney conditions. **Urology** (yū-RŎL-ŏ-jē) is the study of male and female urinary systems as well as the male reproductive system. A **urologist** (yū-RŎL-ŏ-jĭst) is a specialist who diagnoses and treats urinary system conditions, disorders, and diseases.

> To learn more about urology, visit the Why Urology? by the American Urological Association.

DIAGNOSTIC TESTS

Common diagnostic tests related to the urinary system are described in this

section. Diagnostic tests performed for specific medical conditions are discussed in the "Diseases and Disorders of the Urinary System" section.

Blood Tests

Blood Urea Nitrogen (BUN)

Urea nitrogen is a waste product made when the liver breaks down protein. Urea is carried in the blood, filtered out by the kidneys, and removed from the body in urine. A diagnostic test called **blood urea nitrogen** (blŭd yū-rē-ă nī-trŏ-jĕn) **(BUN)** provides important information about kidney and liver function. If the liver is unhealthy, it may not break down proteins the way it should, and if the kidneys aren't healthy, they may not correctly filter urea. Either of these problems can lead to an increased amount of urea nitrogen in the blood. Additionally, dehydration (not enough fluid in the body) can cause higher levels of urea in the blood because not much urine is being created.

Creatinine

A **creatinine** (krē-ĂT-ĭ-nēn) test is used to determine if they kidneys are working normally. Creatinine is a waste product made by muscles as part of regular, everyday activity. Healthy kidneys filter creatinine from the blood and eliminate it in the urine. However, if there is a problem with kidney functioning, creatinine can build up in the blood and less will be released in urine. If creatinine levels in the blood and/or urine are not in normal range, it can be a sign of kidney disease.

Glomerular Filtration Rate

Glomerular filtration rate (GFR) is one of the most common blood tests to check for kidney disease and to determine how well the nephrons are filtering creatinine. People make different amounts of creatinine, depending on their age, gender, height, weight, diet, and activity levels, so a formula is

used to calculate their estimated GFR (eGFR). Lower than normal eGFR levels indicate kidney disease, and very low levels indicate kidney failure.[1]

Urine Tests

Urine Dip

A **urine dip** (yū-rēn dĭp) test refers to a treated chemical strip (dipstick) being placed in a person's urine sample. Patches on the dipstick change color to indicate the presence of substances such as white blood cells, red blood cells, protein, or glucose. See Figure 5.15[2] for an image of a urine dipstick test. Urine is collected for a urine dip test in a clean specimen container. Using the "clean catch" technique, the skin surrounding the urethra is cleaned with a special towelette before the urine is collected.

1. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2023, July 6]. Glomerular Filtration Rate (GFR) Test; [cited 2023, Oct 12]. https://medlineplus.gov/lab-tests/glomerular-filtration-rate-gfr-test/

2. "Chemstrip2.jpg" by J3D3 is licensed under CC BY-SA 3.0

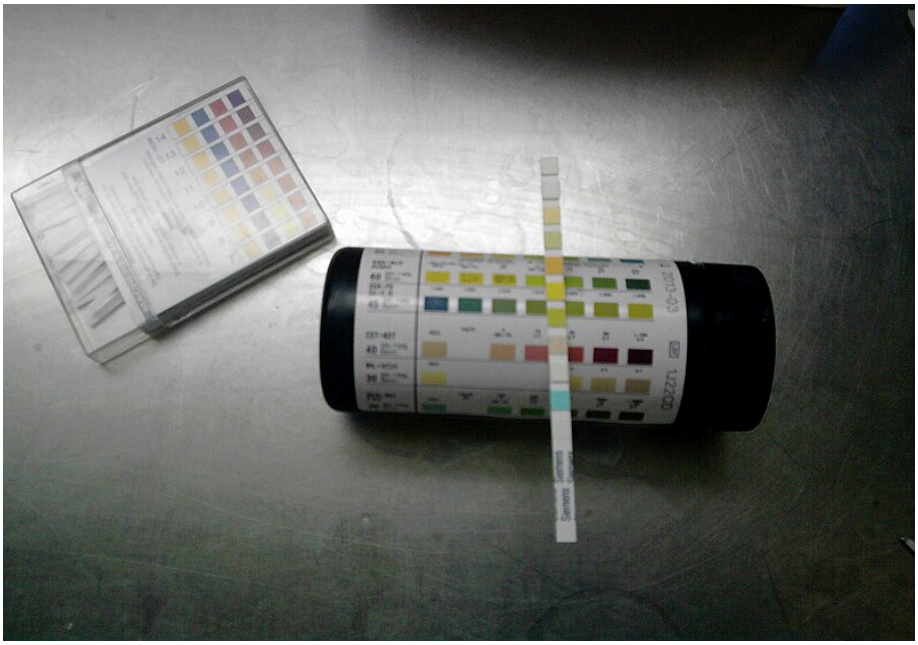

Figure 5.15 Urine Dipstick Test

Urinalysis

A **urinalysis** (yūr-ĭ-NĂL-ĭ-sĭs) **(UA)** includes a physical, chemical, and microscopic examination of urine by a lab technician. It requires collection of a "clean catch" urine sample in a sterile container. It involves analyzing the urine with a microscope for the following[3]:

- Color
- Appearance (i.e., clear or cloudy)
- Odor
- pH level (acidity)
- Specific gravity (concentration of all particles in the urine)
- Substances not usually found in significant amounts in the urine, such as

3. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2016, May 5]. Urinalysis; [cited 2023, Oct 12]. https://medlineplus.gov/urinalysis.html

red blood cells, white blood cells, leukocyte esterase, bacteria, protein, glucose, ketones, and bilirubin
- Cells, crystals, and casts

Urine Culture and Sensitivity

Urine culture and sensitivity (yū-rēn KŬL-chŭr ănd sĕn-sĭ-TĬV-ĭ-tē) **(C&S)** detects and identifies the number and type of bacteria growing in urine that can indicate a urinary tract infection (UTI). If pathogenic bacteria are found, a sensitivity report is generated that lists antibiotics to which the bacteria are sensitive to for treatment. A culture that is reported as "no growth in 24 or 48 hours" usually indicates that there is no infection. If a culture shows growth of several different types of bacteria, then it is likely due to contamination of the urine sample during collection, and a new collection of urine may be required.[4]

24-Hour Urine Collection

During a **24-hour urine collection test** (twehn-tee fôr hour yŭ-rēn kŏ-lĕk-shŭn tĕst), all urinary output from an individual is collected over a 24-hour period of time and analyzed for protein, creatinine, and other substances to evaluate kidney function.

Other Diagnostic Tests

Bladder Scan

A **bladder scan** (blăd-ĕr skăn) uses a portable, noninvasive medical device that uses sound waves to calculate the amount of urine in a patient's bladder.

4. LabTestsOnline.org. (2022, September 29). *Urine culture test*. https://labtestsonline.org/tests/urine-culture

Nurses use bladder scanners at patients' bedsides to determine post-void residual urine amounts without the need to perform urinary catheterization.

CT Scan of Kidney

A **computed tomography scan of the kidney** (kŏm-PYŌŌ-tĕd tō-mŏg-ră-fē skăn ăv thĕ kĭd-nē) **(CT)** is a diagnostic imaging procedure that uses a combination of X-rays and computer technology to produce a variety of images. It provides detailed images of the kidney looking for disease, cancer, obstructions, and other kidney conditions.[5]

Intravenous Pyelogram (IVP)

An **intravenous pyelogram** (ĭn-tră-vē-nŭs PĪ-ĕ-lō-gram) **(IVP)** is a special X-ray exam of the kidneys, bladder, and ureters. An iodine-based contrast (dye) is administered intravenously (into a vein). A series of X-ray images are taken at different times to see how the kidneys remove the dye and collect the urine. Before the final image is taken, the patient is asked to urinate again to see how well the bladder has emptied.[6]

Kidney, Ureter, and Bladder X-ray

A kidney, ureter, and bladder X-ray, often abbreviated KUB, is used to visualize these structures in the urinary system.

5. 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
6. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. Intravenous pyelogram; [reviewed 2023, Jan 1; cited 2023, Oct 12]. https://medlineplus.gov/ency/article/003782.htm

Urodynamic Flow Test

Urodynamic flow testing (yū-rō-dī-NĂM-ĭk flō tĕs-tĭng) is 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.[7]

Voiding Cystourethrogram

A **voiding cystourethrogram** (VOY-dĭng SĬS-tō-ūr-ĒTH-rō-gram) **(VCUG)** uses X-ray technology called fluoroscopy to visualize 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. 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 patient empties their bladder.[8]

7. National Institute of Diabetes and Digestive and Kidney Diseases. (2021, September). *Urodynamic testing*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/urodynamic-testing

8. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2021. Voiding cystourethrogram; [updated 2023, Jan 1 cited 2023, Oct 12]. https://medlineplus.gov/ency/article/003784.htm

Procedures and Surgeries

Cystoscopy

Cystoscopy (sĭs-TŎS-kŏ-pē) is a procedure 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, **stricture** (STRIK-chŭr) or a narrowing of the urethra, and other signs of blockage, such as an enlarged prostate gland.[9] See Figure 5.16[10] for an illustration of cystoscopy.

During a cystoscopy, a urologist may also perform treatments, 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 remove abnormal tissue. The urologist may also perform **retrograde pyelography** (rĕ-trō-grād pī-ĕ-lō-gră-fē), an X-ray procedure where a special dye is injected into the urinary tract to create images of urinary flow to show obstructions such as kidney stones and tumors.[11]

9. National Institute of Diabetes and Digestive and Kidney Disorders. (2021, July). *Cystoscopy & ureteroscopy.* National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/cystoscopy-ureteroscopy

10. "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

11. National Institute of Diabetes and Digestive and Kidney Disorders. (2021, July). *Cystoscopy & ureteroscopy.* National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/cystoscopy-ureteroscopy

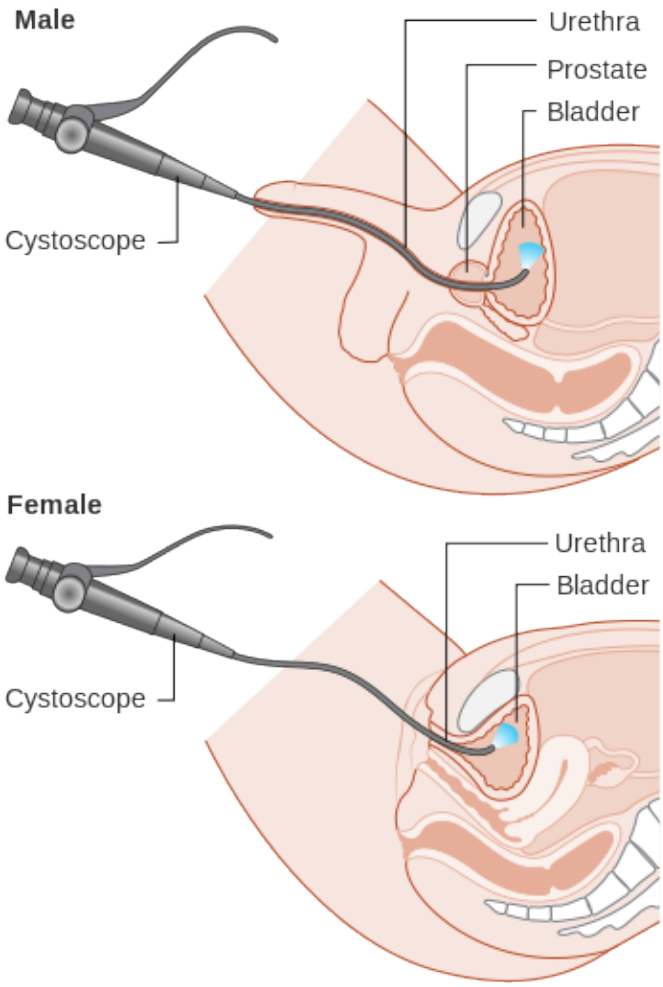

Figure 5.16 Cystoscopy

Dialysis

When kidney failure occurs, treatment is required to eliminate excess wastes, potassium, salt, and water. There are two types of dialysis: hemodialysis and peritoneal dialysis. **Hemodialysis** (hē-mō-dī-ĂL-ĭ-sĭs) uses a special machine that filters the blood. People who are not hospitalized go to a special dialysis clinic for hemodialysis treatments several times a week. **Peritoneal dialysis** (pĕr-ĭ-tŏ-NĒ-ăl dī-ĂL-ĭ-sĭs) uses the lining of the abdomen, called the peritoneal membrane, to filter the blood. Peritoneal dialysis can be performed

in a person's home. See Figure 5.17[12] for an image of a patient undergoing hemodialysis.

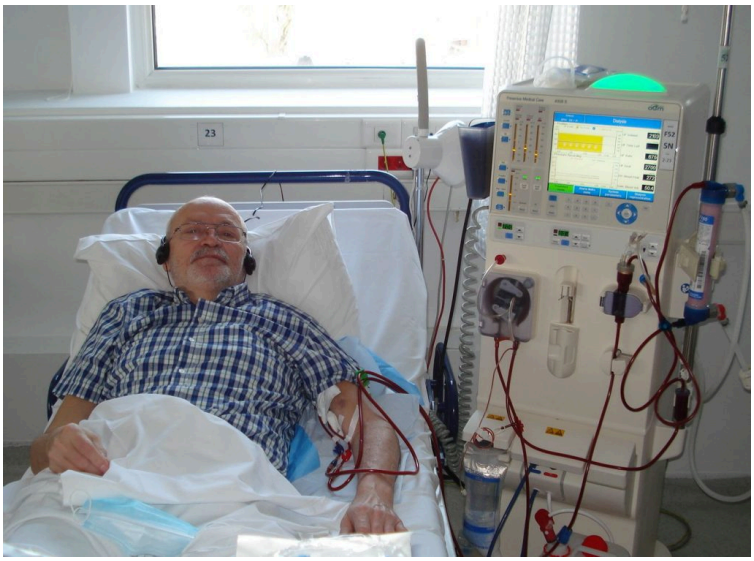

Figure 5.17 Hemodialysis

Kidney Transplantation

A **kidney transplant** (KĬD-nē TRĂNS-plănt), also referred to as **renal transplant** (RĒ-năl TRĂNS-plănt), is a surgical procedure used for some patients in end-stage renal disease. During a transplant, the surgeon places the donated kidney in the lower abdomen and connects a renal artery and renal vein. The healthy donated kidney takes over the work of the two kidneys that failed, so dialysis is no longer needed. Often, the new kidney will start making urine as soon as blood starts flowing through it, but sometimes it takes a few weeks for it to start working. People who have received a kidney transplant must take immunosuppressive medications for the rest of their lives to keep their bodies from rejecting the new kidney.[13]

12. "Dializa-02-2021.jpg" by Mishu57 is licensed under CC BY-SA 4.0

13. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US);

Ureteroscopy

Ureteroscopy (yū-rĕ-tĕr-ŎS-kŏ-pē) is a procedure that uses a ureteroscope to look inside the ureters and kidneys. Like a cystoscope, a ureteroscope has 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. However, a ureteroscope is longer and thinner than a cystoscope so the urologist can see detailed images of the lining of the ureters and kidneys.[14]

Urinary Catheterization

Urinary catheterization (YŪR-ĭ-nĕr-ē kăth-ĭ-tĕr-ī-ZĀ-shŭn) is the insertion of a catheter tube into a person's urethra and then into their bladder to drain urine. This procedure is commonly performed by nurses. Catheterization may include an indwelling catheter or intermittent catheterization.

An **indwelling catheter** (ĭn-DWĔL-ĭng KĂTH-ĭ-tĕr), often referred to as a "Foley catheter," refers to a urinary catheter that remains in place after insertion into the bladder for the continual collection of urine. It has a balloon on the insertion tip to maintain placement in the neck of the bladder. The other end of the catheter is attached to a drainage bag for the collection of urine. See Figure 5.18[15] for an illustration of a urine collection bag connected to an indwelling catheter as the patient is lying in bed.

[updated 2016, Apr 13]. Kidney Transplantation; [cited 2023, Oct 12]. https://medlineplus.gov/kidneytransplantation.html

14. National Institute of Diabetes and Digestive and Kidney Disorders. (2021, July). *Cystoscopy & ureteroscopy*. National Institutes of Health. https://www.niddk.nih.gov/health-information/diagnostic-tests/cystoscopy-ureteroscopy

15. "Closed Urinary Drainage.png" by BruceBlaus is licensed under CC BY-SA 4.0

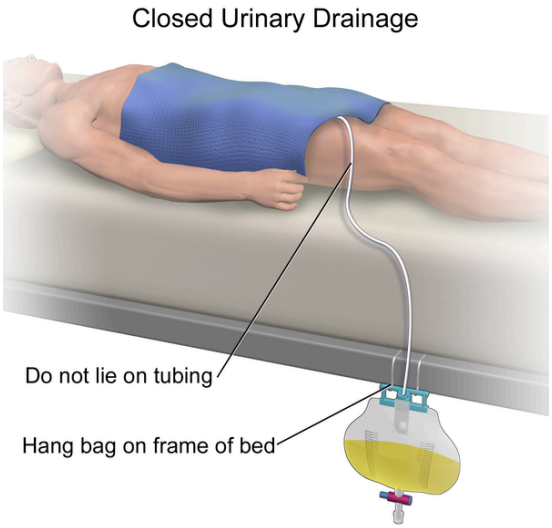

Figure 5.18 Placement of Urine Collection Bag

Intermittent catheterization (ĭn-tĕr-MĬT-ĕnt KĂTH-ĕ-tĕr-ī-ZĀ-shŭn) is used for the relief of urinary retention. It may be performed once, such as after surgery when a patient is experiencing urinary retention due to the effects of anesthesia or performed several times a day to manage chronic urinary retention. A straight catheter is used for intermittent urinary catheterization. The catheter is inserted into the urethra and bladder to allow for the flow of urine and then immediately removed, so a balloon is not required at the insertion tip.[16] See Figure 5.19[17] for an image of a straight catheter.

16. Centers for Disease Control and Prevention. (2015, November 15). *Catheter-associated urinary tract infections (CAUTI)*. https://www.cdc.gov/infectioncontrol/guidelines/cauti/

17. "Urinary catheter.JPG" by Bengt Oberger is licensed under CC BY-SA 3.0

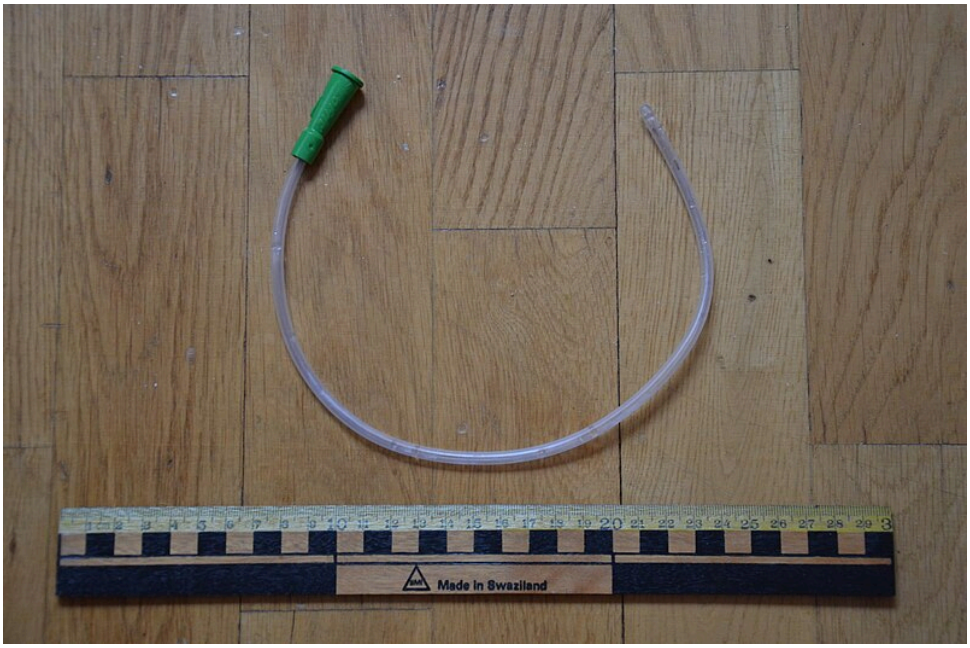

Figure 5.19 Straight Catheter

5.8 Urinary System Learning Activities

Interactive Learning Activity: Label the anatomy of the urinary system using this drag and drop activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3453#h5p-137

Interactive Learning Activity: Study urinary system medical terms discussed in this chapter using these flashcards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3453#h5p-174

Interactive Learning Activity: Test your knowledge of the urinary system by completing this activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3453#h5p-142

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3453#h5p-140

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3453#h5p-141

Interactive Learning Activity: Practice identifying and defining word parts for terms discussed in this chapter:

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3453#h5p-197

You can also print this as a Chapter 5 Practice Worksheet and check your answers with this Answer Key PDF.

5.9 Glossary

24-hour urine collection test (twehn-tee fôr hour yŭ-rēn kŏ-lĕk-shŭn tĕst): A diagnostic procedure where all urine output is collected over a 24-hour period to analyze components such as protein, creatinine, and other substances for evaluating kidney function. (Chapter 5.7)

Acute kidney failure (ā-kūt kĭd-nē fāl-yŭr) (ARF): A rapid loss of kidney function, often within 2 days, due to various causes such as decreased blood flow to the kidneys, infections, and blockages. (Chapter 5.6)

Anuria (ă-NOOR-ē-ă): The absence of urine output, often seen in severe kidney failure, defined as less than 50 mL of urine over a 24-hour period. (Chapter 5.5)

Bladder (blăd-ĕr): A muscular sac in the pelvis that stores urine from the kidneys before it is expelled from the body. (Chapter 5.4)

Bladder scan (blăd-ĕr skăn): A non-invasive, portable medical device using ultrasound technology to estimate the volume of urine in the bladder. (Chapter 5.7)

Blood urea nitrogen (blŭd yū-rē-ă nī-trŏ-jĕn) (BUN): A laboratory test measuring the amount of urea nitrogen in the blood, providing information about kidney and liver function. (Chapter 5.7)

Chronic kidney disease (KRŎN-ĭk kĭd-nē dĭ-ZĒZ) (CKD): A long-term condition where the kidneys progressively lose their ability to filter and eliminate waste products and excess fluids from the body. (Chapter 5.6)

Computed tomography scan of the kidney (kŏm-PYŌŌ-tĕd tŏ-mŏg-ră-fē skăn ăv thĕ kĭd-nē) (CT): An imaging procedure using X-rays and computer technology to create detailed images of the kidneys. (Chapter 5.7)

Creatinine (krē-ĂT-ĭ-nēn): A waste product from muscle metabolism, normally filtered by the kidneys and excreted in urine, used to measure kidney function. (Chapter 5.7)

Cystitis (sĭs-TĪ-tĭs): Inflammation of the bladder, usually due to a urinary tract infection, causing symptoms like pain and increased urge to urinate. (Chapter 5.6)

Cystoscopy (sĭs-TŎS-kŏ-pē): A diagnostic procedure where a cystoscope is used to visually examine the interior of the bladder and urethra. (Chapter 5.7)

Deamination (dē-am-ĭ-NĀ-shŏn): The removal of an amino group from an amino acid or other compound, which occurs in the liver and forms ammonia and urea. (Chapter 5.5)

Distended (dĭs-TĔN-dĕd): Stretched out or enlarged, often used to describe the bladder or abdomen when filled with fluid or gas. (Chapter 5.4)

Diuresis (dī-ū-RĒ-sĭs): Increased or excessive production of urine, which can occur in various medical conditions. (Chapter 5.5)

Diuretic (dī-ū-RĒT-ĭk): A substance or medication that increases the production and excretion of urine, used to treat conditions like high blood pressure. (Chapter 5.5)

Dysuria (dĭs-ŪR-ē-ă): Painful or difficult urination, often a symptom of urinary tract infections or other urological conditions. (Chapter 5.5)

Edema (ĭ-DĒ-mă): Swelling caused by excess fluid trapped in the body's tissues, often seen in kidney or heart disease. (Chapter 5.5)

End-stage renal disease (ĕnd-stāj rē-năl dĭ-ZĒZ) (ESRD): The final phase of chronic kidney disease where the kidneys can no longer meet the body's needs, requiring dialysis or transplantation. (Chapter 5.6)

Enuresis (ĕn-ū-RĒ-sĭs): Involuntary urination, especially common among children during the night (nocturnal enuresis). (Chapter 5.5)

Frequency (FRĒ-kwĕn-sē): The need to urinate more often than usual, a symptom often associated with urinary tract infections or bladder conditions. (Chapter 5.5)

Glomerular filtration (glō-MER-yū-lăr fĭl-TRĀ-shŭn): The process in the kidneys where blood plasma is filtered through the glomeruli, allowing waste products and excess substances to be excreted while retaining necessary components. (Chapter 5.5)

Glomerular filtration rate (glō-MER-yū-lăr fĭl-TRĀ-shŭn rāt) (GFR): A measure of how well the kidneys filter waste from the blood, used as an indicator of kidney function. (Chapter 5.5)

Glomerulonephritis (glō-mĕr-ū-lō-nĕ-FRĪ-tĭs): An inflammation of the glomeruli in the kidneys, affecting their ability to filter blood properly, often leading to kidney damage. (Chapter 5.6)

Glomerulus (glō-MER-yū-lŭs): A network of tiny blood vessels in the kidneys that are involved in the filtration process to form urine. (Chapter 5.4)

Hematuria (hē-mă-TŪR-ē-ă): The presence of blood in the urine, which can be a sign of various urinary tract or kidney conditions. (Chapter 5.5)

Hemodialysis (hē-mō-dī-ĂL-ĭ-sĭs): A medical procedure where a machine filters waste and excess fluids from the blood, used in cases of kidney failure. (Chapter 5.7)

Hydronephrosis (hī-drō-nĕ-FRŌ-sĭs): Swelling of a kidney due to a build-up of urine, often caused by obstruction in the urinary tract. (Chapter 5.6)

Hydrostatic (hī-drō-STAT-ik): Pertaining to the pressure exerted by a fluid at rest. (Chapter 5.5)

Hyperkalemia (hī-pĕr-kă-LĒM-ē-ă): An abnormally high level of potassium in the blood, which can occur in kidney disease or from other causes. (Chapter 5.5)

Incontinence (ĭn-KŎN-tĭ-nĕns): The inability to control urination or defecation, leading to involuntary loss of urine or feces. (Chapter 5.4)

Indwelling catheter (ĭn-DWĔL-ĭng KĂTH-ĭ-tĕr): A type of urinary catheter that remains inside the bladder for continuous urine drainage. (Chapter 5.7)

Intermittent catheterization (ĭn-tĕr-MĬT-ĕnt KĂTH-ĕ-tĕr-ī-ZĀ-shŭn): A method of urinary catheterization where a catheter is temporarily inserted into the bladder to drain urine and then removed. (Chapter 5.7)

Intravenous pyelogram (ĭn-tră-vē-nŭs PĪ-ĕ-lō-gram) (IVP): An imaging test where a contrast dye is injected into a vein and X-rays are taken to visualize the kidneys, ureters, and bladder. (Chapter 5.7)

Kidneys (KĬD-nēz): A pair of organs in the urinary system responsible for filtering waste products and excess substances from the blood to form urine. (Chapter 5.4)

Kidney transplant (KĬD-nē TRĂNS-plănt): A surgical procedure to replace a diseased kidney with a healthy one from a donor. (Chapter 5.7)

Lithotripsy (LĬTH-ō-trĭp-sē): A medical procedure that uses shock waves or other means to break up stones in the kidney, bladder, or ureters. (Chapter 5.6)

Micturate (MĬK-tū-rāt): To urinate or pass urine. (Chapter 5.4)

Nephrolithiasis (nĕf-rō-lĭ-THĪ-ă-sĭs): The presence of stones (calculi) in the kidney. (Chapter 5.6)

Nephrolithotomy (nĕf-rō-lĭ-THŎT-ŏ-mē): A surgical procedure to remove stones from the kidney. (Chapter 5.6)

Nephrologist (nĕ-FRŎL-ŏ-jĭst): A physician who specializes in the diagnosis and treatment of kidney diseases. Nephrologists manage various conditions related to kidney function, including chronic kidney disease, kidney infections, kidney stones, and hypertension related to kidney problems. (Chapter 5.7)

Nephrology (nĕf-RŎL-ŏ-jē): Study of the physiology and diseases of the kidneys. (Chapter 5.7)

Nephron (NĔF-rŏn): The functional unit of the kidney, responsible for filtering and excreting waste products from the blood. (Chapter 5.4)

Nephroscope (NĔF-rŏ-skōp): An instrument used in surgery to visualize the interior of the kidney, particularly in procedures involving kidney stones. (Chapter 5.6)

Nocturia (nŏk-TŪR-ē-ă): The need to wake up and urinate frequently during the night. (Chapter 5.5)

Oliguria (ŏ-lĭ-GŪR-ē-ă): The production of abnormally small amounts of urine, often indicative of kidney dysfunction or dehydration. (Chapter 5.5)

Oncotic pressure (ŏn-KŎT-ĭk PRĔSH-ŭr): The form of osmotic pressure exerted by proteins, particularly albumin, in the blood plasma or other solutions. (Chapter 5.5)

Osmosis (ŏz-MŌ-sĭs): The movement of water molecules through a semipermeable membrane from a region of lower solute concentration to a region of higher solute concentration. (Chapter 5.5)

Partial nephrectomy (pär-shŭl nĕf-RĔK-tŏ-mē): A surgical procedure to remove a portion of the kidney, typically done to treat kidney cancer while preserving kidney function. (Chapter 5.6)

Peritoneal dialysis (pĕr-ĭ-tŏ-NĒ-ăl dī-ĂL-ĭ-sĭs): A form of dialysis where the lining of the abdomen (peritoneum) acts as a filter to remove waste from the blood when the kidneys are not functioning properly. (Chapter 5.7)

Polycystic kidney disease (pŏl-ē-SĬS-tĭk KĬD-nē dĭ-ZĒZ) (PKD): A genetic disorder characterized by the growth of numerous cysts in the kidneys, often leading to kidney failure. (Chapter 5.6)

Polyuria (pŏl-ē-ŪR-ē-ă): The production of abnormally large volumes of dilute urine, often a symptom of conditions like diabetes. (Chapter 5.5)

Post-void residual (pōst voyd rĭ-ZĬD-ū-ăl): The amount of urine remaining in the bladder after urination, as measured for diagnostic purposes. (Chapter 5.6)

Pyelonephritis (pī-ĕl-ō-nĕ-FRĪ-tĭs): A type of urinary tract infection where one or both kidneys become infected and inflamed. (Chapter 5.6)

Pyuria (pī-ŪR-ē-ă): The presence of white blood cells in the urine, indicating an infection in the urinary tract. (Chapter 5.5)

Radical nephrectomy (răd-ĭ-kăl nĕf-RĔK-tŏ-mē): A surgical procedure to remove the entire kidney, along with the adrenal gland, surrounding tissue, and often nearby lymph nodes, usually for cancer treatment. (Chapter 5.6)

Renal (RĒ-năl): Pertaining to the kidneys. (Chapter 5.4)

Renal calculus (RĒ-năl KĂL-kŭ-lŭs): Another term for a kidney stone. (Chapter 5.6)

Renal transplant (RĒ-năl TRĂNS-plănt): Surgical procedure to place a functioning kidney from a donor into a person with end-stage renal disease. (Chapter 5.7)

Retrograde pyelography (rĕ-trō-grād pī-ĕ-lō-gră-fē): A type of X-ray examination of the upper urinary tract, including the kidneys and ureters, typically performed during a cystoscopy. (Chapter 5.7)

Sepsis (SĔP-sĭs): A life-threatening condition that arises when the body's response to an infection causes injury to its own tissues and organs. Sepsis can lead to significant health complications or death, especially if not recognized early and treated promptly. It often presents with fever, increased heart rate, increased breathing rate, and confusion. (Chapter 5.6)

Simple nephrectomy (sĭm-pĭl nĕf-RĔK-tŏ-mē): A surgical procedure to remove a kidney, typically for conditions like severe damage or cancer. (Chapter 5.6)

Sphincters (SFĬNK-tĕrz): Circular muscles that constrict and close a natural body passage; in the urinary system, they control the release of urine from the bladder. (Chapter 5.4)

Stress urinary incontinence (strĕs YŪR-ĭ-nĕr-ē ĭn-KŎN-tĭ-nĕns): Involuntary

leakage of urine during activities that increase abdominal pressure, such as coughing, sneezing, or exercising. (Chapter 5.6)

Stricture (STRIK-chŭr): A narrowing of a tube or passage in the body, such as the urethra, often leading to restricted flow of fluids like urine. (Chapter 5.7)

Transurethral resection of the prostate (trăns-yū-RĒ-thrăl rĭ-SĔK-shŭn ăv thĕ PRŌS-tāt) (TURP): A surgical procedure to remove part of the prostate gland to treat urinary problems. (Chapter 5.6)

Urea (yū-RĒ-ă): A nitrogenous compound produced in the liver as a waste product from the breakdown of proteins, excreted in the urine. (Chapter 5.5)

Ureter (YŪR-ĕ-tĕr): A tube that carries urine from the kidney to the urinary bladder. (Chapter 5.4)

Ureteroscopy (yū-rĕ-tĕr-ŎS-kŏ-pē): A procedure using a ureteroscope to examine or treat disorders of the urinary tract, especially the ureters and kidneys. (Chapter 5.7)

Urethra (yū-RĒ-thră): The tube that carries urine from the bladder to the outside of the body. (Chapter 5.4)

Urgency (ŬR-jĕn-sē): A sudden, compelling need to urinate, often a symptom of urinary tract infections or overactive bladder. (Chapter 5.5)

Urinal (ŪR-ĭn-ăl): A receptacle or device for collecting urine, especially in healthcare settings. (Chapter 5.5)

Urinalysis (yūr-ĭ-NĂL-ĭ-sĭs) (UA): A test of the urine involving physical, chemical, and microscopic examination to detect disorders or diseases. (Chapter 5.7)

Urinary (YŪR-ĭ-nĕr-ē): Relating to urine or the organs of the urinary system. (Chapter 5.4)

Urinary catheterization (YŪR-ĭ-nĕr-ē kăth-ĭ-tĕr-ī-ZĀ-shŭn): The process of inserting a catheter into the bladder through the urethra for the purpose of draining urine. (Chapter 5.7)

Urinary incontinence (YŪR-ĭ-nĕr-ē ĭn-KŎN-tĭ-nĕns): The inability to control urination, resulting in involuntary leakage of urine. (Chapter 5.6)

Urinary retention (YŪR-ĭ-nĕr-ē rĭ-TĔN-shŭn): The inability to empty the bladder completely, resulting in accumulation of urine. (Chapter 5.6)

Urinary tract (YŪR-ĭ-nĕr-ē trăkt): The system of organs that produce, store,

and eliminate urine, including the kidneys, ureters, bladder, and urethra. (Chapter 5.4)

Urinary tract infection (YŪR-ĭ-nĕr-ē trăkt ĭn-FĔK-shŭn) (UTI): An infection in any part of the urinary system, most commonly the bladder and urethra. (Chapter 5.6)

Urinate (YŪR-ĭ-nāt): The act of passing urine from the bladder to the outside of the body. (Chapter 5.4)

Urine culture and sensitivity (yū-rēn KŬL-chŭr ănd sĕn-sĭ-TĬV-ĭ-tē) (C&S): A laboratory test to identify the bacteria causing a urinary tract infection and determine the most effective antibiotics for treatment. (Chapter 5.7)

Urine dip (yū-rēn dĭp): A quick, initial screening test using a dipstick to detect abnormalities in urine, such as the presence of blood, protein, or signs of infection. (Chapter 5.7)

Urodynamic flow testing (yū-rō-dī-NĂM-ĭk flō tĕs-tĭng): A series of diagnostic tests that assess the function of the bladder and urethra, specifically focusing on urine storage and release. (Chapter 5.7)

Urologist (yū-RŎL-ŏ-jĭst): A physician who specializes in diagnosing and treating diseases and disorders of the urinary system and male reproductive organs. (Chapter 5.7)

Urology (yū-RŎL-ŏ-jē): Study of the male and female urinary systems as well as the male reproductive system. (Chapter 5.7)

Vesicoureteral reflux (vĕs-ĭ-kō-yū-RĒT-ĕr-ăl rē-FLŬKS) (VUR): A condition where urine flows backward from the bladder into the ureters and sometimes the kidneys, potentially leading to kidney damage. (Chapter 5.6)

Void (voyd): To empty the bladder; to urinate. (Chapter 5.4)

Voiding cystourethrogram (VOY-dĭng SĬS-tō-ūr-ĒTH-rō-gram) (VCUG): A medical imaging test used to examine the bladder and urethra while the bladder fills and empties. The test involves the insertion of a catheter into the bladder, through which a contrast dye is introduced, followed by X-ray imaging. VCUG is often used to diagnose issues like bladder and urethral dysfunction, vesicoureteral reflux, and urinary tract obstructions, especially in children. (Chapter 5.7)

PART VI

CHAPTER 6 MALE REPRODUCTIVE SYSTEM TERMINOLOGY

6.1 Male Reproductive System Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to the male reproductive system
- Identify meanings of key word components of the male reproductive system
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to the male reproductive system
- Use terms related to the male reproductive system
- Use terms related to the diseases and disorders of the male reproductive system

Introduction to the Male Reproductive System

The male reproductive system produces testosterone to maintain male reproductive function, create sperm, and promote transport of sperm into the female reproductive system for fertilization.[1]

This chapter will review common word components related to the male

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reproductive system to assist learning how to analyze, build, and define medical terms. Other male reproductive terms, whose definitions cannot be easily built from word components, will be described in context based on the anatomy and physiology of the male reproductive system and common diseases and disorders. Medical specialists, diagnostic tests, and procedures related to the male reproductive system will also be discussed.

View the following YouTube video[2] on the male reproductive system: Reproductive System, Part 2 – Male Reproductive System: Crash Course A&P #41

2. CrashCourse. (2015, November 9). *Reproductive system, Part 2 – Male reproductive system: Crash Course Anatomy & Physiology #41* [Video]. YouTube. All rights reserved. https://youtu.be/-XQcnO4iX_U?si=CAHbdwnaGxQOMKP5

6.2 Word Components Related to the Male Reproductive System

This section will describe common word components related to the male reproductive system system. These word components help build definitions for many medical terms. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO THE MALE REPRODUCTIVE SYSTEM

- **a-**: Absence of, without
- **an-**: Absence of, without
- **crypt-**: Hidden
- **dys-**: Painful, difficult
- **epi-**: Above
- **hyper-**: Above, excessive
- **hypo-**: Below
- **par-**: Near
- **trans-**: Through, across, beyond

COMMON WORD ROOTS WITH A COMBINING VOWEL RELATED TO THE

MALE REPRODUCTIVE SYSTEM

- **andr**/o: Male
- **balan**/o: Glans penis
- **epididym**/o: Epididymis
- **gonad**/o: Gonad
- **orch**/o: Testis, testicle
- **orchi**/o: Testis, testicle
- **orchid**/o: Testis, testicle
- **pen**/i: Penis
- **phall**/o: Penis
- **posth**/o: Prepuce, foreskin
- **preputi**/o: Prepuce, foreskin
- **prostat**/o: Prostate gland
- **scrot**/o: Scrotum
- **semin**/i: Semen
- **sperm**/o: Sperm, spermatozoon
- **spermat**/o: Sperm, spermatozoon
- **test**/o: Testis, testicle
- **testicular**/o: Testis, testicle
- **urethr**/o: Urethra
- **vas**/o: Vas deferens, vessel, duct
- **vesicul**/o: Seminal vesicle

COMMON SUFFIXES RELATED TO THE MALE REPRODUCTIVE SYSTEM

- **-al**: Pertaining to
- **-algia**: Pain
- **-ar**: Pertaining to

- **-cision**: Processing of cutting
- **-ectomy**: Excision or surgical removal
- **-genesis**: Beginning, development, or production
- **-gram**: Record
- **-graphy**: Process of recording
- **-ia**: Diseased state, abnormal state, condition of, condition
- **-ic**: Pertaining to
- **-ism**: State of, condition
- **-itis**: Inflammation
- **-logy**: Study of
- **-lysis**: Loosening, dissolution, separating
- **-oma**: Tumor, mass
- **-ous**: Pertaining to
- **-pathy**: Disease
- **-pexy**: Surgical fixation, suspension
- **-plasia**: Development, growth
- **-plasty**: Surgical repair
- **-rrhea**: Flow, discharge
- **-sis**: Condition
- **-stomy**: Creation of new opening, process of new opening
- **-tomy**: Cut into, incision

6.3 Examples of Male Reproductive Terms Easily Defined By Their Word Components

Here are examples of common medical terms related to the male reproductive system that can be easily defined by breaking the terms into their word components.

Prostatitis

1. Break down the medical term into word components: **Prostat/itis**
2. Label the word components: **Prostat** = WR; **itis** = S
3. Define the word components: **Prostat** = prostate; **itis** = inflammation
4. Create a final definition of the medical term: **Inflammation of the prostate gland**

Transurethral

1. Break down the medical term into word components: **Trans/urethr/al**

2. Label the word components: **Trans** = P; **urethr** = WR; **al** = S
3. Define the word components: **Trans** = through; **urethr** = urethra; **al** = pertaining to
4. Create a final definition of the medical term: **Pertaining to through the urethra**

Vasectomy

1. Break down the medical term into word components: **Vas/ectomy**
2. Label the word components: **Vas** = WR; **ectomy** = S
3. Define the word components: **Vas** = vas deferens duct; **ectomy** = excision or removal of
4. Create a final definition of the medical term: **Excision or removal of the vas deferens duct**

Interactive Learning Activity: Practice defining and pronouncing male reproductive system medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=4118#h5p-46

You can also print this as a Chapter 6 Student Companion Worksheet and check your answers with this Answer Key.

6.4 Anatomy of the Male Reproductive System

The structures of the male reproductive system include the testes and epididymis in the scrotum; the vas deferens, seminal vesicles, and bulbourethral glands; the prostate gland; and the penis. These structures are well-vascularized with many glands and ducts to promote the formation, storage, and ejaculation of sperm for fertilization and to also produce testosterone.[1]

See Figure 6.1[2] for an illustration of these structures of the male reproductive system.

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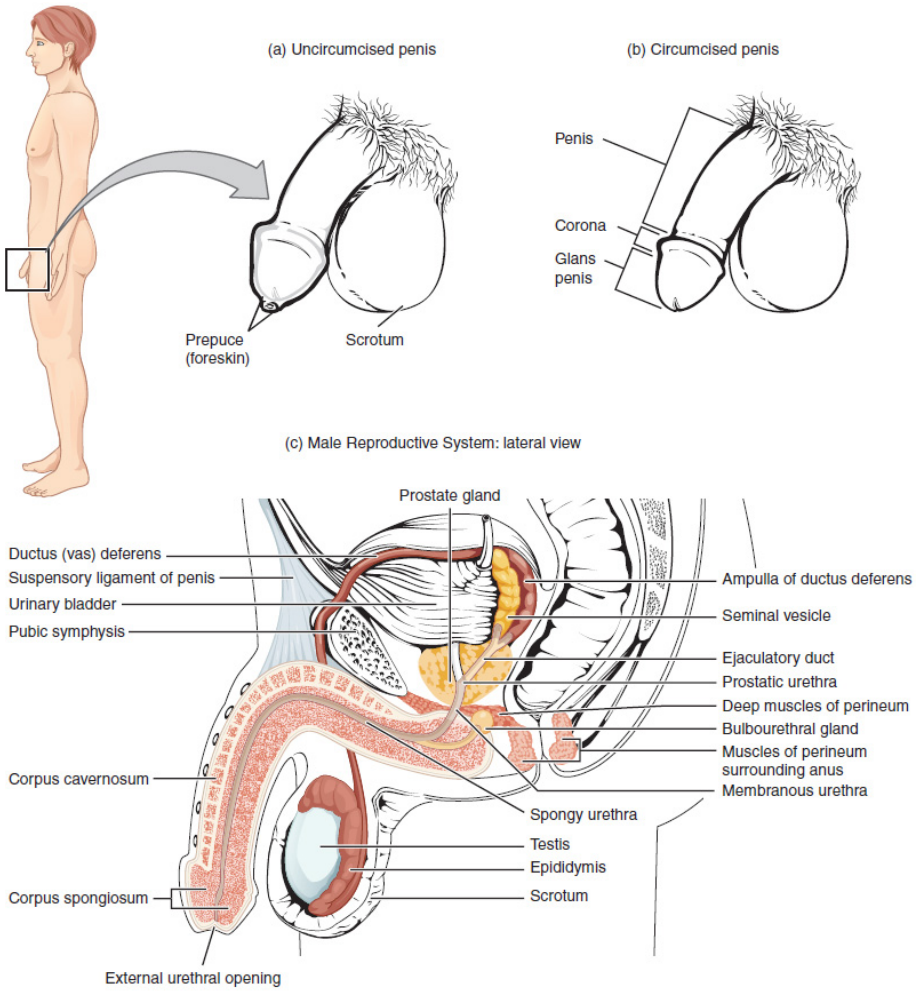

Figure 6.1 Male Reproductive System

TESTES

The **testes** (TĚS-tēz) are the male reproductive organs. They produce both sperm and **androgen** (AN-drŏ-jĕn), (i.e., the male sex hormone testosterone), and are active throughout the reproductive life span of the male. There are two testes, each approximately four to five cm in length, that are housed within the **scrotum** (SKRŌ-tŭm), an external pouch.[3]

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During the seventh month of the developmental period of a male fetus, the testes move through the abdominal musculature to descend into the scrotal cavity. This is called the "descent of the testes." **Cryptorchidism** (krip-TOR-kĭd-izm) is the clinical term used when one or both of the testes fail to descend into the scrotum prior to birth.[4] **Anorchism** (ă-NOR-kĭzm) refers to the absence of one of the testes. See Figure 6.2[5] for an illustration of a testicle.

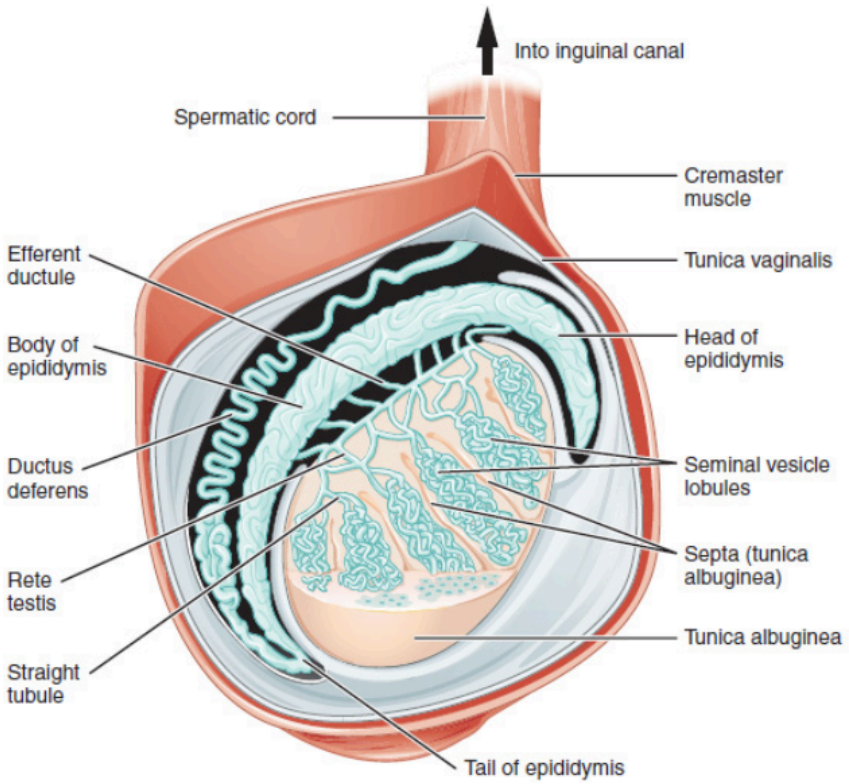

Figure 6.2 Testicle

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The **spermatic cord** (spur-MAT-ĭk KORD) is a bundle of blood vessels, nerves, and ducts that connect the testicles to the abdominal cavity through the inguinal canal. There are several disorders related to the spermatic cord. The spermatic cord is sensitive to **torsion** (TOR-shŏn), in which the testicle rotates within its sac and blocks its own blood supply. An **inguinal hernia** (IN-gwĭ-năl HUR-nē-ă) can occur, referring to protrusion of abdominal contents through the inguinal canal into the scrotum. Varicose veins can occur in the spermatic cord, referred to as **varicocele** (VAR-ĭ-kō-sēl). Though often asymptomatic, about one in four men with varicocele may experience infertility.[6]

Each testis is divided by septa into 300 to 400 structures called lobules. Within the lobules, sperm develop in structures called **seminiferous tubules** (sem-ĭ-NIF-ĕr-ŭs TŪ-būls). Newly produced sperm leave the seminiferous tubules and travel to the **epididymis** (ep-ĭ-DID-ĭ-mĭs), a coiled tube on top of the testes where the newly formed sperm continue to mature for an average of 12 days. As they are moved along the length of the epididymis, the sperm further mature and acquire the ability to move under their own power. Once inside the female reproductive tract, they will use this ability to move independently toward the unfertilized egg. Mature sperm are stored in the tail of the epididymis until ejaculation occurs.[7]

During ejaculation, sperm exit the tail of the epididymis and are pushed by smooth muscle contraction to the **vas deferens** (VĀS DEF-ĕr-ĕnz). Sperm make up only 5 percent of the final volume of **semen** (SĒ-mĕn), the thick, milky fluid that a male ejaculates. This fluid is produced by accessory glands

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of the male reproductive system, the **seminal vesicles** (SEM-ĭ-năl VES-ĭ-kĕlz), the prostate, and the bulbourethral glands. From here, the semen travels through the urethra to the outside of the body during ejaculation.[8]

Because the vas deferens is easily accessible within the scrotum, surgical sterilization to interrupt sperm delivery can be performed by cutting and sealing a small section of the vas deferens, referred to as a **vasectomy** (vă-SEK-tō-mē). Read more about vasectomy in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Male Reproductive System" section.

PROSTATE AND BULBOURETHRAL GLANDS

As sperm pass through the vas deferens at ejaculation, they mix with fluid produced by the associated seminal vesicle. Seminal vesicle fluid contains large amounts of fructose, which is used by the sperm mitochondria to generate energy to allow movement through the female reproductive tract. The seminal fluid, now containing both sperm and seminal vesicle secretions, moves into the associated ejaculatory duct. The paired ejaculatory ducts transport the seminal fluid into the prostate gland.[9]

The **prostate** (PRŌS-tāt) is a gland that is anterior to the rectum at the base of the bladder and surrounds the urethra. A normal prostate gland is the size

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of a walnut. It excretes an alkaline, milky fluid in semen to coagulate (thicken) and then decoagulate the semen following ejaculation. The temporary thickening of semen helps retain it within the female reproductive tract, providing time for sperm to utilize the fructose provided by seminal vesicle secretions. When semen regains its fluid state, the sperm can pass farther into the female reproductive tract.[10]

The final addition to semen is made by two **bulbourethral glands** (bul-bō-ū-RĒ-thrăl glandz) that release a thick, salty fluid to lubricate the end of the urethra and the vagina, as well as cleanse urine residue from the urethra. The fluid from these accessory glands is released after the male becomes sexually aroused and shortly before the release of the semen, so it is often referred to as pre-ejaculate. It is possible for bulbourethral fluid to pick up sperm already present in the urethra and cause pregnancy. Semen moves into the penis via the urethra, a multifunction anatomical structure that also transports urine from the bladder.[11]

PENIS

The **penis** (PĒ-nĭs) is a male reproductive organ that is flaccid during nonsexual actions, such as urination, and becomes stiff and rod-like during sexual arousal. When erect, the stiffness of the penis allows it to penetrate into the vagina and deposit semen into the female reproductive tract, referred to sexual intercourse or **coitus** (KŌ-ĭ-tŭs).

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The **glans penis** (glănz PĒ-nĭs) refers to the tip of the penis. **Circumcision** (sĭr-kŭm-SIZH-ŏn) is the surgical removal of the **foreskin** (FŌR-skin), also called **prepuce** (PRĒ-pyūs), a fold of skin that covers the tip of the penis. Read more about circumcision in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Male Reproductive System" section.

6.5 Physiology of the Male Reproductive System

TESTOSTERONE

Testosterone (tes-TOS-tĕ-rōn) is an **androgen** (AN-drŏ-jĕn) (i.e., male sex hormone) produced in the testes. In a male fetus, testosterone is secreted by the testes by the seventh week of development, with peak concentrations reached in the second trimester. This early release of testosterone results in the anatomical differentiation of the male sexual organs. In childhood, testosterone concentrations are low and then increase during **puberty** (PŪ-bĕrt-ē), the period during which adolescents develop secondary sex characteristics and become capable of reproduction. During puberty, the production of sperm begins.[1]

Testosterone is released into the systemic circulation and plays an important role in muscle development, bone growth, development of secondary sex characteristics, and maintenance of **libido** (lĭ-BĒ-dō) (i.e., sex drive) in both males and females. In females, the ovaries secrete small amounts of testosterone, although most is converted to estradiol (a form of estrogen). A small amount of testosterone is also secreted by the adrenal glands in both sexes.[2]

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SPERMATOGENESIS

Spermatogenesis (spur-mă-tō-JĔN-ĕ-sĭs), the production of sperm, occurs in the testes. Spermatogenesis requires a two- to three-degree lower temperature than body temperature, which is why it occurs outside of the body. It begins at puberty, after which time sperm are produced constantly throughout a man's life.[3]

One production cycle, from spermatogonia through formed sperm, takes approximately 64 days. Sperm counts, the total number of sperm a man produces, slowly decline after age 35. **Azoospermia** (ā-zō-ŏ-SPĔR-mē-ă) refers to the absence of viable sperm in the semen.

Sperm (SPURM), the male reproductive cell, are smaller than most cells in the body. In fact, the volume of a sperm cell is 85,000 times less than that of the egg (female reproductive cell). Approximately 100 to 300 million sperm are produced each day, whereas women typically ovulate only one oocyte (egg) per month. As is true for most cells in the body, the structure of sperm cells speaks to their function. Sperm have a distinctive head, midpiece, and tail region.[4] See Figure 6.3[5] for an illustration of a sperm.

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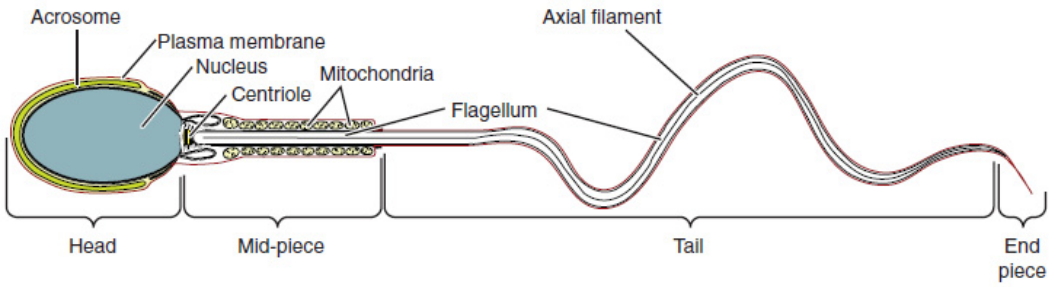

Figure 6.3 Sperm

Ejaculation (i-jak-yŭ-LĀ-shŏn) refers to the ejection of sperm-containing semen from the penis during **orgasm** (OR-gazm), the climax of sexual stimulation.[6] A **condom** (KON-dŏm) is a sheath that may be worn during coitus to prevent pregnancy by collecting ejaculate. Condoms also help prevent the spread of sexually transmitted infections.

Penile erection is caused by vasocongestion of the penile tissues as more arterial blood flows into the penis than is leaving in the veins.[7] **Priapism** (PRĪ-ă-pizm) is a disorder in which the penis maintains a prolonged, rigid erection for four hours or longer, in the absence of stimulation. Priapism that is caused by blood not being able to leave the penis is a medical emergency requiring prompt surgery to prevent damage to the penis. If not treated promptly, priapism can progress to permanent erectile dysfunction.[8] **Erectile**

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dysfunction (ĕ-RĔK-tĭl dis-FŬNGK-shŏn) **(ED)** refers to the inability to attain or maintain an erection sufficient to perform sexual intercourse.

6.6 Diseases and Disorders of the Male Reproductive System

BENIGN PROSTATIC HYPERTROPHY

Benign prostatic hyperplasia (bē-NĪN prŏs-TĂT-ĭk hī-pĕr-PLĀ-zhē-ă) **(BPH)** refers to enlargement of the prostate that is not cancerous. See Figure 6.4[1] for an illustration of BPH. BPH is a common condition in males aged 50 and older. The prostate presses against the urethra, causing it to narrow. Eventually, the bladder becomes weak from trying to pass urine through the narrowed urethra. It loses its ability to completely empty, leaving some urine in the bladder called urinary retention. 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 addressed, it can cause complications such as urinary tract infections, bladder damage, and kidney damage.[2]

1. "Benign_Prostatic_Hyperplasia_nci-vol-7137-300.jpg" by unknown author for National Cancer Institute is licensed in the Public Domain.
2. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2022, Aug. 17]. Enlarged prostate (BPH); [cited 2023, Oct. 10]. https://medlineplus.gov/enlargedprostatebph.html

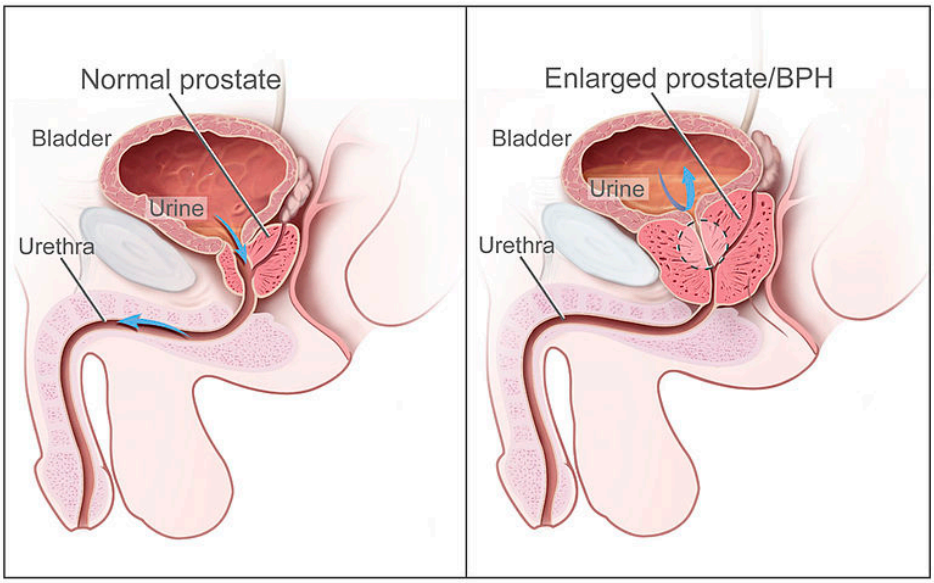

Figure 6.4 Benign Prostatic Hypertrophy

A health care provider may order several types of medical tests to diagnose BPH, such as urodynamic testing or a cystoscopy.[3] Review information about these tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Urinary System" section in the "Urinary System Terminology" chapter.

BPH may be treated with medications or **transurethral** (trans-ū-RĒ-thrăl) procedures where an instrument is inserted through the urethra to widen the urethra or destroy part of the prostate with heat. **Transurethral microwave thermotherapy** (trans-ū-RĒ-thrăl MĪ-krō-wāv THUR-mō-THĚR-ă-pē) **(TUMT)** eliminates excess tissue present in benign prostatic hyperplasia by using heat generated by microwave.

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

3. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2022, Aug. 17]. Enlarged prostate (BPH); [cited 2023, Oct. 10]. https://medlineplus.gov/enlargedprostatebph.html

take pressure off the urethra.[4] For example, **transurethral incision of the prostate** (trans-ū-RĒ-thrăl in-SIZH-ŭn ŏv thĕ PRŌS-tāt) **(TUIP)** is a procedure that widens the urethra by making a few small incisions in the bladder neck and the prostate gland. **Transurethral resection of the prostate** (trans-ū-RĒ-thrăl rĭ-SĔK-shŭn ŏv thĕ PRŌS-tāt) **(TURP)** is the surgical removal of pieces of the prostate gland by using an instrument inserted through the urethra.

CANCER

Prostate Cancer

Prostate cancer (PROS-tāt KAN-sĕr), cancer of the prostate gland, is the second most common cancer occurring in men. Prostate cancer is most common in older 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.[5]

Symptoms of prostate cancer are 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

4. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2022, Aug. 17]. Enlarged prostate (BPH); [cited 2023, Oct. 10]. https://medlineplus.gov/enlargedprostatebph.html

5. National Cancer Institute. (2023, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

include pain in the back, hips, or pelvis that doesn't go away, shortness of breath, fatigue, fast heartbeat, dizziness, or pale skin caused by anemia.[6]

Diagnostic testing for prostate cancer may include the following[7]:

- **Digital rectal exam** (dĭj-ĭ-tăl RĔK-tăl ĕgz-ăm)**:** An exam where the health care provider inserts a lubricated, gloved finger into the rectum and feels the prostate through the rectal wall to assess size, lumps, or other abnormal areas.
- **Pelvic lymphadenectomy** (PĔL-vĭk lim-fad-ĕ-NEK-tō-mē)**:** A surgical procedure to remove the lymph nodes in the pelvis. A pathologist views the tissue under a microscope to look for cancer cells.[8]
- **Prostate-specific antigen** (PRŌS-tāt spĕ-SIF-ĭk AN-tĭ-jĕn) **(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.
- **PSMA PET scan** (PSMA PĒ-Ē-TĔ skăn)**:** 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

6. National Cancer Institute. (2023, February 16). *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, February 16). *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, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

of prostate cancer cells. A PET scanner detects high concentrations of the radioactive molecule and shows where the prostate cancer cells are in the body.

- **Seminal vesicle biopsy** (SEM-ĭ-năl VES-ĭ-kĕl BĪ-ŏp-sē)**:** 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.[9]
- **Transrectal ultrasound** (trans-RĔK-tăl ŬL-tră-sound)**:** 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 body tissues called a sonogram. Transrectal ultrasound may also be used during a biopsy procedure called **transrectal ultrasound guided biopsy** (trăns-RĔK-tăl ŬL-tră-sound GĪ-ded BĪ-ŏp-sē).
- **Transrectal MRI** (trans-RĔK-tăl ĕm-ĀR-ĀĪ)**:** A procedure that uses a strong magnet, radio waves, and a computer to make a series of detailed pictures of areas inside the body. A probe that gives off radio waves is inserted into the rectum near the prostate. This helps the MRI machine make clearer pictures of the prostate and nearby tissue. A transrectal MRI is done to find out 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** (trăns-RĔK-tăl MRĪ GĪ-ded BĪ-ŏp-sē).
- **Transrectal biopsy** (trans-RĔK-tăl BĪ-ŏp-sē)**:** The removal of tissue 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 from. 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

9. National Cancer Institute. (2023, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

include bone scan, MRI, or CT scans. Read more about these diagnostic tests in the "Medical Specialists, Diagnostic Testing, Procedures, and Equipment Related to the Respiratory System."

Treatment

There are several types of treatment for patients with prostate cancer, depending on the stage of the cancer and if it has metastasized (i.e., spread to other areas of the body)[10]:

- Watchful waiting
- Surgery
- Radiation therapy and radiopharmaceutical therapy
- Hormone therapy
- Chemotherapy
- Targeted therapy
- Immunotherapy

WATCHFUL WAITING

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 patient'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.[11]

10. National Cancer Institute. (2023, February 16). *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, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

SURGERY

There are many types of surgeries performed to treat prostate cancer[12]:

- **Radical prostatectomy** (RAD-ĭ-kăl prŌS-tă-TĔK-tŏ-mē)**:** 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** (OPEN RAD-ĭ-kăl prŌS-tă-TĔK-tŏ-mē)**:** 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** (RAD-ĭ-kăl lăp-ă-RŎS-kŏ-pĭk prŌS-tă-TĔK-tŏ-mē)**:** 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** (ROH-bot ă-SĬS-tĕd lăp-ă-RŎS-kŏ-pĭk RAD-ĭ-kăl prŌS-tă-TĔK-tŏ-mē)**:** 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 computer monitor near the operating table.
- **Pelvic lymphadenectomy** (PĚL-vĭk lim-fad-ĕ-NEK-tō-mē)**:** Lymph nodes are removed from the pelvis for examination under a microscope by a

12. National Cancer Institute. (2023, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

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** (trans-ū-RĒ-thrăl rĭ-SĔK-shŭn ŏv thĕ PRŌS-tāt) **(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 (RĀ-dē-Ā-shŭn THĔR-ă-pē) 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[13]:

- 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. In early-stage 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

13. National Cancer Institute. (2023, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

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** (RĀ-dē-ō-far-mă-SOO-tĭ-kăl THĔR-ă-pē) uses a radioactive substance to treat metastatic prostate cancer that has spread to the bone.

HORMONE THERAPY

Hormone therapy (HOR-mōn THĔR-ă-pē), 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** (or-kē-EK-tŏ-mē) is the surgical removal of one or both testicles, the main source of testosterone, to decrease the amount of hormone being made.[14]

CHEMOTHERAPY

Chemotherapy (KĒ-mō-THĔR-ă-pē) 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.[15]

14. National Cancer Institute. (2023, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

15. National Cancer Institute. (2023, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

TARGETED THERAPY

Targeted therapy (TAR-gĕt-ed THĔR-ă-pē) 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.[16]

IMMUNOTHERAPY

Immunotherapy (ĭm-yū-nō-THĔR-ă-pē) uses the patient'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.[17]

Testicular Cancer

Testicular cancer (tĕs-TĬK-ū-lăr KAN-sĕr) is cancer that begins in the cells that make sperm in the testicle. It is rare and is most frequently diagnosed in men ages 20 to 34. Most testicular cancers can be cured, even if diagnosed at an advanced stage. Common symptoms of testicular cancer are a painless lump in the testicle, a dull ache in the lower abdomen or the groin, a sudden build-up of fluid in the scrotum, and pain in a testicle or in the scrotum. Diagnostic tests include an ultrasound of the testes and blood tests for tumor markers. Treatment includes **inguinal orchiectomy** (IN-gwĭ-năl or-kē-EK-tŏ-mē), a procedure to remove the entire testicle through an incision in the inguinal region of the groin.[18]

16. National Cancer Institute. (2023, February 16). *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, February 16). *Prostate cancer treatment (PDQ) – patient version*. National Institutes of Health. https://www.cancer.gov/types/prostate/patient/prostate-treatment-pdq

18. National Cancer Institute. (2023, May 17). *Testicular cancer treatment (PDQ) –*

ERECTILE DYSFUNCTION (ED)

Erectile dysfunction (ĭ-RĒK-tīl dĭs-FŬNK-shŏn) **(ED)** is the inability to achieve or maintain an erection. ED is a common condition as men age, with 40% of men at age 40 and up to 70% of men by age 70 years experiencing ED. ED is also associated with side effects of some medications and many medical disorders such as high blood pressure, diabetes, cardiovascular disease, kidney disease, prostate disorders, and low testosterone levels. ED may be treated with medications or an implanted device.[19]

HYDROCELE

A **hydrocele** (HĪ-drŏ-sēl) is a type of swelling in the scrotum, the pouch of skin that holds the testicles. This swelling happens when fluid collects in the thin sac that surrounds a testicle. Hydroceles are common in newborns. They often go away without treatment by age one.[20]

Older children and adults can get a hydrocele due to an injury to the scrotum or other health problems. For example, a hydrocele may develop

patient version. National Institutes of Health. https://www.cancer.gov/types/testicular/patient/testicular-treatment-pdq

19. National Institute of Diabetes and Digestive and Kidney Diseases. (2017, July). *Definitions & facts for erectile dysfunction*. National Institutes of Health. https://www.niddk.nih.gov/health-information/urologic-diseases/erectile-dysfunction/definition-facts

20. Mayo Clinic. (2023, January 12). *Hydrocele*. https://www.mayoclinic.org/diseases-conditions/hydrocele/symptoms-causes/syc-20363969

after surgery for **varicocele** (VAR-ĭ-kō-sēl), enlarged veins of the spermatic cord that can cause scrotal swelling.

INFERTILITY

Nearly 1 in 7 couples is infertile, which means they haven't been able to conceive a child even though they've had frequent, unprotected sexual intercourse for a year or longer. In up to half of these couples, male infertility plays a role. Male infertility can be caused by low sperm production, abnormal sperm function, or blockages that prevent the delivery of sperm. Illnesses, injuries, chronic health problems, lifestyle choices, and other factors may contribute to male infertility.[21]

For a male to cause pregnancy, the following processes must occur[22]:

- **Healthy sperm are produced.** At least one testicle must be functioning, and the body must produce testosterone and other hormones to trigger and maintain sperm production.
- **Sperm must be carried into the semen.** After sperm are produced in the testicles, tubes transport them until they mix with semen and are ejaculated out of the penis.
- **There must be enough sperm in the semen.** If the number of sperm in the semen (referred to as sperm count) is low, it decreases the odds that one sperm will fertilize a partner's egg. A low sperm count is fewer than 15 million sperm per milliliter of semen or fewer than 39 million per ejaculate. **Aspermia** (ā-SPUR-mē-ă) refers to failure to produce sperm.

21. Mayo Clinic. (2022, December 28). *Male infertility*. https://www.mayoclinic.org/diseases-conditions/male-infertility/symptoms-causes/syc-20374773

22. Mayo Clinic. (2022, December 28). *Male infertility*. https://www.mayoclinic.org/diseases-conditions/male-infertility/symptoms-causes/syc-20374773

- **Sperm must be functional and able to move.** If the movement (referred to as motility) or the function of sperm is abnormal, the sperm may not be able to reach or penetrate the partner's egg.

There are several possible causes of male infertility. If a couple is not able to conceive within one year of having unprotected sex, the couple can visit fertility specialists for diagnostic testing and infertility treatment.

PROSTATITIS

Prostatitis (pros-tă-TĪT-ĭs) refers to inflammation of the prostate gland and sometimes areas surrounding it. Prostatitis can be acute or chronic, and some types are caused by a bacterial infection. Symptoms of acute bacterial prostatitis are typically severe and come on suddenly, whereas chronic prostatitis develops slowly and lasts three or more months. Symptoms may include the following[23]:

- Urinary frequency
- Urinary urgency
- A weak or an interrupted urine stream
- Dysuria
- Fever and/or chills
- Painful ejaculation
- Pain in the penis or testicles

A health care provider diagnoses prostatitis by performing diagnostic tests, such as a urinalysis and cystoscopy. Treatment depends upon the cause and may include antibiotics and pain relievers.

23. Mayo Clinic. (2022, February 19). *Prostatitis.* https://www.mayoclinic.org/diseases-conditions/male-infertility/symptoms-causes/syc-20374773

SEXUALLY TRANSMITTED INFECTIONS

Sexually transmitted infections affect both males and females. The terms **sexually transmitted infection** (SEKS-ū-ă-lē trănz-MĬT-ed ĭn-FĔK-shŏn) **(STI)** and **sexually transmitted disease** (SEKS-ū-ă-lē trănz-MĬT-ed diz-ĒZ) **(STD)** are used interchangeably. STI and STD imply the infection was acquired through sexual transmission. Examples of STIs include chlamydia, gonorrhea, human immunodeficiency virus (HIV), human papillomavirus (HPV), and herpes simplex virus. The only way to completely avoid STIs is to not have vaginal, anal, or oral sex. If you are sexually active, the following factors can lower your chances of getting an STI[24]:

- Being in a long-term mutually monogamous relationship with a partner who has been tested and does not have STI
- Correctly using condoms every time you have sex

Chlamydia

Chlamydia (klă-MĬD-ē-ă) is the most common type of bacterial STI. It is caused by a bacteria called *Chlamydia trachomatis*. Chlamydia is often referred to as a "silent disease" because many people with chlamydia do not have any symptoms and unknowingly pass the infection to their sexual partner(s). Anyone can get chlamydia during oral, vaginal, or anal sex with someone who has chlamydia. A pregnant woman can also pass chlamydia to her baby during childbirth, causing eye infections or pneumonia.[25]

24. Centers for Disease Control and Prevention. (2022, April 12). *Chlamydia – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/chlamydia/stdfact-chlamydia.htm

25. Centers for Disease Control and Prevention. (2022, April 12). *Chlamydia – CDC*

Symptoms may not appear until several weeks after having sex with someone who has chlamydia. Symptoms in women include abnormal vaginal discharge, which may have a strong smell, and a burning sensation when urinating. Symptoms in men include discharge from the penis and a burning sensation when urinating. If untreated, chlamydia in females can lead to **pelvic inflammatory disease** (PĚL-vĭk ĭn-flă-MĂ-tōr-ē dĭ-ZĒZ) **(PID)**, which can cause permanent damage to the reproductive organs and infertility.[26]

Chlamydia is diagnosed by a health care provider by a urine sample or by using a cotton swab to obtain a specimen that is sent to a lab for analysis. Chlamydia is treated with antibiotics. All sexual partners within the past 60 days should be notified and examined by a health care provider, keeping in mind that not having symptoms does not mean there is no infection. Reinfection is common, so people diagnosed with chlamydia should be retested three months after treatment of the initial infection, regardless of whether they believe that their sexual partners were successfully treated.[27]

Gonorrhea

Gonorrhea (gon-ŏ-RĒ-ă) is a bacterial STI caused by *Neisseria gonorrhea*. *Neisseria gonorrhea* infects the mucous membranes of the reproductive tract, including the cervix, uterus, and Fallopian tubes in women, and the

basic fact sheet. U.S. Department of Health & Human Services. https://www.cdc.gov/std/chlamydia/stdfact-chlamydia.htm

26. Centers for Disease Control and Prevention. (2022, April 12). *Chlamydia – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/chlamydia/stdfact-chlamydia.htm

27. Centers for Disease Control and Prevention. (2022, April 12). *Chlamydia – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/chlamydia/stdfact-chlamydia.htm

urethra in both women and men, causing inflammation and discharge. *Neisseria gonorrhea* can also infect the mucous membranes of the mouth, throat, eyes, and rectum. Gonorrhea is transmitted through sexual contact with the penis, vagina, mouth, or anus of an infected partner. Ejaculation does not have to occur for gonorrhea to be transmitted or acquired. Gonorrhea can also be spread perinatally from mother to baby during childbirth, which can cause blindness, joint infection, or a life-threatening blood infection in the baby if left untreated.[28]

Many people infected with gonorrhea have no symptoms and can unknowingly pass the infection on to their sexual partner(s). Most women with gonorrhea are asymptomatic. Even when a woman has symptoms, they are often so mild and nonspecific that they are mistaken for a bladder or vaginal infection. The initial symptoms and signs in women include dysuria, increased vaginal discharge, or vaginal bleeding between periods. Women with gonorrhea are at risk of developing serious complications from the infection, such as pelvic inflammatory disease (PID).

When present, signs and symptoms of gonorrhea in men include dysuria (painful urination) or a white, yellow, or green urethral discharge that usually appears 1 to 14 days after infection. Men may also experience testicular or scrotal pain.

Symptoms of rectal gonorrhea infection in both men and women may include discharge, anal itching, soreness, bleeding, or painful bowel movements. Pharyngeal gonorrhea infection may cause a sore throat, but it is usually asymptomatic.[29]

Urogenital gonorrhea can be diagnosed by testing urine, a urethral swab

28. Centers for Disease Control and Prevention. (2023, April 11). *Gonorrhea – CDC detailed fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea-detailed.htm

29. Centers for Disease Control and Prevention. (2023, April 11). *Gonorrhea – CDC detailed fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea-detailed.htm

(for men), or endocervical or vaginal swab (for women) using **nucleic acid amplification testing** (no◈o-klē-ĭk ĂS-ĭd ăm-plĭ-fĭ-KĀ-shŏn tĕst-ing) **(NAAT)**. It can also be diagnosed using gonorrhea culture, which requires endocervical or urethral swab specimens.[30]

Gonorrhea is treated with an intramuscular (IM) injection of antibiotics. It is important that individuals complete the treatment and abstain from unprotected sexual activity for at least seven days following treatment. All sexual partners within the past 60 days should be notified and examined, keeping in mind that having no symptoms does not mean there is no infection. Reinfection is common, so people with gonorrhea should be retested three months after treatment of the initial infection, regardless of whether they believe that their sexual partners were successfully treated.[31]

Human Immunodeficiency Virus (HIV)

Human immunodeficiency virus (hu-man im-yŭ-nō-dĕ-FISH-ĕn-sē VĪ-rŭs) **(HIV)** is a virus that attacks the T-helper cells (a type of lymphocyte or white blood cell) of the immune system. If HIV is not treated, it can lead to **acquired immunodeficiency syndrome** (ă-KWĪRD im-yū-nō-dĕ-FISH-ĕn-sē SĬN-drōm) **(AIDS)**. There is currently no cure for HIV, so people who become infected with HIV have it for life. However, with proper medical care, HIV can be controlled, and people with HIV can live long, healthy lives while also preventing its spread to their partners.[32]

30. Centers for Disease Control and Prevention. (2023, April 11). *Gonorrhea – CDC detailed fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea-detailed.htm

31. Centers for Disease Control and Prevention. (2023, April 11). *Gonorrhea – CDC detailed fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea-detailed.htm

32. Centers for Disease Control and Prevention. (2022, June 30). *What is HIV?* U.S.

Most people infected with HIV have flu-like symptoms within two to four weeks after becoming infected. Symptoms include fever, night sweats, fatigue, swollen lymph nodes, sore throat, muscle aches, and rash. If not treated, the infection becomes chronic, with or without symptoms, and can take up to ten years to develop AIDS. Without HIV treatment, people with AIDS typically only survive about three years.[33]

HIV tests can be performed on blood or oral fluid. HIV is treated with medication called **antiretroviral therapy** (ăn-tē-rĕ-trō-VĪ-răl THĔR-ă-pē) that reduces the amount of virus in the body, helps maintain a healthy immune system, and prevents AIDS from developing.[34]

Herpes Simplex Virus

Genital herpes (JEN-ĭt-ăl HĔRP-ēz) is an STI caused by the **herpes simplex virus** (HUR-pēz SĬM-pleks VĪ-rŭs) **(HSV)** that is characterized by blisters in the genital area. There are two types of herpes simplex viruses: HSV-1 and HSV-2. HSV-1 (oral herpes) causes mouth ulcers, commonly called "cold sores." HSV-2 causes genital herpes when a person has genital contact with someone who has a genital HSV-2 infection. Additionally, a genital HSV-1 infection can occur when a person receives oral sex from a person with an HSV-1 oral ulcer.

Department of Health & Human Services. https://www.cdc.gov/hiv/basics/whatishiv.html

33. Centers for Disease Control and Prevention. (2022, June 30). *What is HIV?* U.S. Department of Health & Human Services. https://www.cdc.gov/hiv/basics/whatishiv.html

34. Centers for Disease Control and Prevention. (2022, June 30). *What is HIV?* U.S. Department of Health & Human Services. https://www.cdc.gov/hiv/basics/whatishiv.html

Herpes infection can also be passed from mother to child during pregnancy or childbirth, which can result in a potentially fatal neonatal herpes infection.[35]

Herpes lesions typically appear as one or more vesicles (i.e., small blisters), on or around the genitals, rectum, or mouth. The vesicles break and leave painful ulcers that may take two to four weeks to heal after the initial herpes infection. Once a patient is infected with HSV, the virus remains in their body even after the symptoms are gone and can cause recurring outbreaks related to fever, stress, or other triggering factors.[36] See Figure 6.5[37] for an image of a mouth ulcer caused by HSV-1. Although this is not considered an STI, herpes lesions that occur on the genitals have a similar appearance.

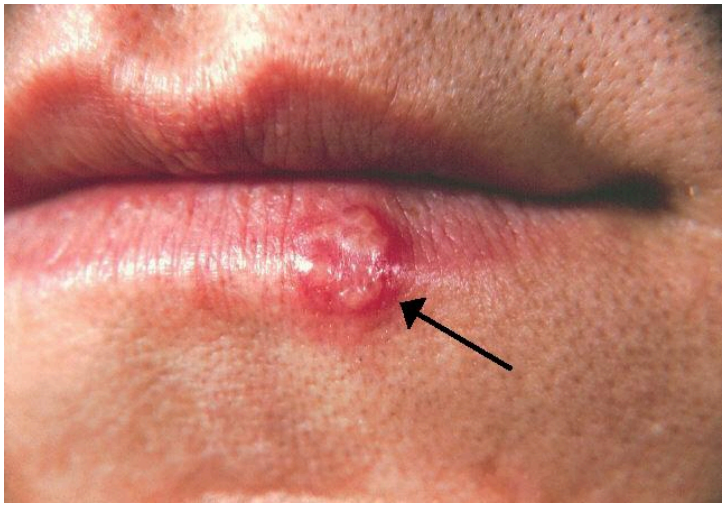

Figure 6.5 Mouth Ulcer Caused by HSV-1

35. Centers for Disease Control and Prevention. (2021, July 22). *Genital herpes – CDC detailed fact sheet.* U.S. Department of Health & Human Services. https://www.cdc.gov/std/herpes/stdfact-herpes-detailed.htm

36. Centers for Disease Control and Prevention. (2021, July 22). *Genital herpes – CDC detailed fact sheet.* U.S. Department of Health & Human Services. https://www.cdc.gov/std/herpes/stdfact-herpes-detailed.htm

37. "Herpes(PHIL_1573_lores).jpg" by Centers for Disease Control and Prevention is licensed in the Public Domain.

HSV nucleic acid amplification tests (NAAT) are the best test for diagnosing herpes, but in some settings, a viral culture is the only test available. There is no cure for herpes. Antiviral medications can shorten outbreaks, and daily suppressive therapy can prevent outbreaks and transmission of the infection to partners.[38]

Human Papillomavirus

Human papillomavirus (hu-man PAP-ĭ-LŌ-mă-VĪ-rŭs) **(HPV)** is a common STI. Almost three quarters of sexually active individuals have been exposed to HPV during their lifetime. HPV spreads through sexual activity and skin-to-skin contact in the genital area with an infected person. Because some types of HPV are asymptomatic, people don't know they have the virus and, consequently, pass the virus to their sexual partners.[39]

There are over 100 strains of HPV, and some strains of HPV can cause visible genital warts. Genital warts usually appear as a small bump or group of bumps in the genital area. They can be small or large, raised or flat, or shaped like a cauliflower. Some strains of HPV cause genital, anal, throat, and cervical cancers. For this reason, routine PAP smears for women can help prevent cervical cancer from HPV.[40]

Treatments are available for genital warts, but there is no cure for HPV. The

38. Centers for Disease Control and Prevention. (2021, July 22). *Genital herpes – CDC detailed fact sheet.* U.S. Department of Health & Human Services. https://www.cdc.gov/std/herpes/stdfact-herpes-detailed.htm

39. Centers for Disease Control and Prevention. (2022, April 12). *Genital HPV infection – basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/hpv/stdfact-hpv.htm

40. Centers for Disease Control and Prevention. (2022, April 12). *Genital HPV infection – basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/hpv/stdfact-hpv.htm

HPV vaccine can protect against diseases (including cancers) caused by HPV. The HPV vaccine is recommended for all preteens (including boys and girls) at age 11 or 12 years and through age 26 years. Most sexually active adults have already been exposed to HPV, so vaccination is not recommended. People who are in a long-term, mutually monogamous relationship are not likely to get a new HPV infection.[41]

Syphilis

Syphilis (SIF-ĭ-lĭs) is an STI that can cause serious health problems without treatment. Infection develops in stages called primary, secondary, latent, and tertiary. Each stage can have different signs and symptoms. Syphilis is spread by direct contact with a syphilis sore during vaginal, anal, or oral sex. Syphilis can also be spread from a mother with syphilis to her unborn baby.[42]

During the first (primary) stage of syphilis, a single sore or multiple sores appear in the location where syphilis entered the body. See Figure 6.6[43] for an image of a sore caused by syphilis, referred to as a chancre. Sores are typically firm, round, and painless. The sore usually lasts three to six weeks and heals regardless of whether treatment is received.

41. Centers for Disease Control and Prevention. (2022, April 12). *Genital HPV infection – basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/hpv/stdfact-hpv.htm

42. Centers for Disease Control and Prevention. (2022, February 10). *Syphilis – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/syphilis/stdfact-syphilis.htm

43. "Extragenital_syphilitic_chancre_of_the_left_index_finger_PHIL_4147_lores.jpg" by Centers for Disease Control and Prevention is licensed in the Public Domain.

Figure 6.6 Syphilis Chancre

During the secondary stage, skin rashes and/or sores in the mouth, vagina, or anus appear. The rash can show up when the primary sore is healing or several weeks after the sore has healed. The rash can also be on the palms of the hands and/or the bottoms of the feet and look rough, red, or reddish-brown. Without treatment, syphilis can spread to the brain and nervous system (neurosyphilis), the eye (ocular syphilis), or the ear (otosyphilis). This can happen during any of the stages. Syphilis is treated with antibiotics, but antibiotics do not reverse any damages that occurred prior to treatment.[44]

Trichomoniasis

Trichomoniasis (trĭk-ō-mō-NĪ-ă-sĭs) is a common STI caused by infection with *Trichomonas vaginalis,* a protozoan (tiny, single-celled) parasite. Although symptoms vary, most people who have trichomoniasis cannot tell they have it. Men with trichomoniasis may notice itching or irritation inside the penis,

44. Centers for Disease Control and Prevention. (2022, February 10). *Syphilis – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/syphilis/stdfact-syphilis.htm

burning after urinating or ejaculating, or discharge from the penis. Women with trichomoniasis may notice itching; burning; redness or soreness of the genitals; dysuria; or a clear, white, yellowish, or greenish vaginal discharge with a fishy smell. Trichomoniasis is diagnosed with a swab specimen evaluated in a laboratory. It is treated with antibiotics taken by mouth.[45]

SPERMATOCELE

A **spermatocele** (spĕr-MĂT-ō-sēl) is an abnormal sac (cyst) that develops in the epididymis, the small, coiled tube located on the upper testicle that collects and transports sperm. The cause of spermatoceles is unknown but could be due to a blockage in one of the tubes that transport sperm. If a spermatocele grows large enough to cause discomfort, surgery may be required.[46]

TESTICULAR TORSION

Testicular torsion (tĕs-TĬK-ū-lăr TOR-shŏn) occurs when a testicle rotates, twisting the spermatic cord that brings blood to the scrotum. The reduced blood flow causes sudden, severe pain and swelling. Testicular torsion commonly occurs between ages 12 and 18 and usually requires emergency

45. Centers for Disease Control and Prevention. (2022, April 25). *Trichomoniasis – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.cdc.gov/std/trichomonas/stdfact-trichomoniasis.htm

46. Mayo Clinic. (2022, March 31). *Spermatocele*. https://www.mayoclinic.org/diseases-conditions/spermatocele/symptoms-causes/syc-20377829

surgery. If treated quickly, the testicle can usually be saved. But when blood flow has been cut off for too long, a testicle might become so badly damaged that it has to be removed.[47]

47. Centers for Disease Control and Prevention. (2022, February 24). *Trichomoniasis – CDC basic fact sheet*. U.S. Department of Health & Human Services. https://www.mayoclinic.org/diseases-conditions/testicular-torsion/symptoms-causes/syc-20378270

6.7 Medical Specialists, Diagnostic Testing, and Procedures Related to the Male Reproductive System

MEDICAL SPECIALISTS

Urology (yū-RŎL-ŏ-jē) is the study of the male and female urinary systems and the male reproductive system.[1] A **urologist** (yū-RŌL-ŏ-jĭst) is a physician who specializes in the diagnosis and treatments of disorders of the urinary and reproductive systems.

> To learn more about urology and the training involved to become a urologist, visit the American Urological Association, Why Urology?

1. American Urological Association. (n.d.). *Why urology?* https://www.auanet.org/about-us/aua-overview/why-urology

DIAGNOSTIC TESTING

Semen Analysis

A **semen analysis** (SĒ-měn ă-NĂL-ĭ-sĭs) evaluates the volume and quality of a man's sperm. It is one of the first tests performed when a couple experiences infertility. It is also performed to determine if a vasectomy was successful. Semen analysis involves collecting a semen sample and evaluating it in a lab.[2]

When used as a fertility test in men, a semen analysis evaluates the following[3]:

- **pH level:** Whether semen is too acidic, which can affect sperm health.
- **Semen volume:** Amount of semen in the sample (in millimeters).
- **Sperm concentration:** Number of sperm per millimeter of semen.
- **Sperm morphology:** Size and shape of the sperm.
- **Sperm motility:** Ability of the sperm to swim toward an egg.
- **Time to liquefaction:** How quickly semen changes from a sticky substance to a liquid.
- **Vitality:** Percent of live sperm in the sample.
- **White blood cells:** A sign of infection or inflammation.

2. Cleveland Clinic. (2021, April 30). *Semen analysis*. https://my.clevelandclinic.org/health/diagnostics/21520-semen-analysis

3. Cleveland Clinic. (2021, April 30). *Semen analysis*. https://my.clevelandclinic.org/health/diagnostics/21520-semen-analysis

PROCEDURES

Circumcision

Circumcision (sĭr-kŭm-SIZH-ŭn) is the surgical removal of the foreskin (prepuce), a fold of skin covering the tip of the penis. It is a common procedure for newborn boys in certain parts of the world, including the United States. For some families, circumcision is a religious ritual or family tradition.[4]

Newborn circumcision is typically done in the hospital nursery by a pediatrician within a few days after birth. The penis and surrounding area are cleansed, and an anesthetic is injected into the base of the penis or applied to the penis as a cream. A special clamp or plastic ring is attached to the penis, and the foreskin will be removed. Afterward, the penis is covered with an ointment and wrapped loosely with gauze. The procedure generally takes about ten minutes.[5]

Circumcision is also used to treat men with **phimosis** (fī-MŌ-sĭs), a tightness of the prepuce (foreskin) that prevents its retraction over the penis. It may be congenital or the result of balanitis. **Balanitis** (băl-ă-NĪ-tĭs) is a common condition that causes an inflammation of the glans penis (i.e., the head of the penis). It can be caused by fungi, yeast, bacteria, or viruses, including those

4. Mayo Clinic. (2022, March 22). *Circumcision (male)*. https://www.mayoclinic.org/tests-procedures/circumcision/about/pac-20393550

5. Mayo Clinic. (2022, March 22). *Circumcision (male)*. https://www.mayoclinic.org/tests-procedures/circumcision/about/pac-20393550

that cause sexually transmitted infections (STI), but balanitis is not considered an STI.[6]

Hydrocelectomy

Hydrocelectomy (hī-drō-sē-LĔK-tō-mē) is the surgical removal of a fluid-filled sac around the testicle that is causing scrotal swelling (i.e., a hydrocele).

Vasectomy

A **vasectomy** (vă-SEK-tŏ-mē) is a surgical procedure that prevents sperm from leaving the body, providing permanent birth control, referred to as **sterilization** (ster-ĭ-lĭ-ZĀ-shŏn). The procedure closes off the ends of the vas deferens, the tubes that carry sperm. Semen samples are routinely checked after a vasectomy to confirm a successful procedure. Vasectomy is safe and effective for preventing pregnancy, but it doesn't protect against sexually transmitted infections.[7]

There are two types of vasectomies. One is an incision vasectomy, and the other is a no-scalpel vasectomy. The incision vasectomy requires two small incisions, whereas the no-scalpel vasectomy requires only one small puncture. Both are done in doctors' offices or outpatient surgery centers and use local anesthesia to numb the scrotum. Both types of vasectomies divide and close off the ends of the vas deferens, preventing sperm from getting through. The vas deferens is divided and tied, clipped, or cauterized (using an electrical current to close the incision).[8]

6. This work is a derivative of StatPearls by Wray, Velasquez, & Khetarpal and is licensed under CC BY 4.0

7. Cleveland Clinic. (2022, February 3). *Vasectomy*. https://my.clevelandclinic.org/health/treatments/4423-vasectomy

8. Cleveland Clinic. (2022, February 3). *Vasectomy*. https://my.clevelandclinic.org/health/treatments/4423-vasectomy

View a MedlinePlus video about a vasectomy procedure.

6.8 Male Reproductive System Learning Activities

Interactive Learning Activity: Label the anatomy of the male reproductive system by completing this drag and drop activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=337#h5p-47

Interactive Learning Activity: Study male reproductive system medical terms discussed in this chapter using these flashcards.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=337#h5p-180

Interactive Learning Activity: Test your knowledge about common male reproductive system terms by completing this activity.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=337#h5p-52

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=337#h5p-51

Interactive Learning Activity: Practice identifying and defining word parts for terms discussed in this chapter.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=337#h5p-198

You can also print this as a Chapter 6 Practice Worksheet and check your answers with this Answer Key PDF.

6.9 Glossary

Acquired immunodeficiency syndrome (ă-KWĪRD im-yū-nō-dĕ-FISH-ĕn-sē SĬN-drōm) (AIDS): A potentially life-threatening disease that is caused by infection with HIV commonly transmitted in infected blood especially during illicit intravenous drug use and in bodily secretions during sexual intercourse. (Chapter 6.6)

Androgen (AN-drŏ-jĕn): Hormones that stimulate or control the development of male characteristics; includes testosterone. (Chapter 6.4, Chapter 6.5)

Anorchism (ă-NOR-kĭzm): The absence of one or both testes. (Chapter 6.4)

Antiretroviral therapy (ăn-tē-rĕ-trō-VĪ-răl THĔR-ă-pē): Treatment using medications that inhibit the replication of retroviruses, such as HIV, improving the health and prolonging the life of people infected. (Chapter 6.6)

Aspermia (ā-SPUR-mē-ă): The complete absence of semen, a rare condition affecting male fertility. (Chapter 6.6)

Azoospermia (ā-zō-ŏ-SPĔR-mē-ă): The absence of sperm in semen, often linked to infertility. (Chapter 6.5)

Balanitis (băl-ă-NĪ-tĭs): Inflammation of the glans penis, often due to infection or irritation. (Chapter 6.7)

Benign prostatic hyperplasia (bē-NĪN prŏs-TĂT-ĭk hī-pĕr-PLĀ-zhē-ă) (BPH): Noncancerous enlargement of the prostate gland. (Chapter 6.6)

Bulbourethral glands (bul-bō-Ū-rĒ-thrăl glandz): Glands that produce a fluid that lubricates the urethra and neutralizes any acidity due to urine. (Chapter 6.4)

Chemotherapy (KĒ-mō-THĔR-ă-pē): The use of drugs to destroy cancer cells, typically by stopping their ability to grow and divide. (Chapter 6.6)

Chlamydia (klă-MĬD-ē-ă): A common sexually transmitted infection caused by the bacterium Chlamydia trachomatis. (Chapter 6.6)

Circumcision (sĭr-kŭm-SIZH-ŏn): The surgical removal of the foreskin from the penis. (Chapter 6.4, Chapter 6.7)

Coitus (KŌ-ĭ-tŭs): The sexual union of a male and female involving insertion of the penis into the vagina. (Chapter 6.4)

Condom (KON-dŭm): A contraceptive device worn over the penis during sexual activity to prevent pregnancy and reduce the risk of STIs. (Chapter 6.5)

Cryptorchidism (krip-TOR-kĭd-izm): A condition where one or both testes fail to descend into the scrotum before birth. (Chapter 6.4)

Digital rectal exam (dĭj-ĭ-tăl RĚK-tăl ĕgz-ăm): A manual examination of the prostate gland through the rectum to check for abnormalities. (Chapter 6.6)

Ejaculation (i-jăk-yŭ-LĀ-shŏn): The discharge of semen from the male reproductive system. (Chapter 6.5)

Epididymis (ep-ĭ-DID-ĭ-mĭs): A long, coiled tube attached to the back of the testis that stores and carries sperm. (Chapter 6.4)

Erectile dysfunction (ĕ-RĚK-tīl dis-FŬNGK-shŏn): The inability to achieve or maintain an erection sufficient for satisfactory sexual performance. (Chapter 6.5, Chapter 6.6)

Foreskin (FŌR-skin): The retractable fold of skin covering the end of the penis. (Chapter 6.4)

Genital herpes (JEN-ĭt-ăl HUR-pēz): A sexually transmitted infection (STI) caused by the herpes simplex virus, characterized by painful blisters in the genital area. (Chapter 6.6)

Glans penis (glănz PĒ-nĭs): The bulbous tip of the penis. (Chapter 6.4)

Gonorrhea (gon-ŏ-RĒ-ă): A sexually transmitted infection caused by the bacterium Neisseria gonorrhoeae. (Chapter 6.6)

Herpes simplex virus (HUR-pēz SĬM-pleks VĪ-rŭs) (HSV): A virus causing contagious sores, most often around the mouth or on the genitals. (Chapter 6.6)

Hormone therapy (HOR-mōn THĚR-ă-pē): Treatment to alter hormone levels to slow or stop cancer cell growth. (Chapter 6.6)

Human immunodeficiency virus (hu-man im-yŭ-nō-dĕ-FISH-ĕn-sē VĪ-rŭs) (HIV): A virus that attacks the T-helper cells of the immune system. (Chapter 6.6)

Human papillomavirus (hu-man PAP-ĭ-LŌ-mă-VĪ-rŭs) (HPV): A group of viruses that can cause warts on the skin or mucous membranes and are associated with some types of cancer. (Chapter 6.6)

Hydrocele (HĪ-drŏ-sēl): A fluid-filled sac around a testicle, often causing swelling in the scrotum. (Chapter 6.6)

Hydrocelectomy (hī-drō-sē-LĚK-tō-mē): Surgical removal of a hydrocele, a fluid-filled sac in the scrotum, to relieve swelling. (Chapter 6.7)

Immunotherapy (ĭm-yū-nō-THĚR-ă-pē): Treatment that uses certain parts of a person's immune system to fight diseases such as cancer. (Chapter 6.6)

Inguinal hernia (IN-gwĭ-năl HUR-nē-ă): A condition where part of the intestine protrudes through the inguinal canal into the scrotum. (Chapter 6.4)

Inguinal orchiectomy (IN-gwĭ-năl or-kē-EK-tŏ-mē): Surgical removal of a testicle through an incision in the groin area. (Chapter 6.6)

Libido (lĭ-BĒ-dō): Sexual desire or drive. (Chapter 6.5)

Nucleic acid amplification testing (noō-klē-ĭk ĂS-ĭd ăm-plĭ-fĭ-KĀ-shŏn tĕst-ing) (NAAT): A laboratory test that increases the amount of DNA or RNA in a sample to detect the presence of specific organisms, such as bacteria or viruses. (Chapter 6.6)

Open radical prostatectomy (OPEN RAD-ĭ-kăl prŌS-tă-TĚK-tŏ-mē): A surgical technique involving an incision to remove the prostate gland. (Chapter 6.6)

Orchiectomy (or-kē-EK-tŏ-mē): Surgical removal of one or both testicles, often done for cancer treatment or hormone therapy. (Chapter 6.6)

Orgasm (OR-găzm): The climax of sexual stimulation. (Chapter 6.5)

Pelvic inflammatory disease (PĚL-vĭk ĭn-flă-MĂ-tōr-ē dĭ-ZĒZ) (PID): A complication of STIs, such as chlamydia or gonorrhea, affecting female reproductive organs. (Chapter 6.6)

Pelvic lymphadenectomy (PĚL-vĭk lim-fad-ĕ-NEK-tō-mē): Surgical removal of lymph nodes in the pelvis to check for cancer spread. (Chapter 6.6)

Penis (PĒ-nĭs): The male organ used for urination and sexual intercourse. (Chapter 6.4)

Phimosis (fī-MŌ-sĭs): A condition where the foreskin cannot be fully retracted over the glans penis, sometimes requiring circumcision for treatment. (Chapter 6.7)

Prepuce (PRĒ-pyūs): Another term for foreskin, the skin covering the glans of the penis. (Chapter 6.4)

Priapism (PRĪ-ă-pĭzm): A prolonged and often painful erection of the penis not associated with sexual desire. (Chapter 6.5)

Prostate (PRŌS-tāt): A gland in the male reproductive system that produces some of the fluid in semen. (Chapter 6.4)

Prostate cancer (PRŌS-tāt KAN-sĕr): A form of cancer that develops in the prostate gland. (Chapter 6.6)

Prostate-specific antigen (PRŌS-tāt spĕ-SIF-ĭk AN-tĭ-jĕn) (PSA): A protein produced by the prostate gland; elevated levels may indicate prostate cancer. (Chapter 6.6)

Prostatitis (prŏs-tă-TĪT-ĭs): Inflammation of the prostate gland, which can cause urinary problems and discomfort. (Chapter 6.6)

PSMA PET scan (PSMA PĒ-Ē-TĔ skăn): An imaging test using a radioactive substance to detect prostate cancer cells by targeting PSMA protein. (Chapter 6.6)

Puberty (PŪ-bĕr-tē): The period during which adolescents reach sexual maturity and become capable of reproduction. (Chapter 6.5)

Radiation therapy (RĀ-dē-Ā-shŭn THĔR-ă-pē): Treatment using high-energy waves like X-rays to destroy cancer cells. (Chapter 6.6)

Radical laparoscopic prostatectomy (RAD-ĭ-kăl lăp-ă-RŎS-kŏ-pĭk prŌS-tă-TĔK-tŏ-mē): Minimally invasive surgery using small incisions and a camera to remove the prostate. (Chapter 6.6)

Radical prostatectomy (RAD-ĭ-kăl prŌS-tă-TĔK-tŏ-mē): Surgery to remove the entire prostate gland and some surrounding tissue. (Chapter 6.6)

Radiopharmaceutical therapy (RĀ-dē-ō-far-mă-SOO-tĭ-kăl THĔR-ă-pē): Treatment using radioactive drugs to target and kill cancer cells. (Chapter 6.6)

Robot-assisted laparoscopic radical prostatectomy (ROH-bot ă-SĬS-tĕd lăp-ă-RŎS-kŏ-pĭk RAD-ĭ-kăl prŌS-tă-TĔK-tŏ-mē): A robotic surgery method for prostate removal using laparoscopic techniques. (Chapter 6.6)

Scrotum (SKRŌ-tŭm): A pouch of skin containing the testicles and part of the spermatic cord. (Chapter 6.4)

Semen (SĒ-mĕn): The fluid that is ejaculated during orgasm, containing sperm and secretions from the male reproductive glands. (Chapter 6.4)

Semen analysis (SĒ-mĕn ă-NĂL-ĭ-sĭs): A test to evaluate the characteristics

of a male's semen and the sperm contained therein, often used to assess fertility. (Chapter 6.7)

Seminal vesicle biopsy (SEM-ĭ-năl VES-ĭ-kĕl BĪ-ŏp-sē): A procedure to remove fluid from seminal vesicles for cancer cell examination. (Chapter 6.6)

Seminal vesicles (SEM-ĭ-năl VES-ĭ-kĕlz): Glandular pouches that secrete semen into the ejaculatory duct. (Chapter 6.4)

Seminiferous tubules (sem-ĭ-NIF-ĕr-ŭs TŪ-būls): Narrow, coiled tubules inside the testes where sperm are produced. (Chapter 6.4)

Sexually transmitted disease (SEKS-ū-ă-lē trăns-MĬT-ed dĭ-ZĒZ) (STD): Diseases that are primarily transmitted through sexual activity. (Chapter 6.6)

Sexually transmitted infection (SEKS-ū-ă-lē trăns-MĬT-ed ĭn-FĔK-shŏn) (STI): Infections typically spread through sexual contact. (Chapter 6.6)

Sperm (SPURM): Male reproductive cells involved in sexual reproduction. (Chapter 6.5)

Spermatic cord (spur-MAT-ĭk KORD): A bundle of nerves, ducts, and blood vessels connecting the testicles to the abdominal cavity. (Chapter 6.4)

Spermatocele (spĕr-MĂT-ō-sēl): A fluid-filled cyst in the epididymis, often painless and found near the testicles. (Chapter 6.6)

Spermatogenesis (spur-mă-tō-JĔN-ĕ-sĭs): The process of sperm cell development. (Chapter 6.5)

Sterilization (ster-ĭ-lī-ZĀ-shŭn): A permanent method of contraception that prevents pregnancy in women and the release of sperm in men. (Chapter 6.7)

Syphilis (SIF-ĭ-lĭs): A sexually transmitted infection caused by the bacterium Treponema pallidum, characterized by various stages including sores, rashes, and potentially serious systemic effects if untreated. (Chapter 6.6)

Targeted therapy (TAR-gĕt-ed THĔR-ă-pē): Cancer treatment that uses drugs to target specific genes and proteins involved in the growth and survival of cancer cells. (Chapter 6.6)

Testes (TĔS-tēz): The male reproductive organs that produce sperm and testosterone. (Chapter 6.4)

Testicular cancer (tĕs-TĬK-ū-lăr KAN-sĕr): Cancer that originates in the testicles, typically diagnosed in younger men. (Chapter 6.6)

Testicular torsion (tĕs-TĬK-ū-lăr TOR-shŏn): A medical emergency where

the spermatic cord becomes twisted, cutting off blood supply to the testicle. (Chapter 6.6)

Testosterone (tĕs-TOS-tĕ-rōn): A primary male sex hormone responsible for the development of male secondary sexual characteristics. (Chapter 6.5)

Torsion (TOR-shŏn): The twisting of the spermatic cord, which can cut off blood supply to the testicle. (Chapter 6.4)

Transrectal biopsy (trans-RĚK-tăl BĪ-ŏp-sē): Tissue sample removal from the prostate via the rectum for cancer testing. (Chapter 6.6)

Transrectal MRI (trans-RĚK-tăl ĕm-ĀR-ĀĪ): Magnetic resonance imaging of the prostate gland through the rectum. (Chapter 6.6)

Transrectal MRI guided biopsy (trăns-RĚK-tăl MRĪ GĪ-ded BĪ-ŏp-sē): A procedure that uses magnetic resonance imaging (MRI) to guide the removal of tissue samples from the prostate through the rectum. (Chapter 6.6)

Transrectal ultrasound (trans-RĚK-tăl ŬL-tră-sound): A diagnostic procedure using ultrasound inserted through the rectum to visualize the prostate. (Chapter 6.6)

Transrectal ultrasound guided biopsy (trăns-RĚK-tăl ŬL-tră-sound GĪ-ded BĪ-ŏp-sē): A procedure in which a probe inserted into the rectum uses ultrasound to guide the removal of tissue samples from the prostate for analysis. (Chapter 6.6)

Transurethral (trans-ū-RĒ-thrăl): Pertaining to going through or across the urethra. (Chapter 6.6)

Transurethral incision of the prostate (trans-ū-RĒ-thrăl in-SIZH-ŭn ŏv thĕ PRŌS-tāt) (TUIP): A surgical procedure to make incisions in the prostate gland to treat urinary problems due to BPH. (Chapter 6.6)

Transurethral microwave thermotherapy (trans-ū-RĒ-thrăl MĪ-krō-wāv THUR-mō-THĚR-ă-pē) (TUMT): A treatment for BPH using microwave energy to reduce prostate size. (Chapter 6.6)

Transurethral resection of the prostate (trans-ū-RĒ-thrăl rĭ-SĚK-shŭn ŏv thĕ PRŌS-tāt) (TURP): A surgical procedure to remove part of the prostate gland to relieve urinary symptoms caused by an enlarged prostate. (Chapter 6.6)

Trichomoniasis (trĭk-ō-mō-NĪ-ă-sĭs): A common sexually transmitted

infection caused by a protozoan parasite, often resulting in vaginal or urethral discharge. (Chapter 6.6)

Urologist (yū-RŌL-ŏ-jĭst): A physician who specializes in the treatment of disorders of the urinary system and male reproductive system. (Chapter 6.7)

Urology (yū-RŎL-ŏ-jē): Study of the male and female urinary tract systems and the male reproductive system. (Chapter 6.7)

Varicocele (VAR-ĭ-kō-sēl): An enlargement of the veins within the scrotum, often associated with infertility. (Chapter 6.6)

Vas deferens (VĀS DEF-ĕr-ĕnz): The duct that conveys sperm from the testicle to the urethra. (Chapter 6.4)

Vasectomy (vă-SEK-tō-mē): A surgical procedure for male sterilization involving the cutting and sealing of part of each vas deferens. (Chapter 6.4, Chapter 6.7)

PART VII

CHAPTER 7 FEMALE REPRODUCTIVE SYSTEM TERMINOLOGY

7.1 Female Reproductive System Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to the female reproductive system
- Identify meanings of keyword components of the female reproductive system
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to the female reproductive system
- Use terms related to the female reproductive system
- Use terms related to the diseases and disorders of the female reproductive system

Introduction to the Female Reproductive System

The female reproductive system produces hormones and matures eggs (called ova) during the monthly menstrual cycle. Every month, an egg (called an ovum) is released from one of the female's ovaries with the potential to become fertilized by male sperm. If fertilization occurs, female hormones develop the fertilized egg into a fetus and, ultimately, a baby ready for delivery in about 40 weeks.

This chapter will review common word components related to the female reproductive system to assist learning how to analyze, build, and define

medical terms. Other female reproductive terms, whose definitions cannot be easily built from word components, will be described in context based on the anatomy and physiology of the female reproductive system and common diseases and disorders. Medical specialists, diagnostic tests, and procedures related to the female reproductive system will also be discussed. Additional information about pregnancy will be discussed in the "Obstetrics Terminology" chapter.

View the following YouTube video[1] on the anatomy and physiology of the female reproductive system: Reproductive System, Part 1 – Female Reproductive System: Crash Course A&P #40

1. CrashCourse. (2015, October 26). *Reproductive system, Part 1 – Female reproductive system: Crash Course Anatomy & Physiology #40* [Video]. YouTube. https://youtu.be/RFDatCchpus?si=1h92ZbG3QUjVHw6b

7.2 Word Components Related to the Female Reproductive System

This section will describe common word components related to the female reproductive system. These word components help build definitions for many medical terms. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO THE FEMALE REPRODUCTIVE SYSTEM

- **a-**: Absence of, without
- **an-**: Absence of, without
- **dys-**: Painful, difficult, abnormal, labored
- **endo-**: Within
- **oligo-**: Small amount
- **peri-**: Surrounding

COMMON WORD ROOTS WITH A COMBINING VOWEL RELATED TO THE FEMALE REPRODUCTIVE SYSTEM

- **arche**/o: First, beginning
- **cervic**/o: Cervix
- **colp**/o: Vagina
- **endometri**/o: Endometrium
- **episi**/o: Vulva
- **gyn**/o: Woman
- **gynec**/o: Woman
- **hemat**/o: Blood
- **hymen**/o: Hymen
- **hyster**/o: Uterus
- **leuk**/o: White
- **mamm**/o: Breast
- **mast**/o: Breast
- **men**/o: Menstruation
- **metr**/i: Uterus
- **my**/o: Muscle
- **oophor**/o: Ovary
- **pelv**/i: Pelvis, pelvic bones, pelvic cavity
- **perine**/o: Perineum
- **py**/o: Pus
- **salping**/o: Uterine tube, fallopian tube
- **son**/o: Sound waves
- **trachel**/o: Cervix
- **vagin**/o: Vagina
- **vulv**/o: Vulva

COMMON SUFFIXES RELATED TO THE FEMALE REPRODUCTIVE SYSTEM

- **-al**: Pertaining to
- **-atresia**: Occlusion, closure
- **-cleisis**: Surgical closure
- **-ectomy**: Excision, surgical removal
- **-gram**: The record, radiographic image
- **-graphy**: Process of recording, radiographic imaging
- **-itis**: Inflammation
- **-logist**: Specialist who studies and treats
- **-logy**: Study of
- **-osis**: Abnormal condition
- **-pexy**: Surgical fixation, suspension
- **-plasty**: Surgical repair
- **-rrhagia:** Rapid flow of blood
- **-rrhaphy**: Suturing, repairing
- **-rrhea**: Flow, discharge
- **-salpinx**: Uterine (fallopian) tube
- **-scope**: Instrument used for visual examination
- **-scopy**: Visually examining
- **-tomy**: Cut into, incision

7.3 Examples of Female Reproductive System Terms Easily Defined By Their Word Components

Here are examples of common medical terms related to the female reproductive system that can be easily defined by breaking the terms into their word components.

Amenorrhea

1. Break down the medical term into word components: **A**/**men**/**o**/**rrhea**
2. Label the word components: **A** = P; **men** = WR; **o** = CV; **rrhea** = S
3. Define the word components: **A** = absence of; **men** = menstruation; **rrhea** = flow
4. Create a final definition of the medical term: **Absence of menstrual flow**

Colposcopy

1. Break down the medical term into word components:

Colp/o/scopy

2. Label the word components: **Colp** = WR; **o** = CV; **scopy** = S
3. Define the word components: **Colp** = vagina; **scopy** = visual examination
4. Create a final definition of the medical term: **Visual examination of the vagina**

Gynecologist

1. Break down the medical term into word components: **Gynec/o/logist**
2. Label the word components: **Gynec** = WR; **o** = CV; **logist** = S
3. Define the word components: **gynec** = women; **logist** = specialist who studies and treats
4. Create a final definition of the medical term: **Specialist who studies and treats female disorders and diseases**

Interactive Learning Activity: Practice defining and pronouncing female reproductive system medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=3753#h5p-29

You can also print this as a Chapter 7 Student Companion Worksheet and check your answers with this Answer Key.

7.4 Anatomy of the Female Reproductive System

Anatomy of the female reproductive system includes the external genitals, the internal reproductive system, and the breasts.

EXTERNAL FEMALE GENITALS

See Figure 7.1[1] for an illustration of the external female genitals. The external female reproductive structures, referred to collectively as the **vulva** (VŬL-vă), include the following[2]:

- The **mons pubis** (MŎNZ PYŪ-bĭs) is a pad of fat that is located anteriorly over the pubic bone. After puberty, it becomes covered in pubic hair.
- The **labia majora** (LĀ-bē-uh MĀ-jŏr-uh) are larger outer folds of hair-covered skin that begin just posterior to the mons pubis.
- The **labia minora** (LĀ-bē-uh mĭ-NŌR-uh) are thinner, hairless, and more pigmented folds found medially to the labia majora.
    - Although they naturally vary in shape and size from woman to woman, the labia minora serve to protect the female urethra and the entrance to the female reproductive tract.

1. "Vulva_Figure_28_02_02.jpg" by OpenStax College is licensed under CC BY 3.0
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    - The superior, anterior portions of the labia minora come together to encircle the **clitoris** (KLĬT-ŏ-rĭs). The clitoris is erectile tissue that originates from the same fetal cells as the penis and has abundant nerves that are important in sexual sensation and orgasm.
- The vestibule is the area between the labia minora and behind the clitoris that contains the urethral and vaginal openings. It is flanked by outlets to the vestibular glands, also known as **Bartholin's glands** (BAR-tō-lĭns glănds), that secrete mucus to keep the vestibular area moist. Read more about the urethra in the "Anatomy of the Urinary System" section in the "Urinary System Terminology" chapter.
- The **perineum** (pĕr-ĭ-NĒ-um) is the area between the vaginal opening and the anus.
-

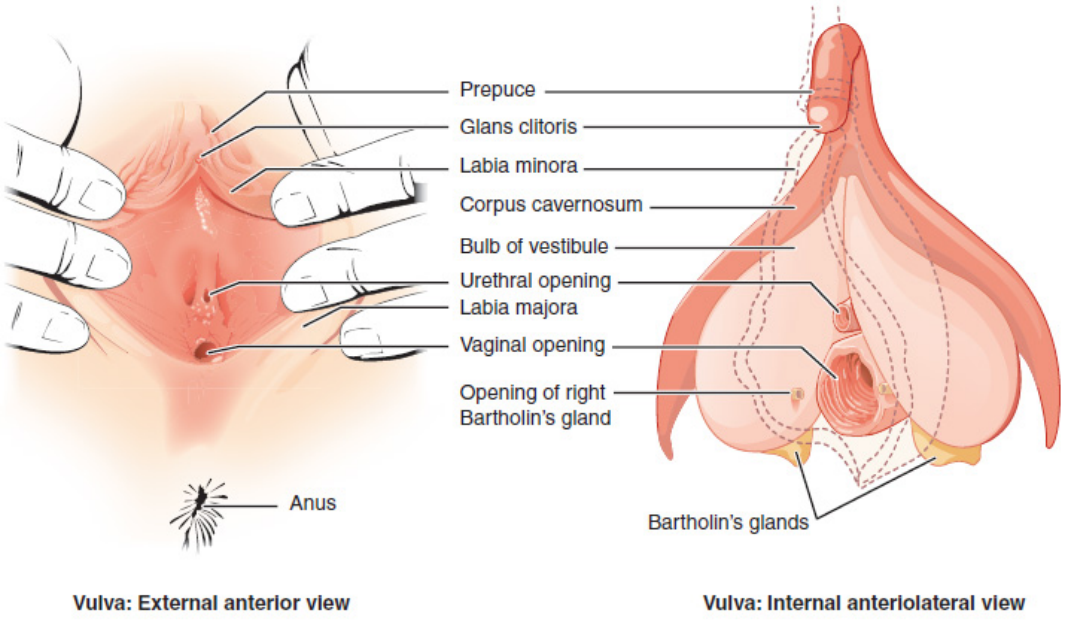

Figure 7.1 Vulva, Collective Term for External Female Genitalia

INTERNAL FEMALE REPRODUCTIVE ORGANS

The internal female reproductive organs include the vagina, uterus, cervix, ovaries, and Fallopian tubes. See Figure 7.2[3] for an illustration of the internal and external structures of the female reproductive system.

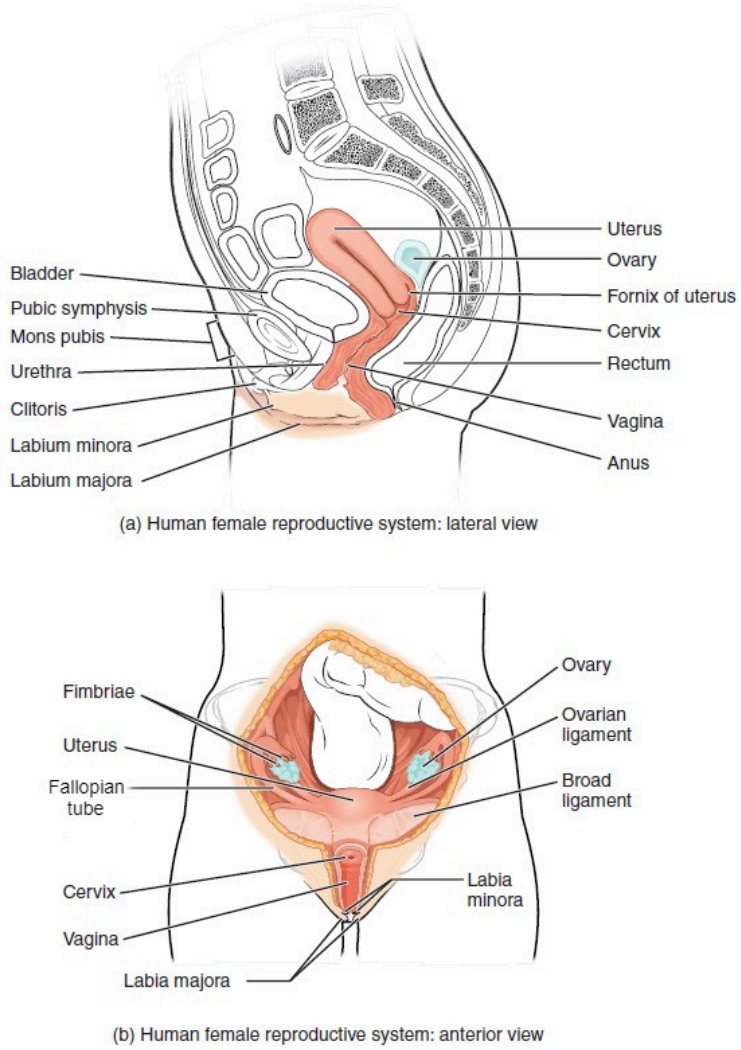

Figure 7.2 Female Reproductive System

3. This image is derivative of "Figure_28_02_01.JPG" by OpenStax College is licensed under CC BY 3.0

Vagina

The **vagina** (vă-JĪN-uh) is a muscular canal that is approximately ten centimeters (cm) long. It serves as the entrance to the reproductive tract, as well as the exit from the uterus during menstruation and childbirth.[4]

The vagina is composed of smooth muscle that allows for expansion during intercourse and childbirth. The vagina is lined with mucous membranes that secrete mucus to keep it moist. The superior portion of the vagina meets the cervix (the opening and lower part of the uterus). The inferior portion of the vagina may have a thin, perforated hymen that partially surrounds the opening to the vagina.[5]

The vagina contains a normal population of healthy bacteria called normal flora that help protect against infection. In a healthy woman, the most common type of normal flora is *lactobacillus* that secretes lactic acid. The lactic acid protects the vagina by maintaining an acidic pH (below 4.5). Lactic acid, in combination with other vaginal secretions, makes the vagina a self-cleansing organ. However, douching can disrupt the normal balance of healthy microorganisms and increase a woman's risk for infections and irritation. It is recommended that women do not douche and that they allow the vagina to maintain its normal healthy population of protective normal flora.[6]

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Uterus and Cervix

The **uterus** (YŪ-tĕr-us) is a muscular, pear-shaped organ that is approximately five cm wide by seven cm long. It is composed of three sections[7]:

- The inferior portion, called the **cervix** (SĔR-vĭks), connects the uterus and the vagina.
- The middle section of the uterus is called the corpus (body of the uterus).
- The superior portion is called the fundus.

An opening in the middle of the cervix allows menstrual blood to exit and sperm to enter the uterus. The cervix dilates (opens) during childbirth to allow the baby to exit the mother's body. The corpus of the uterus expands during pregnancy. The fundus is the location of the uterus that is commonly felt by the health care provider during prenatal exams to indirectly measure the growth of the fetus.[8]

The wall of the uterus is made up of these three layers[9]:

- **Perimetrium** (pār-ĭ-MĒ-trē-um): The serous membrane surrounding the uterus.
- **Myometrium** (my-ō-MĒ-trē-um): A thick layer of smooth muscle responsible for uterine contractions.

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8. Anatomy & Physiology by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

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- **Endometrium** (en-dō-MĒ-trē-um): The innermost layer that provides the site for implantation of a fertilized egg or sheds during menstruation if an egg is not fertilized.

Ovaries

The **ovary** (Ō-văr-ē) is the female reproductive gland located in the pelvic cavity. There are two ovaries, one at the entrance to each Fallopian tube, which are attached to the uterus via the ovarian ligaments. The ovaries create oocytes (eggs) and hormones.[10]

Fallopian Tubes

The **Fallopian** (fă-LŌP-ē-an) **tubes** transport oocytes from the ovary to the uterus. Each of the Fallopian tubes is close to, but not directly connected to, the ovary, so the**fimbriae** (FĬM-brē-ē) catch the oocyte like a baseball in a glove. The middle region of the Fallopian tube, called the ampulla, is where fertilization often occurs. The fertilized egg then moves from the Fallopian tube into the uterus, where it implants into the endometrium.[11]

BREASTS

Although the breasts are located far from the other reproductive organs, they are considered accessory organs of the female reproductive system. The

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function of female breasts is to supply milk to an infant in a process called **lactation** (lak-TĀ-shŏn).[12]

The external features of the breast include a nipple surrounded by a pigmented areola. The areolar region is characterized by small, raised areolar glands that secrete lubricating fluid during lactation to protect the nipple from chafing. When a baby nurses (i.e., draws milk from the breast), the entire areolar region is taken into their mouth.[13]

A breast is made up of three main parts: lobules, ducts, and connective tissue. The lobules are the mammary glands composed of alveoli (tiny sacs) that produce milk. The **lactiferous** (lak-TĬF-ĕr-us) **ducts** are tubes that carry milk to the nipple. The connective tissue (which consists of fibrous and fatty tissue) surrounds and holds everything together.[14]

An infant can draw milk from the lobules and through the ducts and the nipple by suckling. Alveoli are surrounded by fat tissue, which determines the size of the breast. Breast size differs between individuals and does not affect

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13. Anatomy & Physiology by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

14. Centers for Disease Control and Prevention. (2023, July 25). *What is breast cancer?* https://www.cdc.gov/cancer/breast/basic_info/what-is-breast-cancer.htm

the amount of milk produced.[15] See Figure 7.3[16] for an illustration of a breast and milk flow.

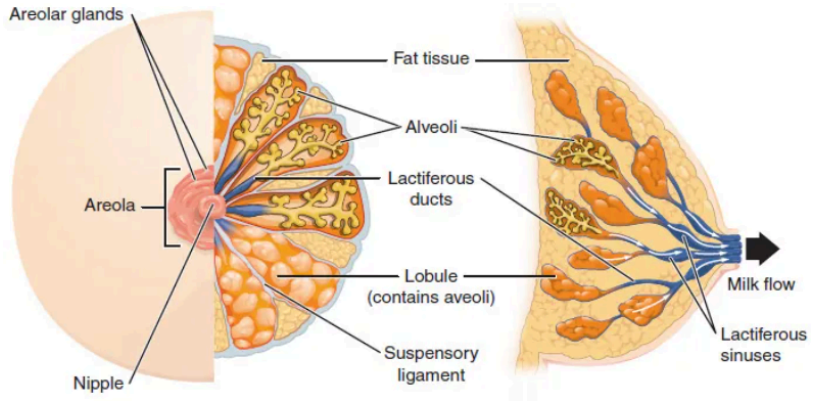

Figure 7.3 Breast and Milk Flow

Some women have **fibrocystic breasts** (fī-brō-SĬS-tĭk brests) with connective tissue that feels lumpy or ropelike in texture. Fibrocystic breast changes are common and no longer considered a disease, although it was formerly referred to as fibrocystic breast disease. Some women also experience breast pain, tenderness, and lumpiness, especially in the upper, outer areas of the breasts, just before menstruation.[17]

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16. "Anatomy_of_the_breast" by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

17. Mayo Clinic. (2023, April 4). *Fibrocystic breasts*. https://www.mayoclinic.org/diseases-conditions/fibrocystic-breasts/symptoms-causes/syc-20350438

7.5 Physiology of the Female Reproductive System

Menstruation (men-strŪ-Ā-shŏn), also called menses, commonly referred to as a woman's "period," is vaginal bleeding that occurs as part of a monthly cycle. Every month, the female body prepares for possible pregnancy. If no pregnancy occurs, the uterus sheds the endometrial lining. Menstrual flow is part blood and part endometrial lining that passes out of the uterus, through the cervix, and into the vagina. Menstruation typically starts in females between the ages of 11 and 14 and continues until menopause at an average age of 51. In addition to bleeding, females may experience additional emotional and physical symptoms, which is referred to as premenstrual syndrome (PMS).[1] Premenstrual syndrome (PMS) is discussed in more detail in the "Diseases and Disorders of the Female Reproductive System" section of this chapter.

THE MENSTRUAL CYCLE

The menstrual cycle is driven by a monthly hormonal cycle as the female's body prepares an egg for fertilization and possible pregnancy. The menstrual cycle is counted from the first day of a bleeding of one cycle to the first day of

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the next menstrual cycle. Menstrual flow usually lasts about three to five days. The typical volume of blood lost during menstruation is approximately 30 milliliters (mL). Amounts greater than 80 mL, menstrual flow longer than five days, or bleeding between cycles can be symptoms of a disorder.[2]

The average menstrual cycle takes about 28 days and occurs in three phases, called the follicular, ovulatory, and luteal phases, also referred to as menses, proliferative, and secretory uterine cycles. Hormone levels change throughout the menstrual cycle. See Figure 7.4 for an illustration of the phases of the menstrual cycle.[3]

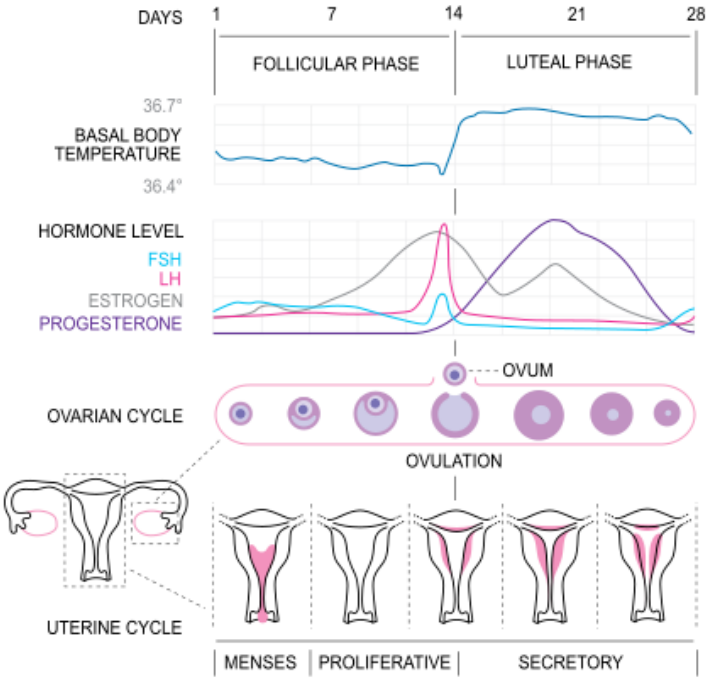

Figure 7.4 Phases of the Menstrual Cycle

2. Anatomy & Physiology by OpenStax is licensed under CC BY 4.0. Access for free at https://openstax.org/books/anatomy-and-physiology/pages/1-introduction

3. "MenstrualCycle2_en.svg.png" by Isometrik is licensed under CC BY 3.0

Follicular Phase

The **follicular phase** (Fŏl-ĭk-yŭ-lăr fāz), also referred to as the pre-ovulatory or proliferative phase, begins when menstrual flow ceases and the endometrium in the uterus begins to thicken. During the follicular phase of the menstrual cycle, the following events occur[4]:

- Two hormones, **follicle stimulating hormone** (FŌL-ĭ-kl stim-YŪ-lā-ting HŌR-mōn) **(FSH)** and **luteinizing hormone** (LŪ-tē-ĭ-nīz-ĭng HŌR-mōn) **(LH)**, are released from the brain and travel in the blood to the ovaries. These hormones stimulate the growth of ova (eggs) in their own shells called **follicles** (FŎL-ĭ-klz).
- The FSH and LH hormones also trigger an increase in the production of the hormone **estrogen** (ĔS-trŏ-jen), which is produced by the developing follicles. As the estrogen level continues to rise, it turns off the production of FSH, like a switch. This careful balance of hormones allows the body to limit the number of follicles to be released.
- As the follicular phase progresses, one follicle in one ovary becomes dominant and continues to mature. This dominant follicle, called the Graafian follicle, suppresses the growth of all other follicles. In addition, this dominant follicle continues to produce estrogen.

Ovulatory Phase

The ovulatory phase usually starts about 14 days after the follicular phase began. During this phase, the following events occur[5]:

- The rise in estrogen from the Graafian (dominant) follicle triggers a surge in the amount of luteinizing hormone (LH) produced by the brain. This

4. Cleveland Clinic. (2022, November 28). *Female reproductive system*. https://my.clevelandclinic.org/health/articles/9118-female-reproductive-system

5. Cleveland Clinic. (2022, November 28). *Female reproductive system*. https://my.clevelandclinic.org/health/articles/9118-female-reproductive-system

surge causes the Graafian (dominant) follicle to release the **ovum** (Ō-vum).

- When the ovum is released from the follicle, it is referred to as **ovulation** (ov-yŭ-LĀ-shŏn). The ovum is captured by the **fimbriae** (FĬM-brē-ā), the finger-like projections on the end of the Fallopian tubes. The fimbriae sweep the egg into the Fallopian tube.
- For one to five days prior to ovulation, many women notice an increase in cervical mucus that looks like egg white. This mucus helps capture and nourish the sperm on the way to meet the egg for fertilization.

Luteal Phase

The luteal (postovulatory) phase begins right after ovulation and involves the following processes[6]:

- After the ovum is released, the empty follicle develops into a new structure called the corpus luteum. The **corpus luteum** (KŌR-pus LŪ-tē-um) is a temporary, hormone-producing gland involved in ovulation and early pregnancy.
- The corpus luteum secretes estrogen and **progesterone** (pro-JĚS-tĕr-ōn). Progesterone prepares the uterus for **implantation** (ĭm-plan-TĀ-shŏn) of a fertilized egg into the uterine lining and is an important hormone during pregnancy.
- If the egg becomes fertilized by sperm, which is referred to as **conception** (kŏn-sĕp-shŏn), it is referred to as an **embryo** (Ĕm-brē-ō). The embryo travels through the Fallopian tubes and implants in the endometrial lining of the uterus.
- If the egg isn't fertilized, it dissolves in the uterus, the endometrial lining breaks down and sheds because it is no longer needed, and menses (bleeding) begins. This is also referred to as the menses or menstrual phase and lasts between 3-5 days. See Figure 7.5[7] for an illustration of the

6. Cleveland Clinic. (2022, November 28). *Female reproductive system*. https://my.clevelandclinic.org/health/articles/9118-female-reproductive-system

progression of a follicle to a corpus luteum.

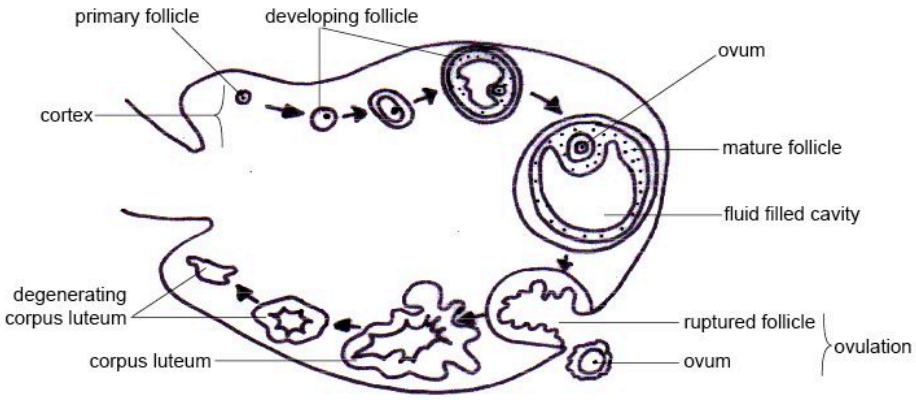

Figure 7.5 Progression from Oocyte to Degenerating Corpus Luteum

View a supplementary MedLine video[8] on ovulation:
Ovulation Video

Fertilization, pregnancy, and contraception are discussed in the "Obstetrics Terminology" chapter.

7. "Anatomy_and_physiology_of_animals_Ovarian_cycle_showing_from_top_left_clockwise.jpg" by Sunshineconnelly at English Wikibooks is licensed under CC BY 3.0

8. A.D.A.M. (2022, January 10). *Ovulation* [Video]. Medline Plus. https://medlineplus.gov/ency/anatomyvideos/000094.htm

OTHER MEDICAL TERMS RELATED TO THE FEMALE REPRODUCTIVE SYSTEM

- **Adnexa** (ăd-NĔK-să): Accessory structures of the uterus, such as the Fallopian tubes and ovaries.
- **Amenorrhea** (ā-men-ŏ-RĒ-ă): Absence of menstrual flow.
- **Anovulation** (an-ov-yŭ-LĀ-shŏn): Absence of ovulation.
- **Contraception** (kon-tră-SEP-shŏn): Intentional prevention of pregnancy.
- **Dysmenorrhea** (dis-men-ŏ-RĒ-ă): Painful menstrual flow.
- **Dyspareunia** (dis-pă-RŪ-nē-ă): Painful sexual intercourse.
- **Fistula** (FIS-chŭ-lă): An abnormal passageway between two organs or an internal organ and the body surface. Although uncommon, a vaginal fistula can develop between the vagina and another organ, such as the urinary bladder, colon, or rectum.
- **Infertility** (ĭn-fĕr-TĬL-ĭ-tē): The inability to conceive.
- **Mastitis** (mas-TĪT-ĭs): Inflammation of the breast that tends to occur when a woman is lactating.
- **Menorrhagia** (mĕn-ō-RĀ-jē-ă): Excessive menstrual bleeding.
- **Menometrorrhagia** (mĕn-ō-mĕt-rō-RĀ-jē-ă): Excessive and prolonged uterine bleeding occurring at irregular and/or frequent intervals.
- **Metrorrhagia** (mē-trō-RĀ-jă): Bleeding from the uterus between menstrual periods.
- **Menarche** (mĕn-ĂR-kē): The first occurrence of menstruation.
- **Oligomenorrhea** (ŏl-ĭ-gō-mĕn-ō-RĒ-ă): Infrequent or very light menstruation.
- **Polymenorrhea** (pŏl-ē-mĕn-ō-RĒ-ă): Frequent menstruation in which menstrual cycles are shorter than 21 days in length.
- **Sexual intercourse** (Sĕk-shū-ăl ĭn-tĕr-kōrs): Sexual contact between individuals that includes insertion of a penis into a vagina.
- **Tubal ligation** (TOO-băl lī-GĀ-shŏn): Surgical closure or blocking of the Fallopian tubes to prevent pregnancy; also referred to as sterilization.

7.6 Diseases and Disorders of the Female Reproductive System

ABNORMAL VAGINAL BLEEDING

Abnormal vaginal bleeding (ăb-nŏr-măl vă-jĭ-năl blēd-ing) refers to very heavy menstrual flow during menses, bleeding between menstrual cycles, or menses that lasts more than seven days. It also refers to bleeding that happens before puberty or after menopause. Very heavy bleeding during menses and/or bleeding that lasts more than seven days is called **menorrhagia** (mĕn-ō-RĀ-jē-ă). For example, women with menorrhagia may bleed enough to soak through one or more tampons or sanitary pads every hour.[1]

A common cause of abnormal bleeding is hormone imbalance referred to **dysfunctional uterine bleeding** (dĭs-fŭnk-shŭn-ăl yŪ-tĕr-ĭn blēd-ing). Dysfunctional uterine bleeding commonly occurs in teenagers or women approaching **menopause** (MEN-ŏ-poz) or the absence of menstruation when an egg is not released from the ovaries as it should (anovulation). Anovulation is a common condition for teenagers who recently started their menstrual cycles, as well as for women approaching menopause. When anovulation occurs, extended estrogen release causes the endometrial lining of the uterus

1. Family Doctor. (2023, June). *Abnormal uterine bleeding*. American Academy of Family Physicians. https://familydoctor.org/condition/abnormal-uterine-bleeding

to continue to grow until it gets too thick. When this thickened lining is shed during menstruation, it causes the bleeding to be very heavy. A hormonal imbalance can also cause the body not to know when to shed the lining, causing **irregular bleeding** (ĭ-rĕg-yŭ-lăr blēd-ing) or "spotting" between periods.[2]

Abnormal vaginal bleeding can also be caused by uterine fibroids (benign growths in the uterus), conditions related to pregnancy, and cancer of the uterus or cervix. Diagnostic testing includes pelvic ultrasounds and procedures such as endometrial biopsy or hysteroscopy. Treatment is based on the cause of the abnormal bleeding and may include medications, dilation and curettage (D&C), endometrial ablation, or hysterectomy.[3] **Endometrial ablation** (en-dō-MĒ-trē-ăl ă-BLĀ-shŏn) is a procedure that destroys the endometrial lining of the uterus to reduce or stop heavy menstrual bleeding. D&C and hysterectomies are further discussed in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Female Reproductive System" section of this chapter.

Medications and medication-secreting devices used to treat dysfunctional uterine bleeding are birth control pills and **intrauterine devices** (ĬN-tră-yŪ-tĕr-ēn dī-VĪS-ĭz) **(IUDs)**. An IUD is a small, T-shaped device that typically contains hormones to prevent ovulation and the thickening of endometrial lining and prevent pregnancy. It is inserted through the cervix by a health care provider. Birth control pills contain hormones that prevent pregnancy by preventing the thickening of the endometrial lining. They can also help keep the menstrual cycle regular and reduce cramping during menstruation.

2. Family Doctor. (2023, June). *Abnormal uterine bleeding*. American Academy of Family Physicians. https://familydoctor.org/condition/abnormal-uterine-bleeding

3. Family Doctor. (2023, June). *Abnormal uterine bleeding*. American Academy of Family Physicians. https://familydoctor.org/condition/abnormal-uterine-bleeding

However, some types of birth control pills, especially the progestin-only pill, can cause abnormal bleeding.[4]

CANCER

Common cancers affecting the female reproductive system include breast, cervical, ovarian, and endometrial.

Breast Cancer

Breast cancer (brest KAN-sĕr) occurs when breast cells mutate and become cancerous cells that multiply and form tumors. There are different kinds of breast cancer, depending on which cells in the breast turn into cancer. Most breast cancers begin in the ducts (called invasive ductal carcinoma) or lobules (called invasive lobular carcinoma). There are also other kinds of breast cancer. Breast cancer can spread outside the breast to other parts of the body through blood and lymph vessels. When breast cancer spreads to other parts of the body, it is said to have **metastasized** (mĕ-tăs-tă-sīzd).[5]

People of both genders who have a strong family history of breast cancer or inherited changes in BRCA1 and BRCA2 genes have a high risk of getting

4. Family Doctor. (2023, June). *Abnormal uterine bleeding*. American Academy of Family Physicians. https://familydoctor.org/condition/abnormal-uterine-bleeding

5. Centers for Disease Control and Prevention. (2023, July 25). *What is breast cancer*? https://www.cdc.gov/cancer/breast/basic_info/what-is-breast-cancer.htm

breast cancer. See Figure 7.6[6] for an illustration of signs of breast cancer. Warning signs of breast cancer include the following[7]:

- New lump in the breast or armpit.
- Thickening or swelling of part of the breast.
- Irritation or dimpling of breast skin.
- Redness or flaky skin in the nipple area or the breast.
- Pulling in of the nipple or pain in the nipple area.
- Nipple discharge other than breast milk, including blood.
- Any change in the size or the shape of the breast.
- Pain in any area of the breast.

6. "En_Breast_cancer_illustrations.png" by Morning2k for the National Institutes of Health is licensed in the Public Domain.

7. Centers for Disease Control and Prevention. (2023, July 25). *What is breast cancer*? https://www.cdc.gov/cancer/breast/basic_info/what-is-breast-cancer.htm

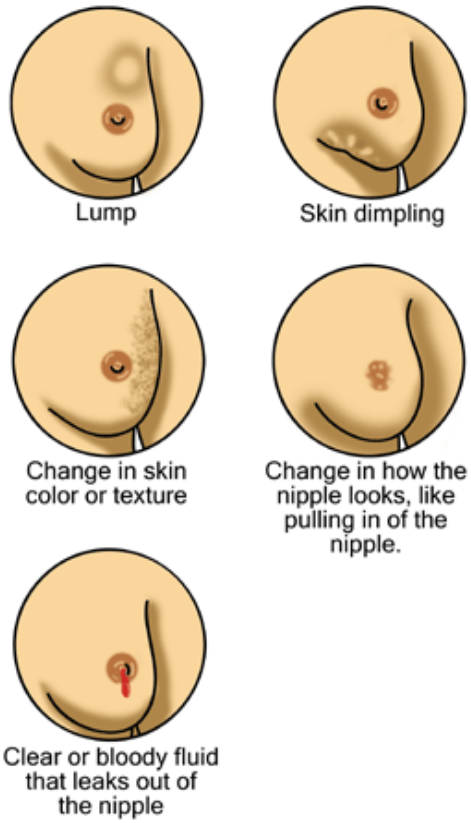

Figure 7.6 Signs of Breast Cancer

The American Cancer Society recommends a mammogram every year for most women starting at age 45.[8] A **mammogram** (MĂM-ō-grăm) is a radiographic image of breast tissue that can detect signs of cancer, often before a lump is felt.

People suspected of having breast cancer or those at high risk may have additional diagnostic tests, such as the following[9]:

8. American Cancer Society. (2023). *Breast cancer*. https://www.cancer.org/cancer/types/breast-cancer/screening-tests-and-early-detection/american-cancer-society-recommendations-for-the-early-detection-of-breast-cancer.html

9. Centers for Disease Control and Prevention. (2023, July 25). *What is breast*

- **Breast ultrasound** (brĕst ŭl-tră-sound)**:** A breast ultrasound uses sound waves to make images, called sonograms, of areas inside the breast.
- **Diagnostic mammogram** (dī-ăg-nŏs-tĭk mă-mō-grăm)**:** If an area of the breast looks abnormal on a screening mammogram, a diagnostic mammogram is performed to get a more detailed X-ray of the breast.
- **Breast magnetic resonance imaging** (brĕst măg-NĔT-ĭk rĕz-ŏ-NĂNS ĬM-ă-jĭng) **(MRI):** A breast MRI is a kind of body scan that uses a magnet linked to a computer. The MRI scan makes detailed pictures of areas inside the breast.
- **Biopsy** (BĪ-ŏp-sē)**:** Tissue, fluid, and/or lymph nodes are removed by a health care provider and sent to a laboratory to be examined under a microscope. There are different kinds of biopsies, such as a fine-needle aspiration, sentinel lymph node biopsy, core biopsy, or open biopsy.

If breast cancer is diagnosed, other diagnostic tests are performed to check for metastasis, including chest X-rays, CT scans, and PET scans. Read more information about these types of diagnostic tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System."

Breast cancer is treated in several ways, depending on the type of breast cancer and how far it has spread in the body. People with breast cancer often get more than one kind of treatment. Treatments may include the following[10]:

- **Surgery** (SŬR-jĕr-ē)**:** There are different types of surgery, depending on how far the cancer has spread in the breasts, lymph nodes, and surrounding tissue.
    - **Breast-conserving surgery** (brĕst kŏn-sĕr-vĭng sŭr-jĕr-ē)**:** Breast-

cancer? https://www.cdc.gov/cancer/breast/basic_info/what-is-breast-cancer.htm

10. National Cancer Institute. (2023, August 23). *Breast cancer treatment – (PDQ) patient version*. National Institutes of Health. https://www.cancer.gov/types/breast/patient/breast-treatment-pdq#_185

conserving surgery removes the cancer and some normal tissue around it, but not the breast itself. This type of surgery may also be called lumpectomy, partial mastectomy, segmental mastectomy, quadrantectomy, or breast-sparing surgery.
    - **Total mastectomy** (tō-tăl mas-TEK-tŏ-mē)**:** Total mastectomy removes the breast that has cancer and some of the lymph nodes in the armpit. This procedure is also called a simple mastectomy.
    - **Modified radical mastectomy** (mŏd-ĭ-fīd răd-ĭ-kăl mas-TEK-tŏ-mē)**:** The whole breast that has cancer and most of the lymph nodes surrounding the breast are removed.
- **Chemotherapy** (kē-mō-THĔR-ă-pē)**:** Specific medications are prescribed by physicians to shrink or kill specific types of cancer cells. Chemotherapy may be given as pills or administered intravenously, depending on the type of medication prescribed.
- **Hormonal therapy** (hôr-MŌ-năl THĔR-ă-pē)**:** Special medications are used to block cancer cells from getting the hormones they need to grow.
- **Targeted therapy** (TĂR-gĭ-tĕd THĔR-ă-pē)**:** Targeted therapy works with the body's immune system to help it fight cancer cells or to control side effects from other cancer treatments.
- **Radiation therapy** (rā-dē-Ā-shŏn THĔR-ă-pē)**:** Radiation therapy uses high-energy rays (similar to X-rays) to kill the cancer cells.

Doctors from different specialties often work together to treat breast cancer. **Surgeons** (SŬR-jŏns) are doctors who perform operations. **Medical oncologists** (mĕd-ĭ-kăl ŏn-KOL-ŏ-jĭsts) are physicians who specialize in the treatment of cancer with medication. **Radiation oncologists** (rā-dē-Ā-shŏn ŏn-KOL-ŏ-jĭsts) are physicians who specialize in the treatments of cancer with radiation.

Cervical Cancer

Cervical cancer (SĔR-vi-kăl KAN-sĕr) is mostly caused by the **human papillomavirus** (HYŪ-măn pă-pĭ-lō-mă VĪ-rŭs) **(HPV)**. HPV is passed from one person to another during sexual contact. HPV causes cervical cells to change into abnormal cells (called dysplasia), which over time can become cancer.

Cervical cancer is highly curable when found and treated early. Early cervical cancer does not cause symptoms, so routine PAP smears are recommended to screen for cancer. Most women between the ages of 21 and 65 should have a PAP smear every three to five years, depending upon their risk factors.[11]

The **Papanicolaou smear** (păp-ă-NĒ-kă-low smēr), commonly referred to as a PAP smear, is a cytological study that screens for cancer in the cervix before symptoms even occur. During a PAP smear, a health care provider inserts a **speculum** (SPEK-yŭ-lŭm) into the patient's vagina to allow visualization of the cervix and obtains samples of cervical cells for laboratory analysis. An **HPV test** (H-P-V tĕst) is also typically performed during a PAP smear to check for infection with high-risk types of HPV that cause cancer.[12]

There are several types of abnormal cells that may be found on PAP smears. For example, **low-grade squamous intraepithelial lesions** (lō-grād SKWĀ-mŭs ĭn-tră-ĕ-pĭ-THĒ-lē-ăl LĒ-zhŭns) **(LSIL)** refer to slightly abnormal changes that are usually caused by an HPV infection that require additional diagnostic testing. **High-grade squamous intraepithelial lesions** (hī-grād SKWĀ-mŭs ĭn-tră-ĕ-pĭ-THĒ-lē-ăl LĒ-zhŭns) **(HSIL)** refer to abnormal cervical cells that could become cancer if not treated. **Adenocarcinoma in situ** (ăd-ĕ-nō-kăr-sĭ-NŌ-mă ĭn SĪ-tū) means an advanced lesion (i.e., area of abnormal tissue) was found in the tissue of the cervix and requires a biopsy.[13]

11. National Cancer Institute. (2021, September). *Understanding cervical changes: A health guide*. National Institutes of Health. https://www.cancer.gov/publications/patient-education/understanding-cervical-changes

12. National Cancer Institute. (2021, September). *Understanding cervical changes: A health guide*. National Institutes of Health. https://www.cancer.gov/publications/patient-education/understanding-cervical-changes

13. National Cancer Institute. (2021, September). *Understanding cervical changes: A health guide*. National Institutes of Health.

Additional diagnostic testing, such as a colposcopy, is performed for abnormal cell changes on PAP smears. A **colposcopy** (kŏl-PŎS-kō-pē) is a procedure in which a lighted, magnifying instrument called a colposcope is used to visually examine the cervix and potentially remove tissue for biopsy.[14]

Treatment for cervical cancers often includes excisional or ablative treatments[15]:

- Cold knife **conization** (kŏn-Ī-ZĀ-shŏn): A scalpel or laser knife is used to remove a cone-shaped section of abnormal tissue in the cervix. This procedure is done at the hospital and requires general anesthesia.
- **Loop electrosurgical excision procedure** (lōōp ĕ-lĕk-trō-SŬR-jĭ-kăl ĕk-SĬZ-shŭn prō-SĒ-jŭr) **(LEEP)**: Electrical current is passed through a thin wire loop to remove abnormal tissue in the cervix. Local anesthesia is used to numb the area, so this procedure can be performed in the health care provider's office.
- **Cryotherapy** (krī-ō-THĔR-ă-pē): A special cold probe is used to destroy abnormal tissue by freezing it. This procedure is done in the health care provider's office. It takes only a few minutes and usually does not require anesthesia.
- **Laser therapy** (LĀ-zĕr THĔR-ă-pē): A laser (narrow beam of intense light) is used to destroy abnormal tissue. This procedure is done at the hospital,

https://www.cancer.gov/publications/patient-education/understanding-cervical-changes

14. National Cancer Institute. (2021, September). *Understanding cervical changes: A health guide*. National Institutes of Health. https://www.cancer.gov/publications/patient-education/understanding-cervical-changes

15. National Cancer Institute. (2021, September). *Understanding cervical changes: A health guide*. National Institutes of Health. https://www.cancer.gov/publications/patient-education/understanding-cervical-changes

and general anesthesia is used.

Endometrial Cancer

The most common type of uterine cancer is **endometrial cancer** (en-dō-MĒ-trē-ăl KAN-sĕr). A common symptom of endometrial cancer is postmenopausal vaginal bleeding.[16]

Diagnostic testing for endometrial cancer includes a transvaginal ultrasound and endometrial sampling. **Endometrial sampling** (ĕn-dō-MĒ-trē-ăl săm-plĭng) is the removal of tissue from the endometrium by a health care provider who inserts a brush, curette, or thin, flexible tube through the cervix and into the uterus. The tool is used to gently scrape a small amount of tissue from the endometrium and then remove the tissue samples. A pathologist views the tissue under a microscope to look for cancer cells. Alternatively, dilation and curettage (D&C) or hysteroscopy may be performed.[17] Read more information about D&C and hysteroscopy procedures in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Female Reproductive System" section.

If endometrial cancer is diagnosed, additional diagnostic tests are performed to see if the cancer has spread to other parts of the body, including chest X-rays, CT scans, MRIs, and PET scans. Read more information about these types of diagnostic tests in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Respiratory System.

Treatment for endometrial cancer may include surgery, such as a hysterectomy, bilateral oophorectomy, and lymph node dissection. Hysterectomy and oophorectomy are discussed in more detail in the "Medical

16. National Cancer Institute. (2023, June 26). *Endometrial cancer screening (PDQ) – patient version.* National Institutes of Health. https://www.cancer.gov/types/uterine/patient/endometrial-screening-pdq

17. National Cancer Institute. (2023, June 26). *Endometrial cancer screening (PDQ) – patient version.* National Institutes of Health. https://www.cancer.gov/types/uterine/patient/endometrial-screening-pdq

Specialists, Diagnostic Testing, and Procedures Related to the Female Reproductive System" section. A **lymph node dissection** (lĭmf nōd dĭ-sĕk-shŏn) is a surgical procedure in which the lymph nodes are removed from the pelvic area, and a sample of tissue is examined under a microscope by a pathologist for signs of metastatic cancer. This procedure is also called **lymphadenectomy** (lĭmf-ăd-ĕ-NEK-tŏ-mē). Other treatments include radiation therapy, chemotherapy, hormone therapy, and targeted therapy.[18]

Ovarian Cancer

Ovarian cancer (ō-VAR-ē-ăn KAN-sĕr) is cancer that grows in the tissues of the ovary. Ovarian cancer has few symptoms other than possible pain and/or swelling in the pelvic area, so it often metastasizes before it is diagnosed. Some types of ovarian cancer are caused by mutations in genes called BRCA1 or BRCA2, so women who have a family history of ovarian cancer are at an increased risk. Other types of ovarian cancer are caused by metastatic cancer from other sites, such as breast, cervical, or colon cancer. Some women who have an increased risk of ovarian cancer may choose to have an oophorectomy to remove healthy ovaries as a preventative measure.[19]

Diagnostic tests for ovarian cancer include blood tests, a transvaginal ultrasound, or CT scans. After ovarian cancer has been diagnosed, additional diagnostic tests, such as an MRI or PET scans, are done to determine if cancer cells have spread within the ovaries or to other parts of the body. Treatment may include surgery, such as a hysterectomy, salpingo-oophorectomy, or omentectomy. Hysterectomy, salpingo-oophorectomy, and oophorectomy

18. National Cancer Institute. (2023, June 26). *Endometrial cancer screening (PDQ) – patient version.* National Institutes of Health. https://www.cancer.gov/types/uterine/patient/endometrial-screening-pdq

19. National Cancer Institute. (2022, December 22). *Ovarian, epithelial, fallopian tube, and primary peritoneal cancer treatment (PDQ®)– patient version.* National Institutes of Health. https://www.cancer.gov/types/ovarian/patient/ovarian-epithelial-treatment-pdq

procedures are discussed in more detail in the "Medical Specialists, Diagnostic Testing, and Procedures Related to the Female Reproductive System" section. An **omentectomy** (ō-měn-TEK-tŏ-mē) is removal of tissue in the peritoneum that contains blood vessels, nerves, lymph vessels, and lymph nodes. The **peritoneum** (pĕr-ĭ-tō-NĒ-ŭm) is the tissue that lines the abdominal wall and covers most of the organs in the abdomen. Additional treatments may include chemotherapy, targeted therapy, radiation therapy, and immunotherapy.[20]

ENDOMETRIOSIS

Endometriosis (en-dō-mē-trē-Ō-sĭs) is a disorder in which tissue similar to the endometrium grows outside the uterus, typically on the ovaries, in Fallopian tubes, and in the pelvis. Estrogen causes these implants to thicken, bleed, and break down during menstrual cycles. Because there is no way for the blood to exit the body, surrounding tissue becomes inflamed and creates scar tissue, which can interfere with the normal functioning of nearby organs and cause pain. Endometriosis can also cause infertility if the ovaries are affected.[21] See Figure 7.7[22] for an illustration of endometriosis.

20. National Cancer Institute. (2022, December 22). *Ovarian, epithelial, fallopian tube, and primary peritoneal cancer treatment (PDQ®)– patient version.* National Institutes of Health. https://www.cancer.gov/types/ovarian/patient/ovarian-epithelial-treatment-pdq

21. Mayo Clinic. (2018, July 24). *Endometriosis*. https://www.mayoclinic.org/diseases-conditions/endometriosis/symptoms-causes/syc-20354656

22. "Blausen_0349_Endometriosis.png" by Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014 is licensed under CC BY 3.0

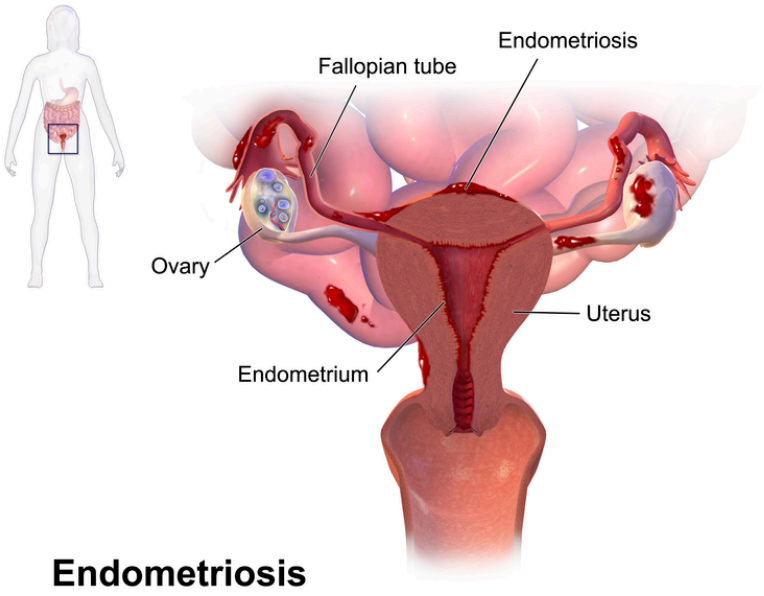

Figure 7.7 Endometriosis

Symptoms of endometriosis include **dysmenorrhea** (dĭs-mĕn-ŏ-RĒ-ă) or painful menstruation for several days that may include low back and abdominal pain. **Dysparenuria** (dĭs-păr-ĕn-ŪR-ē-ă) or pain with intercourse is common, as well as pain with bowel movements or urination. Excessive bleeding or bleeding between menstruation may occur.[23]

Endometriosis may be diagnosed with a transvaginal ultrasound or a laparoscopy. During a **laparoscopy** (lăp-ă-RŎS-kŏ-pē), the patient is under general anesthesia, and a surgeon makes a tiny incision near the navel and inserts a laparoscope, looking for signs of endometrial tissue outside the uterus. A laparoscopy can be performed to provide information about the location, extent, and size of endometrial implants, as well as remove them for

23. Mayo Clinic. (2018, July 24). *Endometriosis*. https://www.mayoclinic.org/diseases-conditions/endometriosis/symptoms-causes/syc-20354656

biopsy. In severe cases of endometriosis, an oophorectomy (removal of an ovary) or a hysterectomy may be required.[24]

MENOPAUSE

Menopause (MEN-ŏ-poz), the cessation of menstruation, is part of the normal aging process and typically occurs in the 40s or 50s. A woman has reached menopause when she has not had a period for one year. Menopause occurs because the woman's ovaries stop producing the hormones estrogen and progesterone. Menopause can also be triggered by surgical removal of the ovaries because of their role in producing these hormones.

Many women experience symptoms for many years before menopause[25]:

- A change in menses, such as shorter or longer menses, lighter or heavier menstrual flow, or more or less time between menstrual cycles
- Hot flashes and/or night sweats
- Trouble sleeping
- Vaginal dryness
- Bladder incontinence
- Mood swings
- Trouble focusing
- Less hair on head and more on face

24. Mayo Clinic. (2018, July 24). *Endometriosis*. https://www.mayoclinic.org/diseases-conditions/endometriosis/symptoms-causes/syc-20354656

25. MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2016, Oct 1]. Menopause; [reviewed 2016, cited 2023, Oct 8.] https://medlineplus.gov/menopause.html

For some women, menopausal symptoms can be severe and disruptive, requiring treatment by a health care provider.

OVARIAN CYST

An **ovarian cyst** (ō-VĀR-ē-an sĭst) is a fluid-filled sac in the ovary. The two most common types of ovarian cysts are follicle cysts and corpus luteum cysts. In a normal menstrual cycle, an ovary releases an ovum (egg) each month. The ovum grows inside a tiny sac called a follicle that breaks open to release the egg. Follicle cysts form when the follicle doesn't break open to release the egg, causing it to continue growing into a cyst. Follicle cysts often have no symptoms and typically resolve in one to three months.

During normal ovulation, after the follicle breaks open and releases the egg, the empty follicle sac shrinks into a mass of cells called a corpus luteum. Corpus luteum cysts form if the empty follicle sac doesn't shrink as it should, but instead reseals itself and builds up with fluid. Most corpus luteum cysts go away after a few weeks, but they can grow to ten centimeters (four inches) wide and cause pain. They may also bleed or cause the ovary to twist, requiring surgery such as a laparoscopy or a laparotomy[26]:

- **Laparoscopy** (lap-uh-ROSS-kuh-pee): During this surgery, the physician makes a very small incision above or below the umbilicus (navel) and inserts instruments with a camera to look inside the pelvic area and remove the cyst, which is then sent to a pathology lab for analysis. This type of surgery is typically performed for smaller cysts that appear benign (i.e., not cancerous) on the ultrasound.
- **Laparotomy** (lap-uh-ROT-uh-mee): A laparotomy is typically performed

26. Office on Women's Health. (2021, February 22). *Ovarian cysts.* https://www.womenshealth.gov/a-z-topics/ovarian-cysts

for large cysts or those that are suspicious on ultrasound as cancerous. This surgery uses a larger incision in the abdomen to remove the cyst, and then the cyst is sent to a pathology lab for analysis.

PELVIC INFLAMMATORY DISEASE

Pelvic inflammatory (PĚL-vĭk ĭn-flă-MĂ-tŏ-rē) **disease (PID)** is inflammation of some or all of the female reproductive organs, resulting from the spread of bacteria from the cervix and vagina. PID is a serious complication of chlamydia and gonorrhea. The most common symptoms of PID are the following[27]:

- Lower abdominal and pelvic pain
- Increased vaginal discharge
- Irregular menstrual bleeding
- Fever (>38° C or >101°F)
- Pain with intercourse
- Painful and frequent urination
- Cervical motion tenderness

Complications of PID include tubo-ovarian abscess, infertility, ectopic pregnancy, and chronic pelvic pain. A **tubo-ovarian abscess** (TŪ-bō ō-VAR-ē-ăn ăb-sĕs) is an inflammatory mass involving the Fallopian tube and ovary and requires hospital admission. Treatment includes broad-spectrum antibiotics with or without a drainage procedure. Surgery may be required for

27. Centers for Disease Control and Prevention. (2021, July 22). *Pelvic inflammatory disease (PID)- CDC detailed fact sheet*. https://www.cdc.gov/std/pid/stdfact-pid-detailed.htm

patients with a suspected rupture or who fail to respond to antibiotics.[28] An **ectopic pregnancy** (ĕk-TŌP-ĭk PRĔG-năn-sē) is the implantation of an embryo outside of the uterus, typically in the fallopian tube.

POLYCYSTIC OVARY SYNDROME

Polycystic ovary syndrome (pŏl-ē-SĬS-tĭk Ō-vă-rē SĬN-drōm) **(PCOS)** is a condition characterized by hormone imbalances, ovulatory dysfunction, and multiple ovarian cysts (i.e., small sacs of fluid). Fluid-filled cysts containing immature eggs are called follicles. Instead of releasing an egg during ovulation, the follicles (cysts) build up and enlarge. See Figure 7.8[29] for an illustration of PCOS.

28. Centers for Disease Control and Prevention. (2021, July 22). *Pelvic inflammatory disease (PID)- CDC detailed fact sheet*. https://www.cdc.gov/std/pid/stdfact-pid-detailed.htm

29. "PCOS_%28Part_2%29.png" by BruceBlaus is licensed under CC BY 4.0

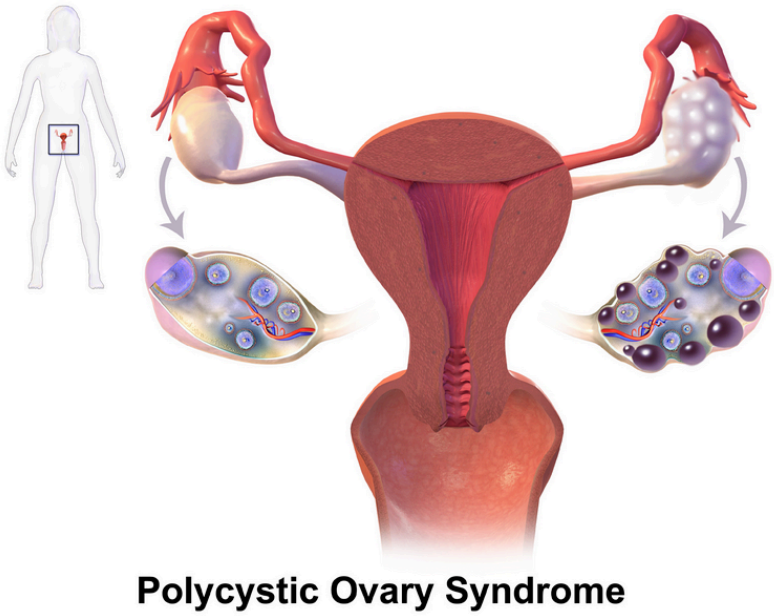

Figure 7.8 PCOS

PCOS has no known cause, but it is associated with obesity and excessive insulin production. Common symptoms of PCOS include oligomenorrhea, amenorrhea, polymenorrhea, and enlarged ovaries due to multiple cysts or follicles. High levels of androgen hormones associated with PCOS can cause **hirsutism** (HĬR-sū-tĭz-ŭm) or excess facial and body hair. PCOS can also cause infertility.[30]

PCOS is diagnosed with blood tests and a transvaginal ultrasound. Treatments for PCOS include birth control pills to control menstrual cycles, diabetes medications to reduce insulin resistance, and medication to promote ovulation.

30. Mayo Clinic. (2022, September 8). *Polycystic ovary syndrome (PCOS)*. https://www.mayoclinic.org/diseases-conditions/pcos/symptoms-causes/syc-20353439

PREMENSTRUAL SYNDROME (PMS)

Premenstrual syndrome (prē-MĚN-stroo-ăl SĬN-drōm) **(PMS)** is a syndrome involving physical and emotional symptoms occurring up to ten days before menstruation. Symptoms may include fluid retention (bloating), headaches, nervous tension, irritability, and breast tenderness. For some women, these symptoms can be so severe it causes them to miss work or school. Researchers think that PMS happens in the days after ovulation because estrogen and progesterone levels begin falling dramatically if the egg is not fertilized. PMS symptoms go away within a few days after menses begins and hormone levels begin rising again.[31].

PREMENSTRUAL DYSPHORIC DISORDER

Premenstrual dysphoric (prē-MĚN-strŭ-ăl dis-FŌR-ĭk) **disorder (PMDD)** is a disorder that affects about 5% of menstruating females. It has similar symptoms as premenstrual syndrome (PMS) but is more serious. PMDD causes severe irritability, depression, or anxiety in the week or two before the menstrual cycle, and these issues go away two to three days after menstruation starts. Symptoms can include the following[32]:

- Lasting irritability or anger that may affect other people

31. Office On Women's Health. (2021, February 22). *Premenstrual syndrome (PMS)*. https://www.womenshealth.gov/menstrual-cycle/premenstrual-syndrome#

32. Office On Women's Health. (2021, February 22). *Premenstrual dysphoric disorder (PMDD)*. https://www.womenshealth.gov/menstrual-cycle/premenstrual-syndrome/premenstrual-dysphoric-disorder-pmdd

- Feelings of sadness or despair, or even thoughts of suicide
- Feelings of tension or anxiety
- Panic attacks
- Mood swings or crying often
- Lack of interest in daily activities and relationships
- Trouble thinking or focusing
- Tiredness or low energy
- Food cravings or binge eating
- Trouble sleeping
- Feeling out of control
- Physical symptoms, such as cramps, bloating, breast tenderness, headaches, and joint or muscle pain

Women with PMDD require medications and other treatments such as the following[33]:

- Antidepressants called selective serotonin reuptake inhibitors (SSRIs) that increase serotonin levels in the brain
- Birth control pills to help regulate hormone levels
- Over-the-counter pain relievers, such as ibuprofen, naproxen, or aspirin to help relieve physical symptoms
- Stress management and relaxation techniques
- Healthy lifestyle changes, such as healthy food choices across the food groups, cutting back on salty and sugary foods, and getting more physical activity

33. Office on Women's Health. (2021, February 22). *Premenstrual dysphoric disorder (PMDD)*. https://www.womenshealth.gov/menstrual-cycle/premenstrual-syndrome/premenstrual-dysphoric-disorder-pmdd

PROLAPSE

A **prolapse** (PRŌ-laps) is the displacement of an organ or anatomic structure from its normal position. A **uterine prolapse** (ŪT-ĕ-rīn PRŌ-laps) is the downward displacement of the uterus into the vagina. A uterine prolapse occurs when the pelvic floor muscles and ligaments stretch and weaken until they no longer provide enough support for the uterus. As a result, the uterus slips down into or protrudes out of the vagina. Uterine prolapse most often affects people after menopause who have had one or more vaginal deliveries. Surgery may be required to treat the prolapse.[34]

An anterior **vaginal prolapse** (vă-jĭ-năl PRŌ-laps), also known as a **cystocele** (SĬS-tō-sēl) or a protrusion of the bladder, is when the bladder drops from its usual position in the pelvis into the vagina. Anterior vaginal prolapse occurs when the pelvic floor becomes weak or if too much pressure is put on the pelvic floor. This can happen over time, during vaginal childbirth, or with chronic constipation, violent coughing, or heavy lifting. Surgery may be required to treat the prolapse.[35]

A posterior vaginal prolapse, also known as a **rectocele** (RĔK-tō-sēl) or rectal prolapse, is when the rectum protrudes into the vagina.

34. Mayo Clinic. (2022, September 8). *Uterine prolapse*. https://www.mayoclinic.org/diseases-conditions/uterine-prolapse/symptoms-causes/syc-20353458

35. Mayo Clinic. (2023, April 6). *Anterior vaginal prolapse*. https://www.mayoclinic.org/diseases-conditions/cystocele/symptoms-causes/syc-20369452

SEXUALLY TRANSMITTED INFECTIONS

Sexually transmitted infections (STI), also known as sexually transmitted diseases, can cause serious disease in both men and women. For brevity of this textbook, STIs are thoroughly discussed in the "Sexually Transmitted Infections" subsection of the "Diseases and Disorders of the Male Reproductive System" section in the "Male Reproductive System Terminology" chapter. Review that section for information about signs and symptoms of several STIs in females.

UTERINE FIBROID

A **uterine fibroid** (ŪT-ĕ-rīn FIB-royd) is a benign tumor in the muscular wall of the uterus in women. See Figure 7.9[36] for an illustration of fibroids.

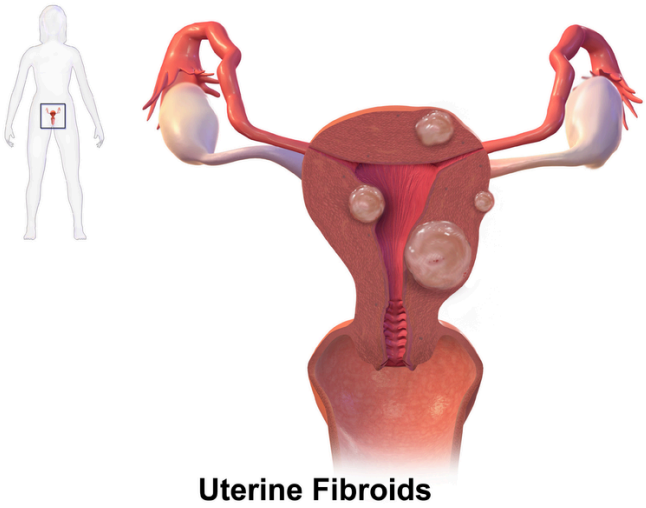

Figure 7.9 Fibroids

36. "Uterine_Fibroids.png" by BruceBlaus is licensed under CC By 4.0

The cause of fibroids is unknown. Symptoms of uterine fibroids are as follows[37]:

- Dysmenorrhea
- Menorrhagia
- Metrorrhagia
- A feeling of fullness in the lower abdomen
- Frequent urination
- Dyspareunia
- Lower back pain
- Reproductive problems, such as infertility, multiple miscarriages, or early labor

Symptomatic uterine fibroids may be treated with birth control pills or medications to shrink the fibroids. For women with fibroids with moderate or severe symptoms, several types of surgery may be used to treat them[38]:

- **Myomectomy** (mī-ō-MĚK-tŏ-mē): Surgery that removes fibroids without taking out healthy tissue of the uterus. This surgery is best for women who wish to have children after treatment. It can be major surgery (involving cutting into the abdomen) or performed with laparoscopy or hysteroscopy.
- **Hysterectomy** (his-tĕ-REK-tŏ-mē): Surgery to remove the uterus when fibroids are large, if the women is experiencing very heavy bleeding, or if the woman is near menopause or does not want future pregnancy. Read more about different types of hysterectomies in the "Medical Specialties, Diagnostic Testing, and Procedures Related to the Female Reproductive System" section.

37. Office on Women's Health. (2021, February 19). *Uterine fibroids*. https://www.womenshealth.gov/a-z-topics/uterine-fibroids

38. Office on Women's Health. (2021, February 19). *Uterine fibroids*. https://www.womenshealth.gov/a-z-topics/uterine-fibroids

- **Endometrial ablation** (ĕn-dō-MĒ-trē-ăl ă-blā-shŏn): The lining of the uterus is removed or destroyed to control very heavy bleeding. This can be done using several methods such as a laser, wire loops, electric current, microwaves, freezing, and other methods. This procedure usually is considered minor surgery and can be done on an outpatient basis or in a doctor's office. A woman cannot have future pregnancies after this procedure.
- **Myolysis** (mī-OL-ŏ-sĭs): A needle is inserted into the fibroids, guided by laparoscopy, and electric current or freezing is used to destroy the fibroids.
- **Uterine fibroid embolization** (ŪT-ĕ-rīn FĪ-brŏyd ĕm-bō-lĭ-ZĀ-shŏn) **(UFE)** or **uterine artery embolization** (ŪT-ĕ-rīn ăr-tĕr-ē ĕm-bō-lĭ-ZĀ-shŏn) **(UAE)**: A thin tube is threaded into the blood vessels that supply blood to the fibroid, then tiny plastic particles are injected into the blood vessels to block the blood supply to the fibroid. The lack of blood supply causes the fibroid to shrink.

TOXIC SHOCK SYNDROME

Toxic shock syndrome (TŌK-sĭk SHŌK SĪN-drōm) **(TSS)** is a severe bacterial infection that has many causes, including superabsorbent **tampon** (TĂM-pon) use. Tampons are cotton plugs used to absorb menstrual flow. TSS is caused by *Staphylococcus* and *Streptococcus* bacteria, and symptoms include sudden high fever, vomiting or diarrhea, a rash resembling a sunburn on the palms and soles, confusion, muscle aches, headaches, low blood pressure, and seizures. TSS can cause acute kidney failure and death. To help prevent TSS, the U.S. Food and Drug Administration requires manufacturers to use standard measurement and labeling for absorbency and to print guidelines

on the boxes. Women should use the lowest absorbency tampon required for their flow and change tampons at least every four to eight hours.[39]

VAGINAL CANDIDIASIS

Vaginal candidiasis (văj-jĭ-năl kăn-dĭ-DĪ-ă-sĭs), also called a yeast infection, is a common fungal infection of the vagina and the vulva that causes thick, white discharge and intense itching. It is typically treated with medication inserted vaginally.[40]

39. Mayo Clinic. (2022, March 23). *Toxic shock syndrome*. https://www.mayoclinic.org/diseases-conditions/toxic-shock-syndrome/symptoms-causes/syc-20355384

40. Mayo Clinic. (2022). *Yeast infection (Vaginal)*. https://www.mayoclinic.org/diseases-conditions/yeast-infection/symptoms-causes/syc-20378999

7.7 Medical Specialists, Diagnostic Testing, and Procedures Related to the Female Reproductive System

MEDICAL SPECIALISTS

Gynecology (gī-nĕ-KOL-ŏ-jē) refers to the study of the female reproductive system. A **gynecologist** (gīn-ĕ-KOL-ŏ-jĭst) (GYN) is a physician who specializes in the diagnosis and treatment of diseases and disorders of the female reproductive system. **Obstetrics** (ŏb-STĔT-rĭks) is a specialty regarding pregnancy, labor, and delivery of a baby. An **obstetrician** (OB) is a physician who specializes in providing medical care through pregnancy, labor, and delivery of a baby. Other subspecialties in women's health include contraception, reproductive endocrinology, infertility, adolescent gynecology, endoscopy, and gynecological oncology.[1]

1. American Board of Medical Specialties. (n.d.). *American board of obstetrics and gynecology specialties & subspecialties*. https://www.abms.org/board/american-board-of-obstetrics-gynecology/

To learn more about obstetrics or gynecology, visit the specialty and subspecialty page of the American Board of Obstetrics and Gynecology.

COMMON DIAGNOSTIC TESTS AND PROCEDURES

Many diagnostic tests and procedures are discussed as they apply to female reproductive system disorders in the "Diseases and Disorders of the Female Reproductive System" section. Common diagnostic tests and procedures used for multiple disorders are described below.

Dilation & Curettage (D&C)

Dilation & curettage (dī-LĀ-shŏn and kūr-ĕ-täj) **(D&C)** is a procedure performed by a physician in which the opening of the cervix is stretched so that a surgical tool can be inserted into the uterus to scrape away the excess endometrial lining. The removed lining is then biopsied for abnormal tissue. A D&C is performed to determine the cause of abnormal vaginal bleeding, as well as to treat it.[2] See Figure 7.10[3] for an illustration of a D&C.

2. Family Doctor. (2023, June 8). *Abnormal vaginal bleeding*. American Academy of Family Physicians. https://familydoctor.org/condition/abnormal-uterine-bleeding

3. "Dilation_%26_curettage.svg.png" by Andrew c is licensed under CC BY-SA 3.0

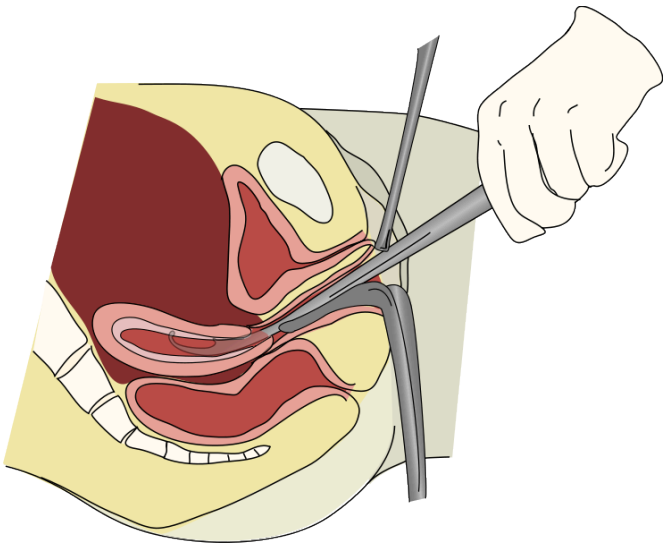

Figure 7.10 D&C

Hysterectomy, Oophorectomy, and Salpingectomy

A **hysterectomy** (his-tĕ-REK-tŏ-mē) is a surgery used to treat a variety of disorders, such as dysfunctional uterine bleeding, fibroids, severe endometriosis, endometrial cancer, and ovarian cancer. See Figure 7.11[4] for an illustration of different types of hysterectomies. There are several types of hysterectomies[5]:

- **Total hysterectomy** (tō-tăl his-tĕ-REK-tŏ-mē): Surgery to remove the uterus, including the cervix. If the uterus and cervix are taken out through the vagina, the operation is called a **vaginal hysterectomy** (vă-jĭ-năl his-tĕ-REK-tŏ-mē). If the uterus and cervix are taken out through a large incision in the abdomen, the operation is called a **total abdominal hysterectomy** (tō-tăl ăb-DŎM-ĭ-năl his-tĕ-REK-tŏ-mē). If the uterus and

4. "me_hysterectomy-en.svg" by Hic et nunc is licensed in the Public Domain.

5. National Cancer Institute. (2020, November 13). *Endometrial cancer treatment (PDQ) – Patient version.* https://www.cancer.gov/types/uterine/patient/endometrial-treatment-pdq#top

cervix are taken out through a small incision in the abdomen using a laparoscope, the operation is called a **total laparoscopic hysterectomy** (tō-tăl lăp-ăr-ŏ-SKŌP-ĭk his-tĕ-REK-tŏ-mē). A **subtotal hysterectomy** (sŭb-tō-tăl his-tĕ-REK-tŏ-mē) removes part of the uterus but leaves the cervix intact.

- **Radical hysterectomy** (răd-ĭ-kăl his-tĕ-REK-tŏ-mē): Surgery to remove the uterus, cervix, and part of the vagina. The ovaries, Fallopian tubes, or nearby lymph nodes may also be removed during this procedure, referred to as a **total hysterectomy/bilateral salpingectomy oophorectomy** (tō-tăl his-tĕ-REK-tŏ-mē / bī-LĂT-ĕr-ăl săl-pĭn-JEK-tŏ-mē ō-ŏ-fŏ-REK-tŏ-mē) **(TAH/BSO)**. An **oophorectomy** (ō-ŏ-fŏ-REK-tŏ-mē) is the surgical removal of one ovary. A **bilateral oophorectomy** (bī-LĂT-ĕr-ăl ō-ŏ-fŏ-REK-tŏ-mē) is the removal of both ovaries. A **salpingectomy** (sal-pĭn-JEK-tŏ-mē) is the removal of a Fallopian tube. A **salpingo-oophorectomy** (săl-pĭn-jō-ō-ŏf-ō-RĔK-tō-mē) is removal of one Fallopian tube and the associated ovary. **Bilateral salpingo-oophorectomy** (bī-LĂT-ĕr-ăl săl-pĭng-gō-ō-ŏ-fŏ-REK-tŏ-mē) means removal of both ovaries and Fallopian tubes.
-

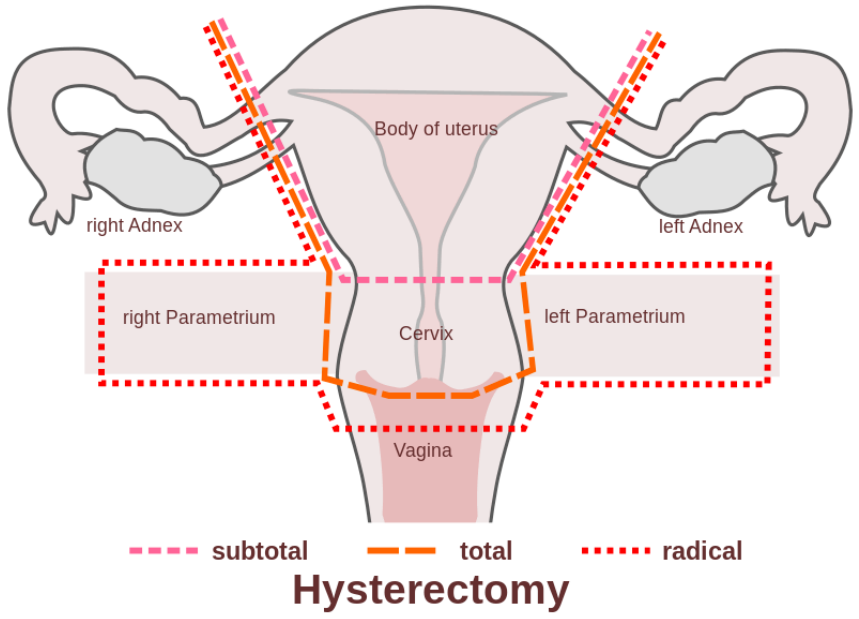

Figure 7.11 Types of Hysterectomies

Hysterosalpingogram

A **hysterosalpingogram** (hĭs-tĕ-RO-săl-pĭnj-ō-gram) is a common imaging procedure performed to assess for potential causes of infertility in women. During the procedure, radiopaque dye is injected into the uterus and fills the uterine cavity, continues into the Fallopian tubes, and eventually reaches fimbriated ends next to the ovaries. Structures are visualized with an X-ray.

Hysteroscopy

A **hysteroscopy** (his-tĕ-ROS-kŏ-pē) is a procedure to visually examine the uterus for abnormal areas. A hysteroscope is a thin, tube-like instrument with a light and a lens for viewing and is inserted through the vagina and cervix into the uterus. It may also have a tool to remove tissue samples, which are examined under a microscope for signs of cancer.[6] See Figure 7.12[7] for an illustration of hysteroscopy.

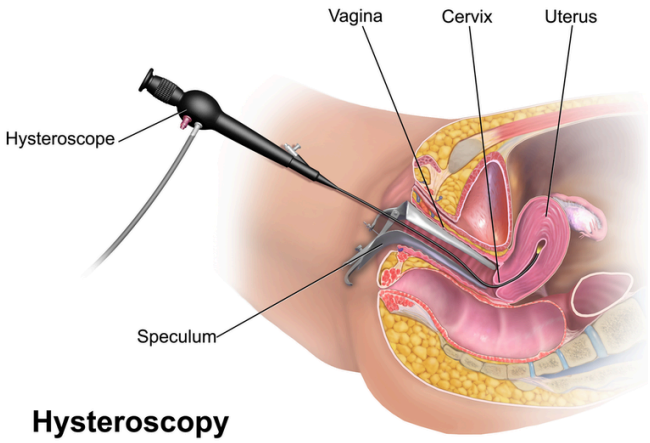

Figure 7.12 Hysteroscopy

6. National Cancer Institute. (2023, June 26). *Endometrial cancer screening (PDQ) – Patient version.* https://www.cancer.gov/types/uterine/patient/endometrial-screening-pdq

7. "Hysteroscopy.png" by BruceBlaus is licensed under CC BY-SA 4.0

Mammogram

A **mammogram** (MĂM-ō-grăm) is a radiographic image of breast tissue to detect signs of breast cancer. See Figure 7.13[8] for an image of a women undergoing a mammogram.

Figure 7.13 Mammogram

Pap Smear

A **Papanicolaou smear** (păp-ă-NĒ-kă-low smēr) or Pap smear is a diagnostic test that screens for suspicious changes in cells of the cervix. During a Pap smear, a health care provider inserts a **speculum** (SPEK-yŭ-lŭm) into the vagina to allow visualization of the cervix. Cells are collected from the cervix using sterile swabs and/or cytobrushes and sent to a lab for analysis for

8. "Woman_receives_mammogram.jpg" by Rhoda Baer and is licensed in the Public Domain.

abnormal cells or cancer. See Figure 7.14[9] for an image of a cytobrush used to collect cervical cell samples during a PAP smear.

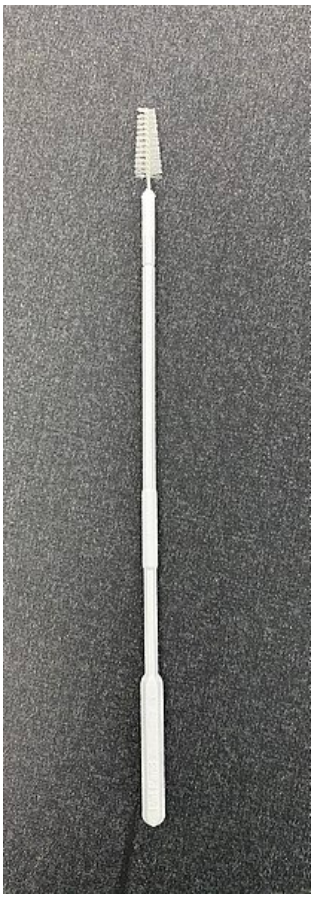

Figure 7.14
Cytobrush

Transvaginal Ultrasound

A **transvaginal ultrasound** (trăns-vă-jĭ-năl ŬL-tră-sound) is a procedure used to examine the vagina, uterus, Fallopian tubes, and bladder. An ultrasound transducer (probe) is inserted into the vagina and used to bounce high-energy sound waves (ultrasound) off internal tissues or organs and make

9. "Cytobrush_for_sampling_endocervical_cells.jpg" by Whispyhistory is licensed under CC BY-SA 4.0

echoes. The echoes form a picture of body tissues called a sonogram. See Figure 7.15[10] for an illustration of the ultrasound transducer placement during a transvaginal ultrasound.

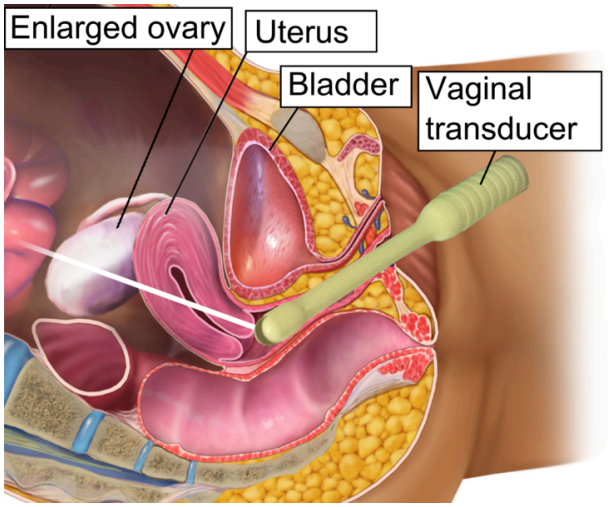

Figure 7.15 Transvaginal Ultrasound

Tubal Ligation

Tubal ligation (TOO-băl lī-GĀ-shŏn) is surgical procedure performed to prevent pregnancy and is also called female sterilization and commonly referred to as "getting your tubes tied." "Tubal" refers to the Fallopian tubes, and "ligation" means to tie off. During this surgery, both Fallopian tubes are blocked or cut to prevent fertilization of the egg by sperm. The procedure is usually performed in the hospital or in an outpatient surgical clinic. After the procedure, the woman still has a monthly menstrual cycle and menstrual flow.[11]

10. "Vaginal_ultrasonography_in_OHSS_-_coronal.png" by BruceBlaus CC BY 3.0

11. Johns Hopkins Medicine. (n.d.). *Tubal ligation*. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/tubal-ligation

7.8 Female Reproductive System Learning Activities

Interactive Learning Activity: Label the anatomy of the female reproductive system.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-30

Interactive Learning Activity: Study female reproductive system medical terms discussed in this chapter.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-181

Interactive Learning Activity: Test your knowledge on terms related to the female reproductive system.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-37

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-34

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-35

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-36

Interactive Learning Activity: Practice identifying and defining word parts for terms discussed in this chapter.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=285#h5p-199

You can also print this as a Chapter 7 Practice Worksheet and check your answers with this Answer Key PDF.

7.9 Glossary

Abnormal vaginal bleeding (ăb-nŏr-măl vă-jĭ-năl blēd-ing): Unusual bleeding from the vagina, including very heavy menstrual flow, bleeding between cycles, or prolonged bleeding. (Chapter 7.6)

Adenocarcinoma in situ (ăd-ĕ-nō-kăr-sĭ-NŌ-mă ĭn SĪ-tū): A condition where advanced, precancerous cells are found in the glandular tissue of the cervix. (Chapter 7.6)

Adnexa (ăd-NĔK-să): The accessory structures of the uterus, including the fallopian tubes and ovaries. (Chapter 7.5)

Amenorrhea (ā-men-ŏ-RĒ-ă): The absence of menstrual flow. (Chapter 7.5)

Anovulation (an-ov-yŭ-LĀ-shŏn): The absence of ovulation when an egg is not released from the ovaries. (Chapter 7.5)

Bartholin's glands (BAR-tō-lĭns glănz): Glands that secrete mucus to keep the vestibular area moist, located near the vaginal opening. (Chapter 7.4)

Bilateral oophorectomy (bī-LĂT-ĕr-ăl ō-ŏ-fŏ-REK-tŏ-mē): Removal of both ovaries. (Chapter 7.7)

Bilateral salpingo-oophorectomy (bī-LĂT-ĕr-ăl săl-pĭng-gō-ō-ŏ-fŏ-REK-tŏ-mē): Removal of both ovaries and both Fallopian tubes. (Chapter 7.7)

Biopsy (BĪ-ŏp-sē): A diagnostic procedure where tissue, fluid, or lymph nodes are removed for examination under a microscope. (Chapter 7.6)

Breast cancer (brest KAN-sĕr): Malignant tumors developing from breast tissue cells. (Chapter 7.6)

Breast-conserving surgery (brĕst kŏn-sĕr-vĭng sŭr-jĕr-ē): Surgical procedure removing only the cancerous part of the breast, not the entire breast. (Chapter 7.6)

Breast magnetic resonance imaging (brĕst măg-NĔT-ĭk rĕz-ŏ-NĂNS ĬM-ă-jĭng (MRI): A diagnostic imaging technique used to create detailed images of the breast tissue, often used in detecting and evaluating breast abnormalities. (Chapter 7.6)

Breast ultrasound (brĕst ŭl-tră-sound): A diagnostic imaging technique using sound waves to create images of the breast tissue. (Chapter 7.6)

Cervical cancer (SĚR-vi-kăl KAN-sĕr): Cancer arising from the cervix, often associated with human papillomavirus (HPV) infection. (Chapter 7.6)

Cervix (SĚR-vĭks): The lower part of the uterus, connecting the uterus to the vagina. (Chapter 7.4)

Chemotherapy (kē-mō-THĚR-ă-pē): The use of drugs to destroy or inhibit the growth of cancerous cells. (Chapter 7.6)

Clitoris (KLĬT-ŏ-rĭs): Erectile tissue originating from the same fetal cells as the penis, containing abundant nerves important in sexual sensation and orgasm. (Chapter 7.4)

Cold knife conization (kŏn-Ī-ZĀ-shŏn): A procedure using a scalpel or laser to remove a cone-shaped section of abnormal cervical tissue. (Chapter 7.6)

Colposcopy (kŏl-PŎS-kō-pē): A procedure using a lighted magnifying instrument to examine the cervix and potentially remove tissue for biopsy. (Chapter 7.6)

Conception (kŏn-sĕp-shŏn): The process of a sperm fertilizing an ovum, forming a zygote. (Chapter 7.5)

Contraception (kon-tră-SEP-shŏn): Methods or devices used to prevent pregnancy. (Chapter 7.5)

Corpus luteum (KŌR-pus LŪ-tē-um): A temporary endocrine structure in female ovaries that is involved in the production of relatively high levels of progesterone and moderate levels of estrogen and inhibin A. (Chapter 7.5)

Cryotherapy (krī-ō-THĚR-ă-pē): A treatment method using extreme cold to destroy abnormal tissue. (Chapter 7.6)

Cystocele (SĬS-tō-sēl): A prolapse of the bladder into the vagina, often referred to as an anterior vaginal prolapse. (Chapter 7.6)

Diagnostic mammogram (dī-ăg-nŏs-tĭk mă-mō-grăm): An enhanced mammogram used when an area of the breast looks abnormal on a screening mammogram. (Chapter 7.6)

Dilation & Curettage (dī-LĀ-shŏn and kūr-ĕ-täj) (D&C): A surgical procedure to remove tissue from the inside of the uterus. (Chapter 7.7)

Dysfunctional uterine bleeding (dĭs-fŭnk-shŭn-ăl yŪ-tĕr-ĭn blēd-ing): Abnormal bleeding from the uterus, often due to hormonal imbalances. (Chapter 7.6)

Dysmenorrhea (dĭs-mĕn-ŏ-RĒ-ă): Painful menstruation, often with cramps. (Chapter 7.5, Chapter 7.6)

Dysparenuria (dĭs-păr-ĕn-ŪR-ē-ă): Pain during sexual intercourse. (Chapter 7.5, Chapter 7.6)

Ectopic pregnancy (ĕk-TŌP-ĭk PRĔG-năn-sē): A pregnancy where the embryo implants outside the uterus, typically in a fallopian tube. (Chapter 7.6)

Embryo (Ĕm-brē-ō): The early developmental stage of an organism following fertilization. (Chapter 7.5)

Endometrial ablation (en-dō-MĒ-trē-ăl ă-BLĀ-shŏn): A procedure that destroys the lining of the uterus to reduce or stop heavy menstrual bleeding. (Chapter 7.6)

Endometrial cancer (en-dō-MĒ-trē-ăl KAN-sĕr): Cancer that originates in the lining of the uterus (endometrium). (Chapter 7.6)

Endometrial sampling (ĕn-dō-MĒ-trē-ăl săm-plĭng): A procedure to remove tissue from the endometrium for examination under a microscope. (Chapter 7.6)

Endometriosis (en-dō-mē-trē-Ō-sĭs): A painful condition where tissue similar to the lining of the uterus grows outside the uterus. (Chapter 7.6)

Endometrium (en-dō-MĒ-trē-um): The innermost lining of the uterus, providing the site for implantation of a fertilized egg or shedding during menstruation. (Chapter 7.4)

Estrogen (ĔS-trŏ-jen): A hormone produced by the ovaries, playing a key role in the female reproductive system, including the menstrual cycle and pregnancy. (Chapter 7.5)

Fallopian tubes (fă-LŌP-ē-an): Tubes that transport oocytes from the ovary to the uterus. (Chapter 7.4)

Fibrocystic breasts (fī-brō-SĬS-tĭk brests): Condition characterized by lumpy or ropelike breast tissue, often experiencing pain, tenderness, and lumpiness especially before menstruation. (Chapter 7.4)

Fimbriae (FĬM-brē-ā): The fringe-like projections at the end of the fallopian tubes, near the ovaries, which help to guide the ovum into the tube after ovulation. (Chapter 7.4, Chapter 7.5)

Fistula (FIS-chŭ-lă): An abnormal passageway between two organs or between an internal organ and the body surface. In the context of the female

reproductive system, it could be between the vagina and another organ such as the urinary bladder, colon, or rectum. (Chapter 7.5)

Follicles (FŎL-ĭ-klz): In the context of the female reproductive system, these are the fluid-filled sacs in the ovaries, each containing an immature ovum (egg). (Chapter 7.5)

Follicle stimulating hormone (FŌL-ĭ-kl stim-YŪ-lā-ting HŌR-mōn) (FSH): A hormone released by the brain that stimulates the growth of ova (eggs) in the ovaries. (Chapter 7.5)

Follicular phase (Fŏl-ĭk-yŭ-lăr fāz): The menstrual cycle phase where the endometrium thickens, and follicle growth is stimulated by FSH and LH. (Chapter 7.5)

Gynecologist (gīn-ĕ-KOL-ŏ-jĭst): A physician who specializes in the diagnosis and treatment of disorders of the female reproductive system and the breasts. (Chapter 7.7)

Gynecology (gī-nĕ-KOL-ŏ-jē): Study of the female reproductive system. (Chapter 7.7)

High-grade squamous intraepithelial lesions (hī-grād SKWĀ-mŭs ĭn-tră-ĕ-pĭ-THĒ-lē-ăl LĒ-zhŭns) (HSIL): More serious changes in the cervical cells that indicate a higher risk of progressing to cervical cancer. (Chapter 7.6)

Hirsutism (HĬR-sū-tĭz-ŭm): Excessive hair growth on the face and body, often a symptom of PCOS. (Chapter 7.6)

Hormonal therapy (hôr-MŌ-năl THĔR-ă-pē): Treatment using hormones to block cancer cells from getting the hormones they need to grow. (Chapter 7.6)

HPV test (H-P-V tĕst): A test to check for infection with high-risk types of human papillomavirus that can lead to cervical cancer. (Chapter 7.6)

Human papillomavirus (HYŪ-măn pă-pĭ-lō-mă VĪ-rŭs) (HPV): A group of viruses, some of which can cause genital warts and are associated with an increased risk of cervical and other types of cancers. (Chapter 7.6)

Hysterectomy (his-tĕ-REK-tŏ-mē): Surgical removal of the uterus, which may include the cervix, ovaries, fallopian tubes, and other surrounding structures. (Chapter 7.6, Chapter 7.7)

Hysterosalpingogram (hĭs-tĕ-RO-săl-pĭnj-ō-gram): A common imaging procedure performed to assess for potential causes of infertility in women.

During the procedure, radiopaque dye is injected into the uterus and fills the uterine cavity, continues into the fallopian tubes, and eventually reaches fimbriated ends next to the ovaries. Structures are visualized with an x-ray. (Chapter 7.7)

Hysteroscopy (his-tĕ-ROS-kŏ-pē): A procedure to look inside the uterus using a thin, telescope-like device inserted through the vagina and cervix. (Chapter 7.7)

Implantation (ĭm-plan-TĀ-shŏn): The process by which a fertilized egg attaches to the lining of the uterus (endometrium) to begin pregnancy. (Chapter 7.5)

Infertility (ĭn-fĕr-TĬL-ĭ-tē): The inability to conceive after a year or more of regular sexual activity without contraception. (Chapter 7.5)

Intrauterine devices (ĬN-tră-yŪ-tĕr-ēn dī-VĪS-ĭz): Contraceptive devices inserted into the uterus to prevent pregnancy. (Chapter 7.6)

Irregular bleeding (ĭ-rĕg-yŭ-lăr blēd-ing): Bleeding between menstrual periods or after menopause. (Chapter 7.6)

Labia majora (LĀ-bē-uh MĀ-jŏr-uh): Larger outer folds of hair-covered skin that begin just posterior to the mons pubis. (Chapter 7.4)

Labia minora (LĀ-bē-uh mĭ-NŌR-uh): Thinner, hairless, and more pigmented folds found medially to the labia majora, protecting the female urethra and the entrance to the female reproductive tract. (Chapter 7.4)

Lactation (lak-TĀ-shŏn): The process of producing milk in the mammary glands to feed an infant. (Chapter 7.4)

Lactiferous (lak-TĬF-ĕr-us) ducts: Tubes carrying milk from the mammary glands (lobules) to the nipple. (Chapter 7.4)

Laparoscopy (lăp-ă-RŎS-kŏ-pē): A surgical procedure using a laparoscope to examine the organs inside the abdomen. (Chapter 7.6)

Laparotomy (lap-uh-ROT-uh-mee): A surgical procedure with a large incision in the abdomen to access the abdominal organs. (Chapter 7.6)

Laser therapy (LĀ-zĕr THĔR-ă-pē): The use of an intense light beam (laser) to treat various medical conditions, including removing abnormal cervical tissue. (Chapter 7.6)

Loop electrosurgical excision procedure (lōōp ĕ-lĕk-trō-SŬR-jĭ-kăl ĕk-SĬZ-shŭn prō-SĒ-jŭr) (LEEP): A surgical technique used to remove abnormal

cervical tissue using a thin wire loop that carries an electric current. (Chapter 7.6)

Low-grade squamous intraepithelial lesions (lō-grād SKWĀ-mŭs ĭn-tră-ĕ-pĭ-THĒ-lē-ăl LĒ-zhŭns) (LSIL): Changes in the cervical cells that are often associated with HPV infection and are typically mild, often resolving on their own. (Chapter 7.6)

Luteinizing hormone (LŪ-tē-ĭ-nīz-ĭng HŌR-mōn) (LH): A hormone involved in triggering ovulation and the development of the corpus luteum. (Chapter 7.5)

Lymphadenectomy (lĭmf-ăd-ĕ-NEK-tŏ-mē): Another term for lymph node dissection, often used in the context of cancer treatment. (Chapter 7.6)

Lymph node dissection (lĭmf nōd dĭ-sĕk-shŏn): Surgical removal of lymph nodes to examine for the presence of cancer. (Chapter 7.6)

Mammogram (MĂM-ō-grăm): An X-ray image of the breast used to detect and diagnose breast abnormalities. (Chapter 7.6, Chapter 7.7)

Mastitis (mas-TĪT-ĭs): Inflammation of the breast, often occurring during lactation. (Chapter 7.5)

Medical oncologists (mĕd-ĭ-kăl ŏn-KOL-ŏ-jĭsts): Physicians specializing in treating cancer with medication. (Chapter 7.6)

Menarche (mĕn-ĂR-kē): The first occurrence of menstruation in a female. (Chapter 7.5)

Menometrorrhagia (mĕn-ō-mĕt-rō-RĀ-jē-ă): Excessive and prolonged uterine bleeding occurring at irregular and/or frequent intervals. (Chapter 7.5)

Menopause (MEN-ŏ-poz): The end of menstrual cycles in a woman's life, marking the end of reproductive years. (Chapter 7.6)

Menorrhagia (mĕn-ō-RĀ-jē-ă): Excessive menstrual bleeding. (Chapter 7.5, Chapter 7.6)

Menstruation (men-strŪ-Ā-shŏn): The monthly shedding of the endometrial lining in females, typically involving vaginal bleeding. (Chapter 7.5)

Metastasized (mĕ-tăs-tă-sīzd): The process by which cancer spreads from the primary site to other parts of the body. (Chapter 7.6)

Metrorrhagia (mē-trō-RĀ-jă): Bleeding from the uterus at any time other than normal menstruation. (Chapter 7.5)

Modified radical mastectomy (mŏd-ĭ-fīd răd-ĭ-kăl mas-TEK-tŏ-mē): Surgery removing the entire breast with cancer, most of the lymph nodes, and sometimes other tissues. (Chapter 7.6)

Mons pubis (MŎNZ PYŪ-bĭs): A rounded mass of fatty tissue lying over the joint of the pubic bones, becoming covered in hair after puberty. (Chapter 7.4)

Myolysis (mī-OL-ŏ-sĭs): A procedure involving the destruction of fibroids using electric current or freezing. (Chapter 7.6)

Myomectomy (mī-ō-MĔK-tŏ-mē): Surgical removal of fibroids from the uterus. (Chapter 7.6)

Obstetrics (ŏb-STĔT-rĭks) (OB): The branch of medicine and surgery concerned with childbirth and the care of women giving birth. (Chapter 7.7)

Oligomenorrhea (ŏl-ĭ-gō-mĕn-ō-RĒ-ă): Infrequent or very light menstruation. (Chapter 7.5)

Omentectomy (ō-mĕn-TEK-tŏ-mē): Surgical removal of the omentum, a part of the peritoneum in the abdomen. (Chapter 7.6)

Oophorectomy (ō-ŏ-fŏ-REK-tŏ-mē): Surgical removal of one or both ovaries. (Chapter 7.7)

Ovarian cancer (ō-VAR-ē-ăn KAN-sĕr): Cancer that originates in the ovarian tissues. (Chapter 7.6)

Ovarian cyst (ō-VĀR-ē-an sĭst): A fluid-filled sac in the ovary, often part of the normal menstrual cycle or a benign condition. (Chapter 7.6)

Ovary (Ō-văr-ē): Female reproductive gland responsible for producing oocytes (eggs) and hormones. (Chapter 7.4)

Ovulation (ov-yŭ-LĀ-shŏn): The release of an ovum (egg) from the dominant follicle in the ovary, typically occurring around the middle of the menstrual cycle. (Chapter 7.5)

Ovum (Ō-vum): The female reproductive cell, or egg, which, when fertilized by a sperm, can develop into an embryo. (Chapter 7.5)

Papanicolaou smear (păp-ă-NĒ-kă-low smēr) (Pap smear): A screening procedure for cervical cancer and precancerous conditions, involving the collection of cells from the cervix. (Chapter 7.6, Chapter 7.7)

Pelvic inflammatory disease (PĚL-vĭk ĭn-flă-MĂ-tŏ-rē) (PID): An infection of the female reproductive organs, often caused by sexually transmitted infections. (Chapter 7.6)

Perineum (pĕr-ĭ-NĒ-um): The area between the vaginal opening and the anus. (Chapter 7.4)

Peritoneum (pĕr-ĭ-tō-NĒ-ŭm): The membrane lining the abdominal cavity and covering most of the abdominal organs. (Chapter 7.6)

Polycystic ovary syndrome (pŏl-ē-SĪS-tĭk Ō-vă-rē SĪN-drōm) (PCOS): A hormonal disorder causing enlarged ovaries with small cysts on the outer edges. (Chapter 7.6)

Polymenorrhea (pŏl-ē-mĕn-ō-RĒ-ă): Condition characterized by frequent menstrual cycles, shorter than 21 days in length. (Chapter 7.5)

Premenstrual dysphoric disorder (prē-MĔN-strŭ-ăl dis-FŌR-ĭk) (PMDD): A severe form of PMS characterized by significant mood disturbances. (Chapter 7.6)

Premenstrual syndrome (prē-MĔN-strŭ-ăl SĪN-drōm) (PMS): A group of symptoms that occur in women, typically between ovulation and a period. (Chapter 7.6)

Progesterone (pro-JĔS-tĕr-ōn): A hormone released by the corpus luteum in the ovary. It plays a role in the menstrual cycle and in maintaining the early stages of pregnancy. (Chapter 7.5)

Prolapse (PRŌ-laps): The slipping down or displacement of an organ or part, such as the uterus. (Chapter 7.6)

Radiation oncologists (rā-dē-Ā-shŏn ŏn-KOL-ŏ-jĭsts): Doctors who treat cancer using radiation therapy. (Chapter 7.6)

Radiation therapy (rā-dē-Ā-shŏn THĔR-ă-pē): The use of high-energy rays to kill or damage cancer cells. (Chapter 7.6)

Radical hysterectomy (răd-ĭ-kăl his-tĕ-REK-tŏ-mē): Extensive surgery to remove the uterus, cervix, part of the vagina, and sometimes other tissues for cancer treatment. (Chapter 7.7)

Rectocele (RĔK-tō-sēl): A posterior vaginal prolapse where the rectum protrudes into the vagina. (Chapter 7.6)

Salpingectomy (sal-pĭn-JEK-tŏ-mē): Surgical removal of one or both Fallopian tubes. (Chapter 7.7)

Salpingo-oophorectomy (săl-pĭng-gō-ō-ŏf-ō-REK-tŏ-mē): Removal of a Fallopian tube and its corresponding ovary. (Chapter 7.7)

Sexual intercourse (Sĕk-shū-ăl ĭn-tĕr-kōrs): The physical act of sex, involving the insertion of the penis into the vagina. (Chapter 7.5)

Speculum (SPEK-yŭ-lŭm): An instrument used to widen the opening of the vagina during medical examinations. (Chapter 7.6, Chapter 7.7)

Subtotal hysterectomy (sŭb-tō-tăl his-tĕ-REK-tŏ-mē): Removal of part of the uterus, leaving the cervix in place. (Chapter 7.7)

Surgeons (SŬR-jŏns): Medical doctors who perform operations. (Chapter 7.6)

Surgery (SŬR-jĕr-ē): Medical procedures involving the manual and instrumental techniques to treat diseases, injuries, or deformities. (Chapter 7.6)

Tampon (TĂM-pon): A plug of soft material inserted into the vagina to absorb menstrual blood. (Chapter 7.6)

Targeted therapy (TĂR-gĭ-tĕd THĔR-ă-pē): Treatment that uses drugs to target specific molecules involved in cancer growth and progression. (Chapter 7.6)

Total abdominal hysterectomy (tō-tăl ăb-DŎM-ĭ-năl his-tĕ-REK-tŏ-mē): Removal of the uterus through an incision in the abdomen. (Chapter 7.7)

Total hysterectomy (tō-tăl his-tĕ-REK-tŏ-mē): Removal of the entire uterus, including the cervix. (Chapter 7.7)

Total hysterectomy/bilateral salpingectomy oophorectomy (tō-tăl his-tĕ-REK-tŏ-mē / bī-LĂT-ĕr-ăl săl-pĭn-JEK-tŏ-mē ō-ŏ-fŏ-REK-tŏ-mē) (TAH/BSO): A surgical procedure involving the removal of the uterus (hysterectomy), both Fallopian tubes (salpingectomy), and both ovaries (oophorectomy). (Chapter 7.7)

Total laparoscopic hysterectomy (tō-tăl lăp-ăr-ŏ-SKŌP-ĭk his-tĕ-REK-tŏ-mē): Removal of the uterus using laparoscopic techniques, involving small incisions and a camera. (Chapter 7.7)

Total mastectomy (tō-tăl mas-TEK-tŏ-mē): Surgical removal of the entire breast that has cancer. (Chapter 7.6)

Toxic shock syndrome (TŌK-sĭk SHŌK SĬN-drōm): A rare, life-threatening complication of certain bacterial infections, associated with tampon use. (Chapter 7.6)

Transvaginal ultrasound (trăns-vă-jĭ-năl ŬL-tră-sound): An ultrasound procedure where a probe is inserted. (Chapter 7.7)

Tubal ligation (TOO-băl lī-GĀ-shŏn): A permanent surgical procedure for female sterilization, involving sealing, tying, or cutting the Fallopian tubes. (Chapter 7.5, Chapter 7.7)

Tubo-ovarian abscess (TŪ-bō ō-VAR-ē-ăn ăb-sĕs): An inflammatory mass involving the fallopian tube and ovary, often a complication of PID. (Chapter 7.6)

Uterine artery embolization (ŪT-ĕ-rīn ăr-tĕr-ē ĕm-bō-lĭ-ZĀ-shŏn): Another term for uterine fibroid embolization. (Chapter 7.6)

Uterine fibroid (ŪT-ĕ-rīn FĪ-brŏyd): Benign tumors in the muscular wall of the uterus. (Chapter 7.6)

Uterine fibroid embolization (ŪT-ĕ-rīn FĪ-brŏyd ĕm-bō-lĭ-ZĀ-shŏn): A procedure to block blood flow to fibroids, causing them to shrink. (Chapter 7.6)

Uterine prolapse (ŪT-ĕ-rīn PRŌ-laps): A condition where the uterus sags or slips from its normal position into the vaginal canal. (Chapter 7.6)

Uterus (YŪ-tĕr-us): A muscular, pear-shaped organ responsible for housing and nourishing a developing fetus. (Chapter 7.4)

Vagina (vă-JĪN-uh): A muscular canal serving as the entrance to the reproductive tract and the exit from the uterus during menstruation and childbirth. (Chapter 7.4)

Vaginal candidiasis (vă-jĭ-năl kăn-dĭ-DĪ-ă-sĭs): A fungal infection in the vagina, commonly known as a yeast infection, causing itching and a thick, white discharge. (Chapter 7.6)

Vaginal hysterectomy (vă-jĭ-năl his-tĕ-REK-tŏ-mē): Removal of the uterus through the vagina. (Chapter 7.7)

Vaginal prolapse (vă-jĭ-năl PRŌ-laps): A condition where the vagina itself sags or slips out of its normal position. (Chapter 7.6)

Vulva (VŬL-vă): The external part of the female genitalia, which includes the labia majora, labia minora, clitoris, and the opening of the vagina. (Chapter 7.4)

PART VIII

CHAPTER 8 OBSTETRICS TERMINOLOGY

8.1 Obstetrics Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to obstetrics
- Identify meanings of key word components related to obstetrics
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to obstetrics
- Use terms related to obstetrics
- Use terms related to obstetric disorders

Introduction to Obstetrics

Obstetrics (ŏb-STE-triks) **(OB)** is a medical specialty concerning care of the mother and fetus during pregnancy, childbirth, and immediately after childbirth. This chapter will review common word components related to fertilization, pregnancy, and childbirth to assist learning how to analyze, build, and define medical terms. Other terms whose definitions cannot be easily built from word components will be described in context. Medical specialists, diagnostic tests, and procedures related to fertilization, pregnancy, and childbirth will also be discussed. Additional information about the female reproductive system is discussed in the "Female Reproductive System Terminology" chapter.

View this YouTube video[1] for an introduction to pregnancy and development: Reproductive System, Part 4 – Pregnancy & Development: Crash Course A&P #43

1. CrashCourse. (2015, November 23). *Reproductive system, Part 4 – Pregnancy & development: Crash Course Anatomy & Physiology #43* [Video]. YouTube. All rights reserved. https://youtu.be/BtsSbZ85yiQ?si=DSdQWrT6GeIs3QxG

8.2 Word Components Related to Obstetrics

This section will describe common word components related to fertilization, pregnancy, and childbirth. These word components help build definitions for many medical terms. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO OBSTETRICS

- **ante-**: Before
- **dys-**: Painful, labored, difficult
- **intra-**: Within
- **micro-**: Small
- **multi-**: Many
- **neo-**: New
- **nulli-**: None
- **post-**: After
- **pre-**: Before

COMMON WORD ROOTS WITH A COMBINING VOWEL RELATED TO OBSTETRICS

- **amni**/o, **amnion**/o: Amnion, amniotic fluid
- **cephal**/o: Head
- **chori**/o: Chorion
- **embry**/o: Embryo
- **episi**/o: Vulva
- **esophag**/o: Esophagus
- **fet**/o or **fet**/i: Fetus, unborn offspring
- **gravid**/o: Pregnancy
- **hydr**/o: Water
- **lact**/o: Milk
- **nat**/o: Birth
- **olig**/o: Scanty, few
- **omphal**/o: Umbilicus, navel
- **par**/o: To bear, labor, childbirth, give birth to
- **part**/o: To bear, labor, childbirth, give birth to
- **prim**/i: First
- **pseud**/o: False
- **puerper**/o: Childbirth
- **pylor**/o: Pylorus, pyloric sphincter
- **terat**/o: Malformations

COMMON SUFFIXES RELATED TO OBSTETRICS

- **-a**: No meaning, noun ending

- **-al**: Pertaining to
- **-amnios**: Amnion, amniotic fluid
- **-centesis**: Surgical withdrawal of fluid
- **-cyesis**: Pregnancy
- **-e**: Noun ending, no meaning
- **-gen**: Substance that produced, agent that produced
- **-genic**: Producing, originating, causing
- **-graphy**: Process of recording
- **-ic**: Pertaining to
- **-is**: Noun suffix, no meaning
- **-itis**: Inflammation
- **-logist**: Specialist who studies and treats
- **-logy**: Study of
- **-oid**: Resembling
- **-oma**: Tumor
- **-rrhea**: Discharge, flow
- **-rrhexis**: Rupture
- **-stenosis**: Constriction, narrowing
- **-tocia**: Birth, labor
- **-tomy**: Incision, cut into
- **-um**: Noun ending, no meaning
- **-us**: Noun ending, no meaning

8.3 Examples of Obstetrical Terms Easily Defined By Their Word Components

Here are examples of common medical terms related to obstetrics that can be easily defined by breaking the terms into their word components.

Amniocentesis

1. Break down the medical term into word components: **Amni/o/centesis**
2. Label the word components: **Amni** = WR; **o** = CV; **centesis** = S
3. Define the word components: **Amni** = amniotic fluid; **centesis** = surgical withdrawal of fluid
4. Create a final definition of the medical term: **Surgical withdrawal of amniotic fluid**

Postpartum

1. Break down the medical term into word components: **Post/part/um**
2. Label the word parts: **Post** = P; **part** = WR
3. Define the word components: **Post** = after; **part** =

childbirth; **um**=no meaning

4. Create a final definition of the medical term: **After childbirth**

Teratogenic

1. Break down the medical term into word components: **Terat/o/genic**
2. Label the word parts: **Terat** = WR; **o** = CV; **genic** = S
3. Define the word components: **Terat** = malformations; **genic** = producing
4. Create a final definition of the medical term: **Producing malformations**

Interactive Learning Activity: Practice defining and pronouncing obstetrics medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=4273#h5p-40

You can also print this as a Chapter 8 Student Companion Worksheet and check your answers with this Answer Key.

8.4 Fertilization, Pregnancy, Labor, Delivery, Newborn Care, and Postpartum Care

FERTILIZATION

There are two types of gametes involved in reproduction: the male gametes, called sperm, and female gametes, called ova. The male gametes are produced in the testes through a process called spermatogenesis, which begins at about 12 years of age. The female gametes are present at birth but are immature. They are stored in the ovaries until puberty, when one ovum ripens and is released about every 28 days in a process called **oogenesis** (ō-ŏ-JEN-ĕ-sĭs).[1]

After the ovum is released from the ovary, it is drawn into the Fallopian tube. If sexual intercourse occurs, millions of sperm are ejaculated into the vagina, but only a few reach the ovum. **Fertilization** (fĕr-tĭ-lĪ-zā-shŏn) occurs when a sperm and an ovum combine, also referred to as **conception** (kŏn-SEP-shŏn). See Figure 8.1[2] for an image of conception.

1. This work is a derivative of Lifespan Development by Julie Lazzara and is licensed under CC BY 4.0
2. "Sperm-egg.jpg" by Unknown author is licensed in the Public Domain.

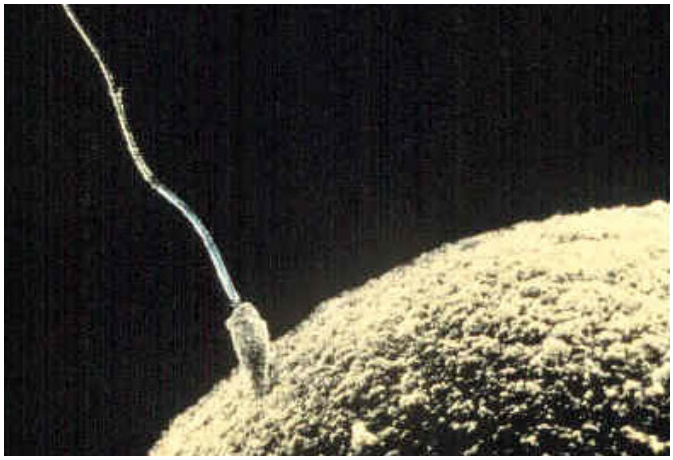

Figure 8.1 Conception

After a single sperm has entered the ovum, the wall of the ovum becomes hard and prevents other sperm from entering. The head of the sperm, containing the genetic information from the father, unites with the nucleus of the ovum, and a new cell is formed. Reproductive cells are haploid cells containing half of the genetic material needed to form a human being, so their combination forms a diploid cell called a **zygote** (ZĪ-gōt).[3]

During the first week after conception, the zygote divides and multiplies, going from a one-cell structure to two cells, then four cells, then eight cells, and so on. This process of cell division is called **mitosis** (mī-TŌ-sĭs). The zygote continues to divide and travel through the Fallopian tube for about 7-10 days, at which point it arrives in the uterus. Once in the uterus, the zygote implants itself in the **endometrium** (en-dō-MĒ-trē-ŭm), the inner lining of the uterus, where the embryonic stage begins about three weeks after conception.[4]

Human chorionic gonadotropin (hū-MĂN kor-ē-ON-ĭk gō-năd-ō-TRO-pin) is a hormone produced by cells that will eventually make up the placenta in

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the early stages of pregnancy. HCG can be detected by a blood pregnancy test at around 7-12 days after conception and by a urine pregnancy test about two weeks after conception. HCG increases quickly (almost doubling every three days) for the first eight to ten weeks of pregnancy.[5]

View the following YouTube video[6] illustrating conception: Fertilization

EMBRYONIC STAGE

An **embryo** (EM-brē-ō) is an organism in its early stages of development, specifically from Day 16 through Week 8. See Figure 8.2[7] for an image of a human embryo.

5. Cleveland Clinic. (2022, March 11). *Human chorionic gonadotropin*. https://my.clevelandclinic.org/health/treatments/4423-vasectomy

6. Nucleus Medical Media. (2013, January 31). *Fertilization* [Video]. YouTube. All rights reserved. https://youtu.be/_5OvgQW6FG4?si=siTDwkcpfKtYJ9LC

7. "9-Week_Human_Embryo_from_Ectopic_Pregnancy.jpg" by Ed Uthman from Houston, TX, USA is licensed under CC BY 2.0

Figure 8.2 Human Embryo

During the embryonic stage, blood vessels grow, forming the placenta. The **placenta** (plă-SEN-tă) is a structure that connects the fetus to the uterus, providing oxygen and nutrients from the mother to the developing embryo via the **umbilical cord** (ŭm-BĬL-ĭ-kăl kŏrd). Basic structures of the embryo start to develop into areas that will become the head, chest, and abdomen. During the embryonic stage, the heart begins to beat, and organs form and begin to function. At 22 days after conception, the neural tube forms along the back of the embryo, developing into the spinal cord and brain.[8]

About 20 percent of embryos do not successfully make it through the embryonic stage, usually due to chromosomal abnormalities. It is during this stage that the major structures of the body are forming, making the

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embryonic period a vulnerable time if the embryo is exposed to a harmful substance. **Teratogens** (tĕr-AT-ŏ-jĕnz), agents that cause malformations in a developing embryo, include alcohol, drugs, diseases, chemicals, and environmental exposures. Many mothers are not aware they are pregnant during the embryonic period, further increasing the risk of teratogen exposure to the developing embryo.[9]

FETAL STAGE

When the embryo is about nine weeks old until birth, it is called a **fetus** (FĒ-tŭs). At the beginning of this stage, the fetus is about the size of a kidney bean and begins to take on the recognizable form of a human being. See Figure 8.3[10] for an image of an early fetus.

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10. "Human_fetus_10_weeks_with_amniotic_sac_-_therapeutic_abortion.jpg" by suparna sinha is licensed under CC BY-SA 2.0

Figure 8.3 Fetus

Mothers experience **quickening** (KWĬK-ĕn-ĭng), the first feeling of movement of the fetus in utero, around 16 to 20 weeks. By the time the fetus reaches the sixth month of development (23-24 weeks), it weighs up to 1.4 pounds. Hearing has developed, so the fetus can respond to sounds. The internal organs, such as the lungs, heart, stomach, and intestines, have formed enough that a fetus born prematurely at this point has a chance of survival with intensive medical care.

Between the seventh and ninth months, the fetus is primarily preparing for birth. It is exercising its muscles, and its lungs begin to expand and contract. Around 36 weeks, the fetus is almost ready for birth. It weighs about six pounds and is about 18.5 inches long. By Week 37 all organ systems are developed enough that the fetus could survive outside the mother's uterus without many of the risks associated with premature birth. The fetus

continues to gain weight and grow in length until approximately 40 weeks. See Figure 8.4[11] for an illustration of fetal growth.[12]

Figure 8.4 Fetal Growth

11. "CNX_Psych_09_02_Stages.jpg" by unknown author is licensed under CC BY 4.0. Access for free at https://open.maricopa.edu/devpsych/chapter/chapter-2-genetics-and-prenatal-development/

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View the following TED Talk video[13] showing human development from conception on: Conception to Birth – Visualized

PREGNANCY

A full-term pregnancy lasts approximately 270 days (approximately 38.5 weeks) from conception to birth. Because it is easier to remember the first day of the **last menstrual period** (last MEN-strū-ăl PĒ-rē-ŏd) **(LMP)** than to estimate the date of conception, obstetricians set the due date as 284 days (approximately 40.5 weeks) from the LMP. This assumes that conception occurred on Day 14 of the woman's cycle. These 40 weeks of pregnancy are usually discussed in terms of three **trimesters** (TRĪ-mĕs-tĕrz), each trimester lasting approximately 13 weeks.

During the first trimester, it is common for the mother to experience nausea as a result of higher levels of estrogen in her body, commonly called "morning sickness." Other symptoms during pregnancy may include

13. Tsiaras, A. (2010, December). *Conception to birth — Visualized* [Video]. Ted.com. All rights reserved. https://www.ted.com/talks/alexander_tsiaras_conception_to_birth_visualized

heartburn, gas, hemorrhoids, backache, leg cramps, insomnia, constipation, and varicose veins.[14] See Figure 8.5[15] for an image of a pregnant woman.

Figure 8.5 Pregnancy

Labor and Delivery

The process of childbirth, referred to as labor and delivery, is divided into three stages:

- First Stage: Cervical dilation

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15. "PregnantWoman.jpg" by Ken Hammond is licensed in the Public Domain.

- Second Stage: Expulsion or birth
- Third Stage: Delivery of the placenta

See Figure 8.6[16] for an illustration of childbirth.

16. "2920_Stages_of_Childbirth-02.jpg" by OpenStax College is licensed under CC BY 4.0

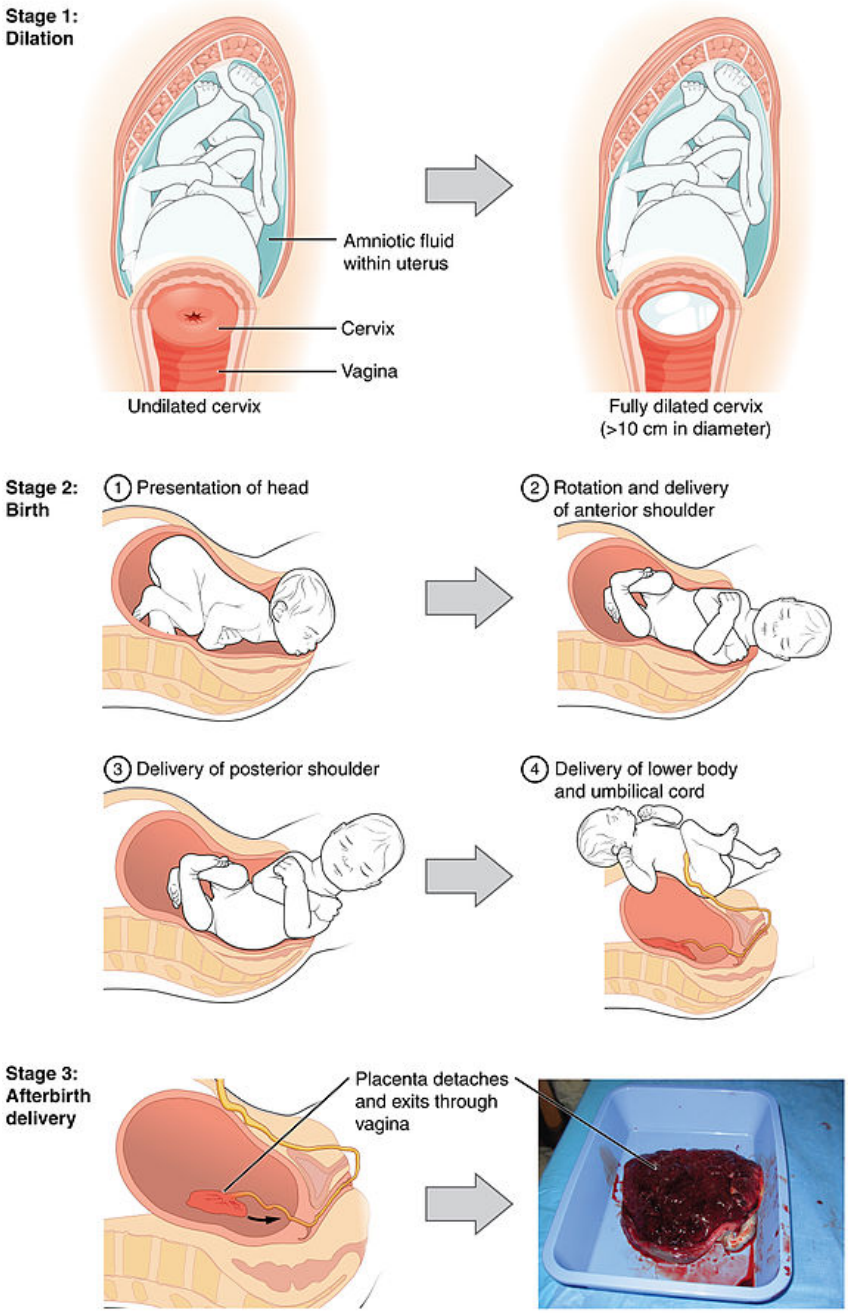

Figure 8.6 Stages of Childbirth

First Stage: Cervical Dilation

The first stage of labor begins with uterine contractions that initially last about 30 seconds and are spaced 15 to 20 minutes apart. Uterine contractions are the rhythmic tightening and shortening of the uterine muscles during labor. These contractions increase in duration and frequency to more than a

minute long and three to four minutes apart. Women are typically advised to go to the hospital for delivery when contractions are coming about every five minutes. Some women experience **Braxton-Hicks** (BRAX-tŏn HIKS) contractions, which are irregular false contractions that occur before actual labor begins. Women are counseled that real labor pains typically increase with walking, resulting in the cessation of walking until the contraction stops. Labor may also begin with clear or pink-tinged mucus discharge (called a mucus plug) or a gush of amniotic fluid.[17]

During labor, the cervix dilates to ten centimeters (just under four inches) so it is wide enough to deliver the newborn's head. Dilation may take around 12-16 hours for woman delivering their first child or about 6-9 hours for women who have previously given birth. However, labor varies widely among women and may take over 24 hours. In each subsequent labor, the labor stage tends to be shorter.[18]

Second Stage: Expulsion or Birth

The second stage involves the passage of the baby through the birth canal. **Parturition** (păr-tū-RĬSH-ŭn) is a medical term for the act of giving birth. This stage takes about 10-40 minutes. Contractions usually come about every 2-3 minutes, and the mother pushes and relaxes as directed by the medical staff.

Normally, the head of the baby emerges first, referred to as a **cephalic presentation** (sĕ-FAL-ĭk prē-zen-TĀ-shŏn). **Crowning** (KROWN-ĭng) refers to the appearance of the baby's head at the vaginal opening.

The baby's head is turned when it is in the head-down position, referred to as **cephalic version** (sĕ-FAL-ĭk VĔR-zhŏn), so that one shoulder can emerge,

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followed by the other shoulder. The rest of the baby quickly passes through, and then the umbilical cord is clamped and cut.[19]

In some cases, the baby is not in a head-down position during labor and delivery. **Breech** (brēch) refers to a feet-first position that requires additional interventions by medical staff and perhaps delivery by cesarean section.

Third Stage: Delivery of Placenta

The third stage is relatively painless in comparison to the other stages. During this stage, the placenta is delivered. This typically occurs within 20 minutes after delivery of the baby.[20] Following delivery, if the mother experienced tearing of the perineum, it is repaired by the obstetrician or midwife. The **perineum** (pĕr-ĭ-NĒ-ŭm) is the area between the vagina and the anus. An **episiotomy** (ĕp-ĭ-zē-OT-ŏ-mē) is a surgical incision of the vulva to widen the vaginal opening to prevent ripping or tearing of the perineum during delivery.

View the following YouTube video[21] on childbirth: Patient Education Animation: Labor and Vaginal Birth

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21. Nucleus Medical Media. (2012, August 20). *Patient education animation: Labor and vaginal birth* [Video]. YouTube. All rights reserved. https://youtu.be/ZDP_ewMDxCo?si=kFvTxtkYvr0TH8Te

Cesarean Section

Cesarean section (si-ZAR-ē-ăn SEK-shŏn), also known as C-section, is delivery of the fetus through an abdominal incision made by the obstetrician. Cesarean sections are performed when a vaginal delivery would put the baby or mother at risk. Common reasons for C-sections include obstructed labor based on the shape of the mother's pelvis, breech presentation of the baby, complications with the placenta or umbilical cord, twin pregnancy, or high blood pressure in the mother.[22]

Newborn Assessment

The average newborn weighs approximately 7.5 pounds. In the minutes following birth, a newborn must undergo dramatic body system changes to be able to survive outside the womb. The **Apgar score** (AP-gar skōr) is an evaluation of a newborn's physical condition within one to five minutes after birth and was developed by and named for Virginia Apgar (making this an eponym).

The technique for determining an Apgar score is quick, easy, painless, and does not require any instruments except for a stethoscope. A convenient way to remember the five scoring criteria is to apply the mnemonic APGAR[23]:

- **A**ppearance (skin color)
- **P**ulse (heart rate)
- **G**rimace (reflex)
- **A**ctivity (muscle tone)
- **R**espiration

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Skin color, heart rate, reflex, muscle tone, and respiration are assessed, and each criterion is assigned a score of 0, 1, or 2. Scores are taken at one minute after birth and again at five minutes after birth. After each time the scores are taken, the five scores are added together. High scores (out of a possible 10) indicate the baby has made the transition well, whereas lower scores indicate that the baby may be in distress. See Figure 8.7[24] for APGAR criteria.[25]

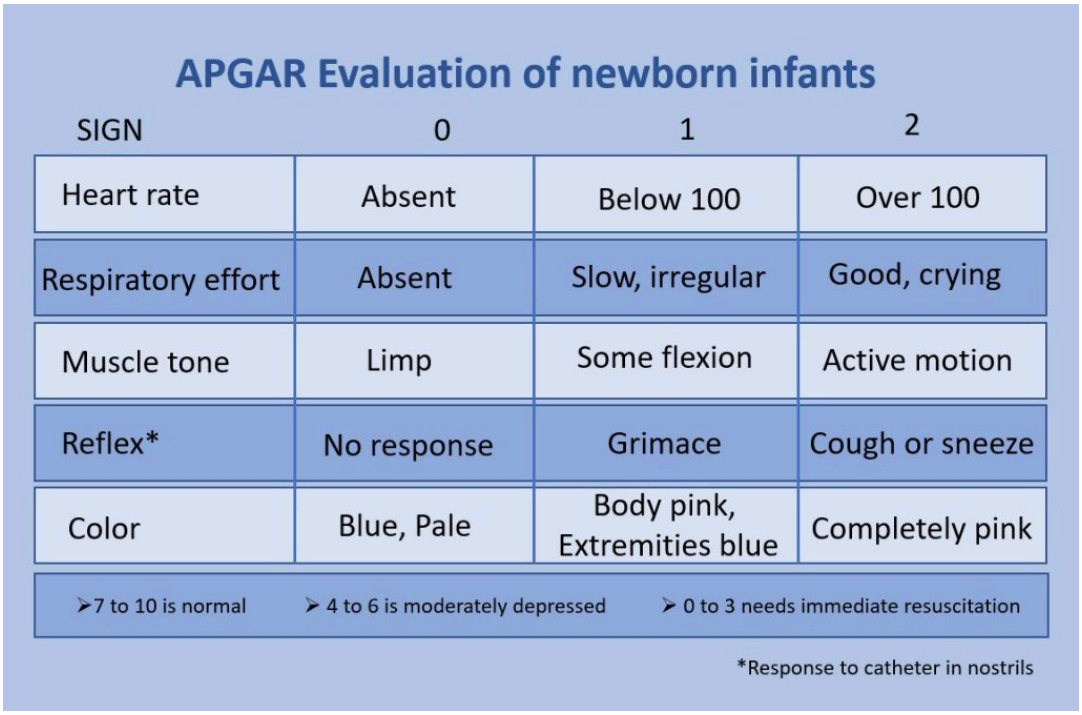

Figure 8.7 APGAR

Of the five Apgar criteria, heart rate and respiration are the most critical. Poor scores for either of these measurements may indicate the need for immediate medical attention to resuscitate or stabilize the newborn. In

24. "APGAR_score.jpg" by Dr.Vijaya chandar is licensed under CC BY-SA 4.0

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general, any score lower than 7 at the five-minute mark indicates that medical assistance may be needed. A total score below 5 indicates an emergency situation. Normally, a newborn will get an intermediate score of 1 for some of the Apgar criteria and will progress to a 2 by the five-minute assessment. Scores of 8 or above are normal.[26]

Many newborns are covered with **lanugo** (lă-NOO-gō), a fine, downy hair and **vernix** (VĚR-nĭks), a white, waxy substance covering the skin. Within 24-48 hours of birth, newborns pass their first stool, called **meconium** (mē-KŌ-nē-ŭm). Meconium is dark, thick, and sticky. Sometimes a fetus passes meconium if they are stressed during labor and delivery. If the fetus inhales meconium into the lungs in utero, it can cause severe respiratory complications. This condition is called **meconium aspiration** (mĕ-KŌ-nē-ŭm AS-pĭ-RĀ-shŏn).

POSTPARTUM PERIOD

The **postpartum** (pōst-PÄR-tŭm) period begins immediately after childbirth as the mother's body, including hormone levels and uterus size, returns to a nonpregnant state. The terms puerperium, puerperal period, or postpartum period are commonly used to refer to the first six weeks following childbirth. During this time, the mother is monitored for bleeding, bowel and bladder function, and baby care. The infant's health is also monitored, and vaccines are administered. The postpartum period can be divided into three stages[27]:

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- Acute phase: Six to 12 hours after childbirth
- Subacute postpartum period: Two to six weeks after childbirth
- Delayed postpartum period, which can last up to six months.

Acute Phase

The first 6 to 12 hours after childbirth is the initial or acute phase of the postpartum period. During this time the mother is monitored by nurses or midwives for potential complications such as postpartum hemorrhage. Immediately after childbirth, the infant is placed directly on the mother's chest whenever possible. See Figure 8.8[28] for an image of chest-to-chest positioning of the mother and infant.[29]

Figure 8.8 Postpartum Chest to Chest Positioning

28. "Postpartum_baby2.jpg" by Tom Adriaenssen is licensed under CC BY-SA 2.0

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The greatest health risk during the acute phase is postpartum bleeding. Following delivery, the area where the placenta was attached to the uterine wall bleeds, and the uterus must contract to prevent blood loss. After contraction takes place, the fundus (top) of the uterus can be palpated as a firm mass at the level of the navel. It is important that the uterus remains firm, and nurses or midwife will make frequent assessments of both the fundus and the amount of bleeding. Uterine massage is commonly used to help the uterus contract and prevent postpartum hemorrhage.[30]

Subacute Postpartum Period

The subacute postpartum period lasts two to six weeks. During this time, **lochia** (LŌ-kē-ă), vaginal discharge after birth, will turn color from bright red, to brownish, to yellow. It will gradually decrease in amount and cease at around five or six weeks.[31]

At two to four days postpartum, a woman's breast milk will generally come in and is called **lactation** (lăk-TĀ-shŏn). Mothers are encouraged to breastfeed their babies every three hours during the day and night. During pregnancy and the first few days after delivery, **colostrum** (kŏ-LOS-trŭm), a thin, milky fluid, is secreted by the breast. Colostrum is rich in immunoglobulin A (IgA), which helps protect the infant from infection. Colostrum also helps to establish a normal gut microbiome in the infant and further protects against infection. Human colostrum is ideal for newborns and is preferable over formula or milk from other animals.[32]

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Approximately 70-80% of postpartum women will experience the "baby blues" for a few days due to the rapid change in hormone levels. However, some women experience more serious clinical depression during pregnancy or after childbirth, referred to as **peripartum depression** (pĕr-ĭ-PÄR-tŭm di-PRESH-ŭn), also known as postpartum depression. They may feel depressed, anxious, guilty, agitated, or weepy. They may not want to hold or care for their newborn, even in cases in which the pregnancy was desired and intended. Family and friends who recognize these symptoms in a pregnant or postpartum woman should encourage them to see a health care provider for treatment.[33]

Delayed Postpartum Period

The delayed postpartum period starts after the subacute postpartum period and lasts up to six months. During this time, the mother's muscles and connective tissue return to a pre-pregnancy state. During this period, infant sleeping during the night gradually increases and maternal sleep generally improves.[34]

Other Definitions Related to Obstetrics

- **Abortion** (ă-BOR-shŏn) **(AB)**: Termination of pregnancy before the fetus is viable. Medically, this term refers to spontaneous miscarriages, as well as elective termination of pregnancy.
- **Ectopic pregnancy** (ek-TOP-ik PREG-năn-sē): Pregnancy occurring outside the uterus, commonly in the Fallopian tube.
- **Gestation** (jĕs-TĀ-shŏn): The period of development during pregnancy.

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- **Gravida** (GRĂV-ĭ-dă): A woman who is or has been pregnant, regardless of outcome.
- **Induction** (in-DŬK-shŏn): A process of bringing on or starting labor through medical interventions such as a membrane sweep and/or the intravenous administration of oxytocin to the mother.
- **Multigravida** (mŭl-tĭ-GRĂV-ĭ-dă): A woman who has been pregnant two or more times regardless of outcome.
- **Multipara** (mŭl-TĬP-ă-ră): A woman who has given multiple births to an offspring after 20 weeks, live or stillborn.
- **Neonate** (NĒ-ō-nāt): An infant from birth to four weeks of age.
- **Nulligravida** (nŭl-ĭ-GRĂV-ĭ-dă): A woman who has never been pregnant.
- **Oligohydramnios** (ŏl-ĭg-ō-hī-DRĂM-nē-ōs): Minimal amniotic fluid within the placental sac that can restrict the fetus from movement and growth.
- **Oxytocin** (ŏk-sē-TŌ-sĭn): A hormone that stimulates contractions during labor and the secretion of milk.
- **Para** (PĂR-ă): A woman who has given birth to an offspring after 20 weeks, live or stillborn.
- **Placenta abruptio** (plă-SENT-ā ă-BRŬP-shē-ō): Premature separation of the placenta from the uterine wall.
- **Placenta previa** (plă-SENT-ā PRĒ-vē-ă): An abnormally low implantation of the placenta on the uterine wall, which can result in hemorrhage. Mothers with placenta previa may require a C-section.
- **Prenatal** (prē-NĀT-ăl): Pertaining to before birth.
- **Stillborn** (STIL-bōrn): The birth of an infant who has died in the uterus.

8.5 Complications of Pregnancy and Delivery

Several complications may occur during pregnancy, labor, delivery, and postpartum.

COMPLICATIONS OF PREGNANCY

There are several complications that can occur during pregnancy that pose health risks to mother and child. Common complications include the following[1]:

- **Gestational diabetes** (jĕs-TĀ-shŏn-ăl dī-ă-BĒ-tĭs): High blood sugar levels that develop in a woman during pregnancy who has not been previously diagnosed with diabetes. After pregnancy, blood sugars typically return to normal although the mother has increased risk of developing type 2 diabetes mellitus later in life.
- **Hyperemesis gravidarum** (HĪ-pĕr-ĕm-Ē-sĭs GRAV-ĭ-dar-ŭm): Severe, persistent vomiting during pregnancy causing dehydration and weight loss. It is more severe than nausea associated with “morning sickness.”
- **Preeclampsia** (prē-ĕ-KLAMP-sē-ă): High blood pressure during pregnancy with additional signs like edema and protein in the urine. If not effectively treated, preeclampsia can evolve into **eclampsia** (ĕ-KLAMP-sē-ă), severe complication characterized by seizures and a risk of

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coma and death.

- **Deep vein thrombosis** (dēp vān throm-BOH-sĭs): The formation of a blood clot in a deep vein, most commonly in the legs.
- **Postpartum hemorrhage** (pōst-PÄR-tŭm HEM-ŏr-ij): Cumulative blood loss greater than 1,000 mL with signs and symptoms of hypovolemia within 24 hours of the birth process, regardless of the route of delivery. **Hypovolemia** (hī-pō-vō-LĒ-mē-ă) is a life-threatening condition where the plasma (liquid portion of the blood) is too low, resulting in the organs not receiving enough oxygenated blood flow. The most common cause of postpartum hemorrhage is lack of effective contraction of the uterus after childbirth.[2]
- **Pregnancy-related death** (PRĔG-năn-sē ri-LĀ-tĭd dĕth): The Centers for Disease Control and Prevention defines a pregnancy-related death as the death of a woman during pregnancy or within one year of the end of pregnancy from a pregnancy complication, a chain of events initiated by pregnancy, or the aggravation of an unrelated condition by the physiologic effects of pregnancy. Most of these pregnancy-related deaths are preventable. It is important for all women of reproductive age to adopt healthy lifestyles (e.g., maintain a healthy diet and weight, be physically active, quit all substance use, prevent injuries) and address any health problems before getting pregnant. A healthy pregnancy begins before conception and continues with prenatal care, along with early recognition and management of complications if they arise.[3]

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3. Centers for Disease Control and Prevention. (2023, April 26). *Preventing pregnancy-related deaths.* Department of Health & Human Services. https://www.cdc.gov/reproductivehealth/maternal-mortality/preventing-pregnancy-related-deaths.html

CONGENITAL ANOMALY

A **congenital anomaly** (kŏn-JĔN-ĭ-tăl ă-NOM-ă-lē) is an abnormality in a baby that is present at birth. Many congenital anomalies are caused by **teratogens** (tĕr-AT-ŏ-jĕnz), substances toxic to a developing fetus. For example, excessive alcohol intake by the mother can cause fetal alcohol spectrum disorder. Maternal diseases during pregnancy can also cause a birth defect or a chronic health problem. Some diseases that are known to potentially have an adverse effect on the fetus include diabetes, cytomegalovirus, toxoplasmosis, rubella, varicella, hypothyroidism, and infections caused by *streptococcus B*. For example, if an unvaccinated mother contracts rubella during the first three months of pregnancy, damage can occur to the baby's eyes, ears, heart, or brain.[4]

Fetal Alcohol Spectrum Disorders

One of the most commonly used teratogens is alcohol. Because half of all pregnancies in the United States are unplanned, it is recommended that women of child-bearing age take great caution against drinking alcohol when not using birth control and when pregnant. Alcohol consumption, particularly during the second month of prenatal development, but at any point during pregnancy, may lead to neurocognitive and behavioral difficulties that can last a lifetime.[5]

There is no acceptable safe limit for alcohol use during pregnancy, but binge drinking (five or more drinks on a single occasion) or having seven or more drinks during a single week places a child at particularly high risk. In extreme cases, alcohol consumption can lead to fetal death, but more

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frequently it can result in **fetal alcohol spectrum disorders** (FĒ-tăl AL-kŏ-hŏl SPEK-trŭm dĭs-ŎR-dĕrz) **(FASD)**. This terminology is now used when looking at the effects of exposure and replaces the term fetal alcohol syndrome. It is preferred because it recognizes that symptoms occur on a spectrum and that all individuals do not have the same characteristics. Children with FASD share certain physical features such as flattened noses, small eye openings, small heads, intellectual developmental delays, and behavioral problems. See Figure 8.9[6] for an image of a child with FASD.[7]

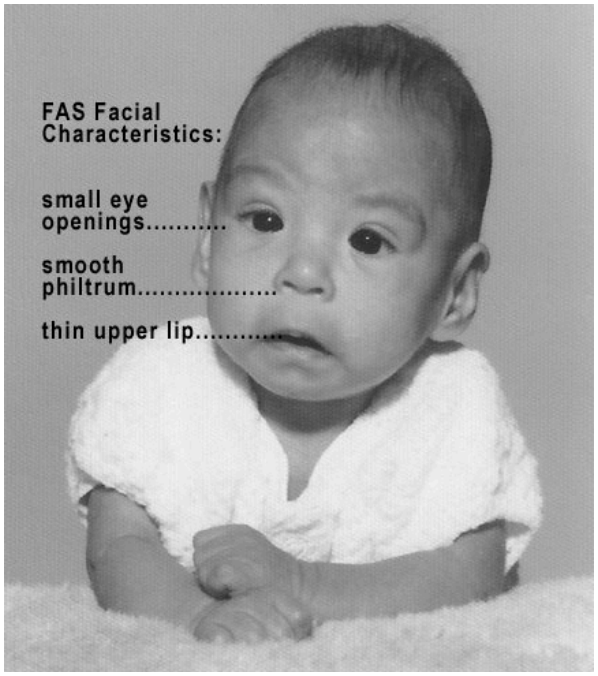

Figure 8.9 Fetal Alcohol Spectrum Disorder

6. "Photo_of_baby_with_FAS.jpg" by Teresa Kellerman is licensed under CC BY-SA 3.0

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PREMATURE LABOR AND PREMATURE INFANT

Preterm labor (PRĒ-tûrm LĀ-bŏr) is defined as labor occurring between 20 and 37 weeks of gestation. There are many potential causes of preterm labor, such as stress, infection, placental abruption, placenta previa, substance use, history of preterm birth or abortion, inadequate prenatal care, smoking, maternal age <18 or >40, poor nutrition, low body mass index, fetal congenital anomaly, fetal growth restriction, oligohydramnios, polyhydramnios, vaginal bleeding, **premature preterm rupture of membranes** (prē-mă-CHŪR prē-tûrm RŬP-chĕr ŏv MEM-brānz) **(PPROM)**, and other environmental factors.[8]

The main concern with premature labor is the prematurity of the infant, which can cause respiratory distress and impaired neurological development. A **premature infant** (prē-mă-CHŪR IN-fănt) refers to an infant who is born before completing 37 weeks of gestation. Treatment of premature labor is based on the gestational age at which the mother presents to the hospital and may include medications to stop labor from progressing, such as magnesium sulfate.[9]

Cerclage (sĕr-KLĂZH) is a procedure typically performed during the second semester of pregnancy to prevent preterm labor and miscarriage. During the procedure, the cervix is sewed shut with sutures to prevent dilation and premature delivery. It is performed in women whose cervix isn't strong enough to stay closed as the pregnancy grows. The suture is removed when the fetus is full-term, which allows vaginal delivery to proceed.[10]

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10. The American College of Obstetricians and Gynecologists. (2021, November).

MISCARRIAGE AND STILLBIRTH

Pregnancy loss is experienced in over ten percent of pregnancies, typically due to chromosomal abnormalities before the 12th week of pregnancy. **Miscarriage** (MĬS-kăr-ĭj) refers to loss of a fetus before the 20th week of pregnancy. It typically causes cramping and bleeding, similar to heavy menses. In some cases, a surgical procedure called dilation and evacuation (D&E) is required. Normal menstrual cycles generally return within a few months.[11]

Stillbirth (STĬL-bûrth), also known as **intrauterine fetal demise** (ĬN-tră-YŪ-tə-rīn FĒT-ăl dĕ-MĪZ), refers to the loss of a fetus after 20 weeks' gestation. About 24,000 babies are stillborn every year in the United States. Although many times the cause of the stillbirth is unknown, there are several potential causes, such as infection, chromosomal abnormalities, placental problems.[12]

Cervical cerclage. https://www.acog.org/womens-health/faqs/cervical-cerclage

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8.6 Medical Specialists, Diagnostic Testing, and Procedures Related to Pregnancy

Medical Specialists

Obstetrics (ŏb-STE-triks) **(OB)** is a medical specialty dealing with pregnancy, childbirth, and postpartum, also known as **puerperium** (pū-ĕr-PĒ-rē-ŭm), the period from delivery until the reproductive organs return to normal (approximately six weeks).

An **obstetrician** (ob-stĕ-TRISH-ăn) is a physician who specializes in obstetrics (OB) and gynecology (GYN) and are commonly referred to as "OB/GYNs."

Midwifery (mĭd-WIF-ĕr-ē) is the practice of assisting in childbirth. A **midwife** (MĬD-wīf) is an individual who practices midwifery. A **certified nurse-midwife** (SĔR-tĭ-fīd NŬRS mĭd-wīf) **(CNM)** is a type of advanced practice registered nurse who has completed advanced education and training. CNMs provide health care to women, including family planning, gynecological checkups, prenatal care, delivery of babies, and postpartum care.

A **pediatrician** (pēd-ē-ă-TRISH-ăn) is a doctor who focuses on the health of infants, children, and adolescents. Pediatric care starts at birth. **Neonatologists** (nē-ō-nă-TOL-ŏ-jĭsts) are physicians who specialize in the care of newborns. Newborns can present a unique set of health challenges that require special medical expertise, especially premature newborns and those with underdeveloped organs.

DIAGNOSTIC TESTING

Amniocentesis

Amniocentesis (am-nē-ō-sen-TĒ-sĭs) is a procedure that removes a small amount of amniotic fluid from the uterus under ultrasound guidance. The fluid is tested for potential fetal abnormalities. See Figure 8.10[1] for an illustration of amniocentesis.

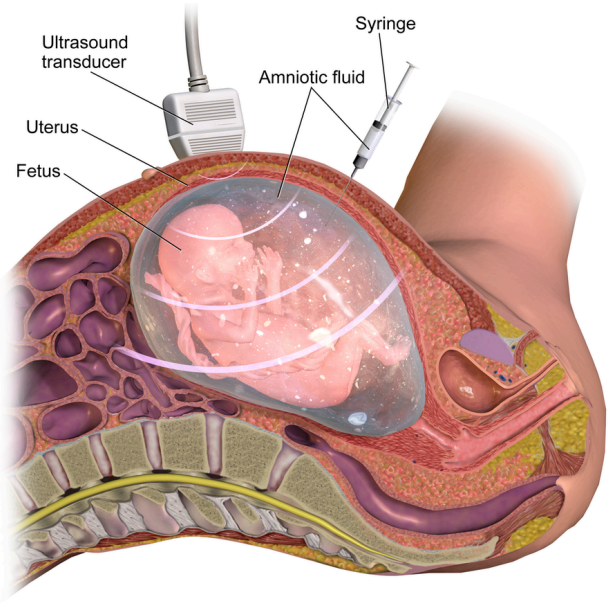

Figure 8.10 Amniocentesis

Chorionic Villus Sampling

Chorionic villus sampling is performed to diagnose chromosome problems or other genetic diseases in a fetus by checking chorionic villi, the tiny finger-like growths found in the placenta. Chorionic villi contain the same chromosomes as the fetus, so this test can show if an extra chromosome, missing

1. "Amniocentesis.png" by BruceBlaus is licensed under CC BY-SA 4.0

chromosomes, or damaged chromosomes are present that can cause serious health problems.[2]

Contraction Stress Test

A **contraction stress test** (kŏn-TRAK-shŏn STRĒS test) involves monitoring the baby's heart rate while inducing contractions in the mother. This diagnostic test may be performed if there are abnormal results from a nonstress test. Fetal heart monitoring is used while oxytocin is administered to the mother, causing the uterus to contract. Every contraction means the baby gets less blood and oxygen for a short while. A contraction stress test shows how the baby's heart rate reacts to the stress of contractions. If the baby's heart rate slows down rather than speeds up after a contraction, the baby may have problems during labor. If the results are abnormal, delivery may be induced.[3] **Induction** (in-DUK-shŏn) is when a provider administers medicine or uses other methods to artificially start labor before it begins naturally.

Noninvasive Prenatal Testing

Noninvasive prenatal testing (nŏn-ĭn-VĀ-sĭv prē-NĀ-tăl TĔS-tĭng), sometimes called noninvasive prenatal screening, is a method of determining the risk that the fetus will be born with certain genetic abnormalities. This testing analyzes small fragments of DNA that are circulating in a pregnant woman's blood. It is considered noninvasive because it requires drawing blood only from the pregnant woman and does not pose any risk to the fetus.[4]

2. Medline Plus. (2021). *Chorionic villus sampling (CVS)*. https://medlineplus.gov/lab-tests/chorionic-villus-sampling-cvs/
3. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. Monitoring your baby before labor; [reviewed 2022, Apr 19; cited 2023, Oct 20]. https://medlineplus.gov/ency/patientinstructions/000485.htm
4. Medline Plus. (2021). *What is noninvasive prenatal testing and what disorders*

Nonstress Test

A **nonstress test** (NŎN-strĕs tĕst) is a safe, noninvasive test that measures the heart rate of the fetus as it moves within the uterus. In most healthy babies, the fetal heart rate increases during their movement in the uterus. If nonstress test results show the fetal heart rate is not normal, it may mean that the baby is not getting enough oxygen. If this happens, additional testing may be performed, or delivery may be induced.

Pelvic Ultrasound

A pelvic ultrasound, also called **pelvic sonography** (PEL-vik sō-NOG-ră-fē), is the process of recording sound waves pertaining to the pelvis. It is performed during pregnancy to check the growth and wellness of the fetus and to estimate a due date. A prenatal ultrasound evaluation of fetal well-being is also referred to as a **biophysical profile** (BĪ-ō-FĬZ-ĭ-kăl PRO-fīl).

PROCEDURES

Fetal Heart Monitoring

Fetal heart monitoring (FĒ-tăl HÄRT MON-ĭt-or-ing) refers to tracking the heart rate of the fetus. The most common form of monitoring is external electronic fetal monitoring. Sensors are strapped to the mother's abdomen, and instruments record the baby's heartbeat. If the mother is in labor, the contractions are also monitored to see how the baby is responding to the contractions.[5]

can it screen for? https://medlineplus.gov/genetics/understanding/testing/nipt/

5. Familydoctor.org. (2017, October 20). *Monitoring baby's heart rate during*

Internal monitoring uses an electrode attached to a wire that is placed directly on the baby's scalp to monitor the heartbeat. The electrode is threaded through the cervix and into the uterus, where it is attached to the baby's scalp. A small tube can also be inserted to measure contractions. The two devices can provide more accurate measurements of the baby's heartbeat and the mother's contractions.[6]

In Vitro Fertilization

In vitro fertilization (in VĪ-trō FĚR-tĭ-lĭ-ZĀ-shŏn) **(IVF)** is an assisted reproductive technology. There are many different indications for IVF. For example, a woman may produce normal eggs, but the eggs cannot reach the uterus because the uterine tubes are blocked or otherwise compromised. A man may have a low sperm count, low sperm motility, sperm with an unusually high percentage of morphological abnormalities, or sperm that are incapable of penetrating the zona pellucida of an egg. There are five basic steps of IVF[7]:

- **Stimulation** (STĬM-yū-LĀ-shŏn) (also called superovulation): Medicines, called fertility drugs, are given to the woman to boost egg production.
- **Egg retrieval** (Ĕg rĭ-TREE-vəl): A minor surgery, called follicular aspiration, is done to remove the eggs from the woman's ovaries. The health care provider inserts a thin needle through the vagina into the ovary and into

labor. American Academy of Family Physicians. https://familydoctor.org/monitoring-babys-heart-rate-labor/

6. Familydoctor.org. (2017, October 20). *Monitoring baby's heart rate during labor*. American Academy of Family Physicians. https://familydoctor.org/monitoring-babys-heart-rate-labor/

7. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; c1997-2023. In vitro fertilization (IVF); [reviewed 2022, Jan 10; cited 2023, Oct 20]. https://medlineplus.gov/ency/article/007279.htm

the follicles containing mature eggs. The needle is connected to a suction device, which pulls the eggs and fluid out of each follicle, one at a time. If a woman does not produce any eggs, donated eggs may be used.

- **Insemination** (in-sem-ĭ-NĀ-shŏn) and **fertilization** (fĕr-tĭ-lī-ZĀ-shŏn): Sperm is mixed with the best quality eggs, called insemination. The sperm most often enters (fertilizes) an egg a few hours after insemination. If the chance of fertilization is low, the sperm may be directly injected into the egg, called intracytoplasmic sperm injection.
- **Embryo culture** (ĔM-brē-ō Kŭl-chər): The retrieved egg is maintained and monitored under stable conditions promoting cell division until it is ready to be transferred into the uterus. The process usually takes 3-5 days.
- **Embryo transfer** (ĔM-brē-ō TRĂNS-fər): Embryos are placed into the woman's uterus 3 to 5 days after egg retrieval and fertilization. The doctor inserts a thin tube containing the embryos into the vagina, through the cervix, and up into the uterus. If an embryo implants in the endometrium and grows, pregnancy results. More than one embryo may be placed into the uterus at the same time, which can lead to twins, triplets, or more. Unused embryos may be frozen and implanted or donated at a later date.

8.7 Obstetrics Learning Activities

Interactive Learning Activity: Study the obstetrics medical terms discussed in this chapter.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=312#h5p-182

Interactive Learning Activity: Test your knowledge on terms related to obstetrics.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=312#h5p-44

Interactive Learning Activity: Using the sample documentation provided, drag the terms on the right to their appropriate spaces within the documentation.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=312#h5p-43

8.8 Glossary

Abortion (ă-BOR-shŏn) (AB): The termination of pregnancy by the removal or expulsion of an embryo or fetus before it is viable. (Chapter 8.4)

Amniocentesis (am-nē-ō-sen-TĒ-sĭs): A procedure that removes and tests amniotic fluid for fetal abnormalities. (Chapter 8.6)

Apgar score (AP-gar skōr): A quick test performed on a newborn baby at 1 and 5 minutes after birth to assess the baby's heart rate, respiration, muscle tone, skin color, and reflexes. (Chapter 8.4)

Biophysical profile (BĪ-ō-FĬZ-ĭ-kăl PRO-fīl): Fetal well-being assessment combining nonstress test results and ultrasound findings. (Chapter 8.6)

Braxton-Hicks (BRAX-tŏn HIKS): Irregular, often painless contractions that occur throughout pregnancy, also known as false labor. (Chapter 8.4)

Breech (brēch): A fetal position where the buttocks or feet are positioned to be delivered first rather than the head. (Chapter 8.4)

Cephalic presentation (sĕ-FAL-ĭk prē-zen-TĀ-shŏn): The common childbirth position where the baby's head comes out first. (Chapter 8.4)

Cephalic version (sĕ-FAL-ĭk VĔR-zhŏn): A procedure used to turn a fetus from a breech position or side-lying position into a head-down (cephalic) position before labor begins. (Chapter 8.4)

Cerclage (sĕr-KLĂZH): A procedure in which the cervix is stitched shut to prevent dilation and premature delivery. (Chapter 8.5)

Certified nurse-midwife (SĔR-tĭ-fīd NŬRS mĭd-wīf) (CNM): An advanced practice registered nurse who provides prenatal, delivery, postpartum and gynecological care. (Chapter 8.6)

Cesarean section (si-ZAR-ē-ăn SEK-shŏn) (C section): A surgical procedure in which one or more incisions are made through a mother's abdomen (laparotomy) and uterus (hysterotomy) to deliver one or more babies. (Chapter 8.4)

Colostrum (kŏ-LOS-trŭm): A form of milk produced by the mammary glands of mammals in late pregnancy and the few days after giving birth. (Chapter 8.4)

Conception (kŏn-SEP-shŏn): The moment when a sperm cell successfully fertilizes an ovum, leading to the beginning of a pregnancy. (Chapter 8.4)

Congenital anomaly (kŏn-JĔN-ĭ-tăl ă-NOM-ă-lē): A structural, functional, or metabolic abnormality present at birth that can lead to physical or mental disabilities. (Chapter 8.5)

Contraction stress test (kŏn-TRAK-shŏn STRĒS test): A test that monitors the fetal heart rate in response to induced contractions. (Chapter 8.6)

Crowning (KROWN-ĭng): The appearance of the baby's head at the vaginal opening during childbirth. (Chapter 8.4)

Deep vein thrombosis (dēp vān throm-BOH-sĭs) (DVT): The formation of a blood clot in a deep vein, predominantly in the legs, which can be a risk in pregnancy due to increased blood clotting. (Chapter 8.5)

Eclampsia (ĕ-KLAMP-sē-ă): A severe complication of preeclampsia, involving seizures or coma in the pregnant woman. (Chapter 8.5)

Ectopic pregnancy (ek-TOP-ik PREG-năn-sē): A pregnancy in which the fertilized egg implants outside the uterus, often in the Fallopian tube. (Chapter 8.4)

Egg retrieval (Ĕg rĭ-TREE-vəl): A minor surgery to collect mature eggs from the ovaries. (Chapter 8.6)

Embryo (EM-brē-ō): An organism in early stages of development, specifically from day 16 through week 8 of human pregnancy. (Chapter 8.4)

Embryo culture (ĔM-brē-ō Kŭl-chər): Maintaining and monitoring embryos until ready for transfer in IVF. (Chapter 8.6)

Embryo transfer (ĔM-brē-ō TRĂNS-fər): Placing embryos into the uterus in IVF. (Chapter 8.6)

Endometrium (en-dō-MĒ-trē-ŭm): The mucous membrane lining the uterus, which thickens during the menstrual cycle in preparation for possible implantation of an embryo. (Chapter 8.4)

Episiotomy (ĕp-ĭ-zē-OT-ŏ-mē): A surgical incision of the vulva to widen the vaginal opening to prevent ripping or tearing of the perineum during delivery. (Chapter 8.4)

Fertilization (fĕr-tĭ-lī-ZĀ-shŏn): The union of a male sperm cell and a female egg cell to form a zygote, initiating the development of a new individual. (Chapter 8.4, Chapter 8.6)

Fetal alcohol spectrum disorders (FĒ-tăl AL-kŏ-hŏl SPEK-trŭm dĭs-ŎR-dĕrz) (FASD): The effects caused by maternal alcohol intake during pregnancy, ranging from physical, mental, and behavioral disabilities. (Chapter 8.5)

Fetal heart monitoring (FĒ-tăl HÄRT MON-ĭt-or-ing): Tracking the fetal heart rate during pregnancy and labor. (Chapter 8.6)

Fetus (FĒ-tŭs): A developing human from roughly the end of the eighth week after conception to the moment of birth. (Chapter 8.4)

Gestation (jĕs-TĀ-shŏn): The period of development of the fetus in the mother's uterus, typically lasting from conception to birth. (Chapter 8.4)

Gestational diabetes (jĕs-TĀ-shŏn-ăl dī-ă-BĒ-tĭs): A form of diabetes that occurs only during pregnancy and usually resolves after delivery. (Chapter 8.5)

Gravida (GRĂV-ĭ-dă): A pregnant woman; often used in medical contexts to specify a woman's number of pregnancies. (Chapter 8.4)

Human chorionic gonadotropin (hū-MĂN kor-ē-ON-ĭk gō-năd-ō-TRO-pin): A hormone produced during pregnancy by cells that will eventually form the placenta. (Chapter 8.4)

Hyperemesis gravidarum (HĪ-pĕr-ĕm-Ē-sĭs GRAV-ĭ-dar-ŭm): A severe form of nausea and vomiting in pregnancy that can lead to dehydration and weight loss. (Chapter 8.5)

Hypovolemia (hī-pō-vō-LĒ-mē-ă): A decrease in the volume of blood plasma, which can be a critical condition following postpartum hemorrhage. (Chapter 8.5)

In vitro fertilization (in Vī-trō FĚR-tĭ-lĭ-ZĀ-shŏn) (IVF): An assisted reproductive technology in which eggs are fertilized outside the body and transferred to the uterus. (Chapter 8.6)

Induction (in-DŬK-shŏn): The process of artificially initiating childbirth by stimulating uterine contractions. (Chapter 8.4, Chapter 8.6)

Insemination (in-sem-ĭ-NĀ-shŏn): Mixing eggs with sperm in IVF. (Chapter 8.6)

Intrauterine fetal demise (ĬN-tră-YŪ-tə-rīn FĒT-ăl dĕ-MĪZ): Fetal death that occurs after 20 weeks of pregnancy. (Chapter 8.5)

Lactation (lăk-TĀ-shŏn): The secretion of milk by the mammary glands. (Chapter 8.4)

Lanugo (lă-NOO-gō): Fine, soft hair, especially that which covers the body and limbs of a human fetus or newborn. (Chapter 8.4)

Last menstrual period (last MEN-strū-ăl PĒ-rē-ŏd) (LMP): The first day of a woman's last menstrual cycle, used as a marker to estimate the date of conception. (Chapter 8.4)

Lochia (LŌ-kē-ă): Vaginal discharge after giving birth (puerperium), containing blood, mucus, and uterine tissue. (Chapter 8.4)

Meconium (mē-KŌ-nē-ŭm): The first stool of a newborn. (Chapter 8.4)

Meconium aspiration (mĕ-KŌ-nē-ŭm AS-pĭ-RĀ-shŏn): A medical condition affecting newborns in which meconium is ingested into their lungs in utero. (Chapter 8.4)

Midwife (MĬD-wīf): An individual who practices midwifery. (Chapter 8.6)

Midwifery (mĭd-WIF-ĕr-ē): The practice of assisting women in childbirth. (Chapter 8.6)

Miscarriage (MĬS-kăr-ĭj): Loss of a fetus before the 20th week of pregnancy. (Chapter 8.5)

Mitosis (mī-TŌ-sĭs): A type of cell division that results in two daughter cells each having the same number and kind of chromosomes as the parent nucleus. (Chapter 8.4)

Multigravida (mŭl-tĭ-GRĂV-ĭ-dă): A woman who has been pregnant more than once. (Chapter 8.4)

Multipara (mŭl-TĬP-ă-ră): A woman who has given birth to more than one child. (Chapter 8.4)

Neonate (NĒ-ō-nāt): A newborn child, specifically within the first four weeks after birth. (Chapter 8.4)

Neonatologists (nē-ō-nă-TOL-ŏ-jĭsts): Physicians who specialize in the medical care of newborns. (Chapter 8.6)

Noninvasive prenatal testing (nŏn-ĭn-VĀ-sĭv prē-NĀ-tăl TĔS-tĭng): A blood test of the mother to determine risk of fetal genetic abnormalities. (Chapter 8.6)

Nonstress test (NŎN-strĕs tĕst): A test that monitors the fetal heart rate in response to fetal movement. (Chapter 8.6)

Nulligravida (nŭl-ĭ-GRĂV-ĭ-dă): A woman who has never been pregnant. (Chapter 8.4)

Obstetrician (ob-stĕ-TRISH-ăn): A physician who specializes in obstetrics (OB) and gynecology (GYN). (Chapter 8.6)

Obstetrics (ŏb-STE-triks) (OB): A medical specialty concerning care of the mother and fetus during pregnancy, childbirth, and immediately after childbirth. (Chapter 8.1, Chapter 8.6)

Oligohydramnios (ŏl-ĭg-ō-hī-DRĂM-nē-ōs): A condition in pregnancy characterized by a deficiency in amniotic fluid, which can compromise the fetus's development. (Chapter 8.4)

Oogenesis (ō-ŏ-JEN-ĕ-sĭs): The process in female reproduction where ova (egg cells) are produced in the ovaries. (Chapter 8.4)

Oxytocin (ŏk-sē-TŌ-sĭn): A hormone that causes the uterus to contract during labor and stimulates the mammary glands to release milk. (Chapter 8.4)

Para (PĂR-ă): A term used in obstetrics to indicate the number of live births a woman has had. (Chapter 8.4)

Parturition (păr-tū-RĬSH-ŭn): The act of giving birth; the process of childbirth. (Chapter 8.4)

Pediatrician (pēd-ē-ă-TRISH-ăn): A doctor who focuses on the health of infants, children, and adolescents. (Chapter 8.6)

Pelvic sonography (PEL-vik sō-NOG-ră-fē): An ultrasound of the pelvic region, used during pregnancy to evaluate fetal growth and well-being. (Chapter 8.6)

Perineum (pĕr-ĭ-NĒ-ŭm): The area between the anus and the vulva in females, and between the anus and the scrotum in males. (Chapter 8.4)

Peripartum depression (pĕr-ĭ-PĂR-tŭm di-PRESH-ŭn): Depression that occurs during pregnancy or within four weeks of childbirth. (Chapter 8.4)

Placenta (plă-SEN-tă): An organ that develops in the uterus during pregnancy, providing oxygen and nutrients to the growing baby and removing waste products. (Chapter 8.4)

Placenta abruptio (plă-SENT-ā ă-BRŬP-shē-ō): A condition in which the placenta separates from the wall of the uterus prematurely during pregnancy. (Chapter 8.4)

Placenta previa (plă-SENT-ā PRĒ-vē-ă): A condition in which the placenta

covers the cervix, often leading to severe bleeding before or during delivery. (Chapter 8.4)

Postpartum (pōst-PÄR-tŭm): The period after childbirth when the mother's body, including hormone levels and uterus size, returns to a pre-pregnancy state. (Chapter 8.4)

Postpartum hemorrhage (pōst-PÄR-tŭm HEM-ŏr-ij): Heavy bleeding after giving birth, which can be a serious complication. (Chapter 8.5)

Preeclampsia (prē-ĕ-KLAMP-sē-ă): A pregnancy complication characterized by high blood pressure and signs of damage to another organ system, often the kidneys. (Chapter 8.5)

Pregnancy-related death (PRĔG-năn-sē ri-LĀ-tĭd dĕth): The death of a woman during pregnancy, childbirth, or shortly after, due to complications from the pregnancy. (Chapter 8.5)

Premature infant (prē-mă-CHŪR IN-fănt): An infant born before completing 37 weeks of gestation. (Chapter 8.5)

Premature preterm rupture of membranes (prē-mă-CHŪR prē-tûrm RŬP-chĕr ŏv MEM-brānz) (PPROM): Rupture of the amniotic sac before 37 weeks of pregnancy. (Chapter 8.5)

Prenatal (prē-NĀT-ăl): Pertaining to the period before birth, during pregnancy. (Chapter 8.4)

Preterm labor (PRĒ-tûrm LĀ-bŏr): Labor occurring between 20 and 37 weeks of gestation. (Chapter 8.5)

Puerperium (pū-ĕr-PĒ-rē-ŭm): The period from delivery until the reproductive organs return to normal, approximately six weeks. (Chapter 8.6)

Quickening (KWĬK-ĕn-ĭng): The first feeling of movement of the fetus in utero, typically experienced by the mother around 16 to 20 weeks of pregnancy. (Chapter 8.4)

Stillbirth (STĬL-bûrth): Loss of a fetus after 20 weeks' gestation, also called intrauterine fetal demise. (Chapter 8.5)

Stillborn (STIL-bōrn): The birth of a fetus that has died in the uterus, typically after surviving at least the first 28 weeks of pregnancy. (Chapter 8.4)

Stimulation (STĬM-yū-LĀ-shŏn): Also called superovulation, this therapy refers to administering fertility medication to boost egg production. (Chapter 8.6)

Teratogens (tĕr-AT-ŏ-jĕnz): Agents that cause malformations in a developing embryo, including alcohol, drugs, diseases, chemicals, and environmental exposures. (Chapter 8.4, Chapter 8.5)

Trimesters (TRĪ-mĕs-tĕrz): Three periods of approximately three months each, into which a typical pregnancy is divided for medical purposes. (Chapter 8.4)

Umbilical cord (ŭm-BĬL-ĭ-kăl kŏrd): A flexible cord-like structure containing blood vessels, connecting the fetus to the placenta. (Chapter 8.4)

Vernix (VĚR-nĭks): A greasy deposit covering the skin of a baby at birth. (Chapter 8.4)

Zygote (ZĪ-gōt): The initial cell formed when a sperm cell fertilizes an ovum, representing the earliest developmental stage of the embryo. (Chapter 8.4)

PART IX

CHAPTER 9 CARDIOVASCULAR SYSTEM TERMINOLOGY

9.1 Cardiovascular System Introduction

Learning Objectives

- Apply the rules of medical language to build, analyze, spell, pronounce, abbreviate, and define terms as they relate to the cardiovascular system
- Identify meanings of key word components of the cardiovascular system
- Categorize diagnostic, therapeutic, procedural, or anatomic terms related to the cardiovascular system
- Use terms related to the cardiovascular system
- Use terms related to the diseases and disorders of the cardiovascular system

Introduction to the Cardiovascular System

The cardiovascular system consists of the heart and a complex network of arteries and veins. The heart serves as a pump to transport blood throughout the body. The healthy functioning of the cardiovascular system is foundational to the health of all other body systems because the transportation of blood directly impacts the cellular functioning of all tissues and organs.

This chapter will review common word components related to the cardiovascular system to assist learners in analyzing, building, and defining

medical terms. Other terms, whose definitions cannot be easily built from word components, will be described in context based on the anatomy and physiology of the cardiovascular system and common diseases and disorders. Medical specialists, diagnostic tests, and procedures related to the cardiovascular system will also be discussed.

View the following YouTube video[1] on the heart: The Heart, Part 1 – Under Pressure: Crash Course Anatomy & Physiology #25

1. CrashCourse. (2015, July 6). *The heart, Part 1 – Under pressure: Crash Course Anatomy & Physiology #25 [Video*]. YouTube. All rights reserved. https://youtu.be/X9ZZ6tcxArI?si=lDbroqj9mvfnGdar

9.2 Word Components Related to the Cardiovascular System

This section will describe common word components related to the cardiovascular system. These word components help build definitions for many medical terms. Other common prefixes are described in Chapter 1.3, and common suffixes are described in Chapter 1.5.

COMMON PREFIXES RELATED TO THE CARDIOVASCULAR SYSTEM

- **a-**: Absence of, without
- **bi-**: Two
- **brady-**: Slow
- **dys-**: Bad, abnormal, painful, difficult
- **endo-**: Within, in
- **epi-**: On, upon, over
- **hyper-**: Above, excessive
- **hypo-**: Below, deficient
- **inter-**: Between
- **pan-**: All, total
- **peri-**: Surrounding, around
- **poly-**: Excessive, over, many
- **tachy-**: Fast, rapid
- **tri-**: Three

COMMON WORD ROOTS WITH A COMBINING VOWEL RELATED TO THE CARDIOVASCULAR SYSTEM

- **angi**/o: Vessel
- **aort**/o: Aorta
- **arteri**/o: Artery
- **ather**/o: Yellowish, fatty plaque
- **atri**/o: Atrium
- **card**/i or cardi/o: Heart
- **coron**/o: Heart, crown, or circle
- **ech**/o: Sound
- **electr**/o: Electricity
- **isch**/o: Deficiency, blockage
- **my**/o or **myos**/o: Muscle
- **plasm**/o: Plasma
- **symptomat**/o: Symptom
- **thromb**/o: Clot
- **valv**/o or **valvul**/o: Valve
- **vas**/o: Vessel
- **ven**/o: Vein
- **ventricul**/o: Ventricle

COMMON SUFFIXES RELATED TO THE CARDIOVASCULAR SYSTEM

- **-ac**: Pertaining to
- **-ade**: Process of
- **-al**: Pertaining to

- **-apheresis**: Removal
- **-ar**: Pertaining to
- **-centesis**: Surgical puncture to aspirate fluid
- **-dynia**: Pain
- **-ectomy**: Excision, surgical removal
- **-emia**: Condition of blood
- **-genic**: Producing, originating, causing
- **-gram**: Record, radiographic image
- **-graph**: Instrument used to record
- **-graphy**: Process of recording, radiographic imaging
- **-ia**: Condition of, diseased state, abnormal state
- **-ic**: Pertaining to
- **-ion**: Process
- **-itis**: Inflammation
- **-lgia**: Pain
- **-logist:** Specialist who studies and treats
- **-lysis**: Loosening, dissolution, separating
- **-megaly**: Enlarged, enlargement
- **-oma**: Tumor
- **-osis**: Abnormal condition
- **-ous**: Pertaining to
- **-pathy**: Disease
- **-penia**: Abnormal reduction in number
- **-pexy**: Surgical fixation, suspension
- **-plasty**: Surgical repair
- **-poiesis**: Formation
- **-sclerosis**: Hardening
- **-scope**: Instrument used to view
- **-scopy**: Process of viewing
- **-stasis**: Stop, stopping, controlling
- **-stenosis**: Narrowing, constriction
- **-tomy**: Cut into, incision

9.3 Examples of Cardiovascular Terms Easily Defined By Their Word Components

Here are examples of common medical terms related to the cardiovascular system that can be easily defined by breaking the terms into their word components.

Cardiologist

1. Break down the medical term into word components: **Cardi/o/logist**
2. Label the word components: **Cardi** = WR; **o** = CV; **logist** = S
3. Define the word components: **Cardi** = heart; **logist** = specialist who studies and treats
4. Create a final definition of the medical term: **A specialist who studies and treats diseases of the heart**

Bradycardia

1. Break down the medical term into word components: **Brady/cardi/a**

2. Label the word components: **Brady** = P; **card** = WR; **ia** = S
3. Define the word components: **Brady** = slow; **card** = heart; **ia**=condition of
4. Create a final definition of the medical term: **Condition of slow heart (rate)**

Electrocardiogram

1. Break down the medical term into word components: **Electr/o/cardi/o/gram**
2. Label the word components: **Electr** = WR; **o** = CV; **cardi** = WR; **o** = CV; **gram** = S
3. Define the word components: **Electr** = electricity; **cardi** = heart; **gram** = record
4. Create a final definition of the medical term: **A record of electrical (activity) of the heart**

Interactive Learning Activity: Practice defining and pronouncing cardiovascular system medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=4355#h5p-144

Interactive Learning Activity: Practice defining and pronouncing cardiovascular system medical terms by breaking them down into word parts.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://wtcs.pressbooks.pub/medterm/?p=4355#h5p-157

You can also print these flashcard activities as a Chapter 9 Student Companion Worksheet and check your answers with this Answer Key.

9.4 Anatomy of the Cardiovascular System

THE HEART

The heart is located within the thoracic cavity, medially between the lungs, and in the space known as the mediastinum. The great veins (the superior and inferior venae cavae) and the great arteries (the aorta and pulmonary artery) are attached to the superior surface of the heart called the base. See Figure 9.1[1] for an illustration of the heart in the thoracic cavity.[2] The inferior tip of the heart, the **apex** (Ā-peks), lies just to the left of the sternum between the junction of the fourth and fifth ribs. Health care professionals must know the position of the heart when placing a **stethoscope** (STETH-ŏ-skōp) to listen to heart and lung sounds, referred to as **auscultation** (os-kŭl-TĀ-shŏn).[3]

1. "2001_Heart_Position_in_ThoraxN.jpg" by OpenStax College is licensed under CC BY 3.0

2. "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

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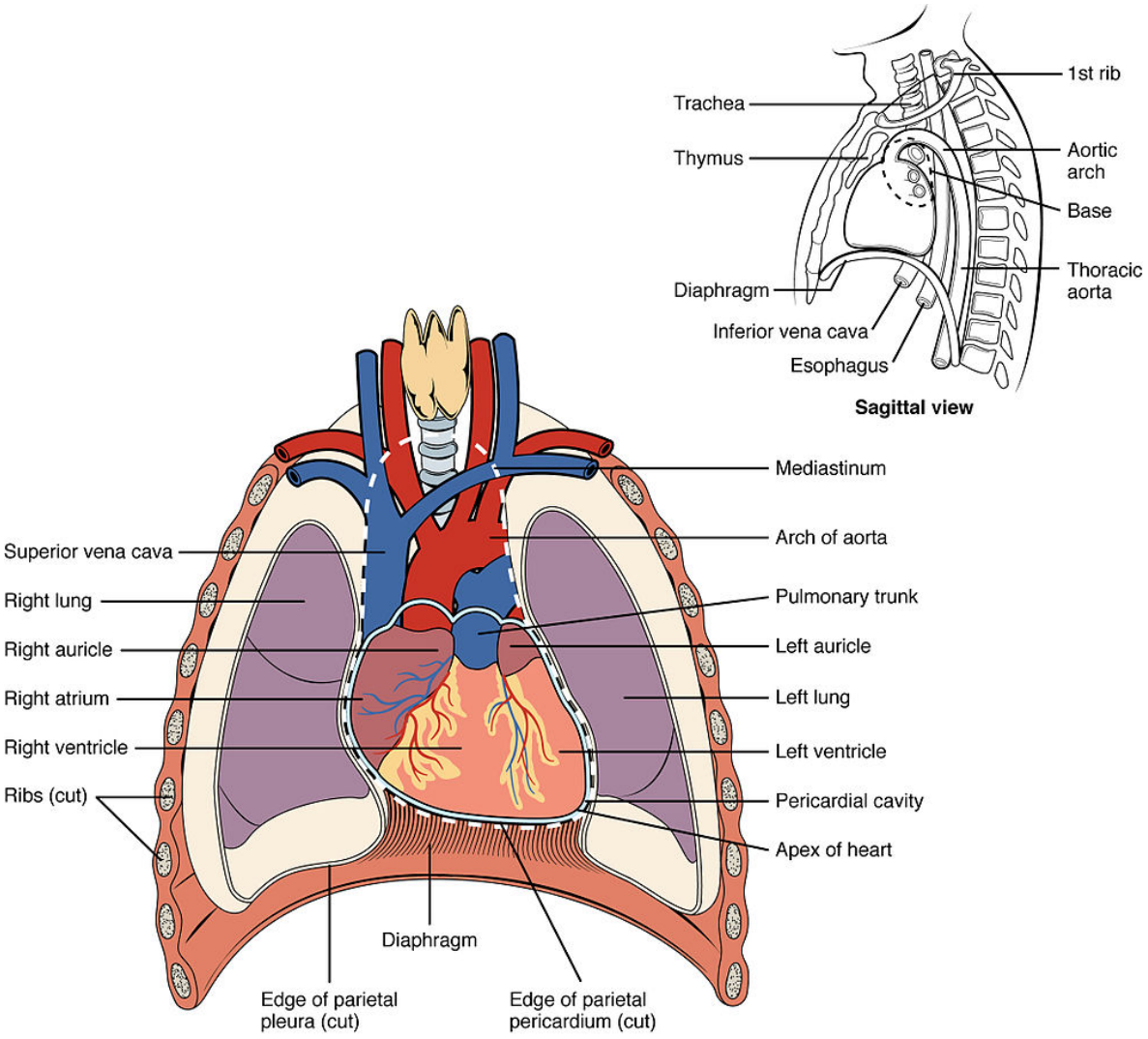

Figure 9.1 Position of the Heart in the Thoracic Cavity

See Figure 9.2[4] for an illustration of the heart. The heart consists of four chambers: two atria and two ventricles. The right atrium receives deoxygenated blood from the body via the inferior and superior vena cava. The right ventricle pumps the deoxygenated blood to the lungs. The left

4. "Heart_diagram-en.svg.png" by ZooFari is licensed under CC BY-SA 3.0

atrium receives oxygenated blood from the lungs and propels it into the left ventricle. The left ventricle pumps blood to the rest of the body.[5]

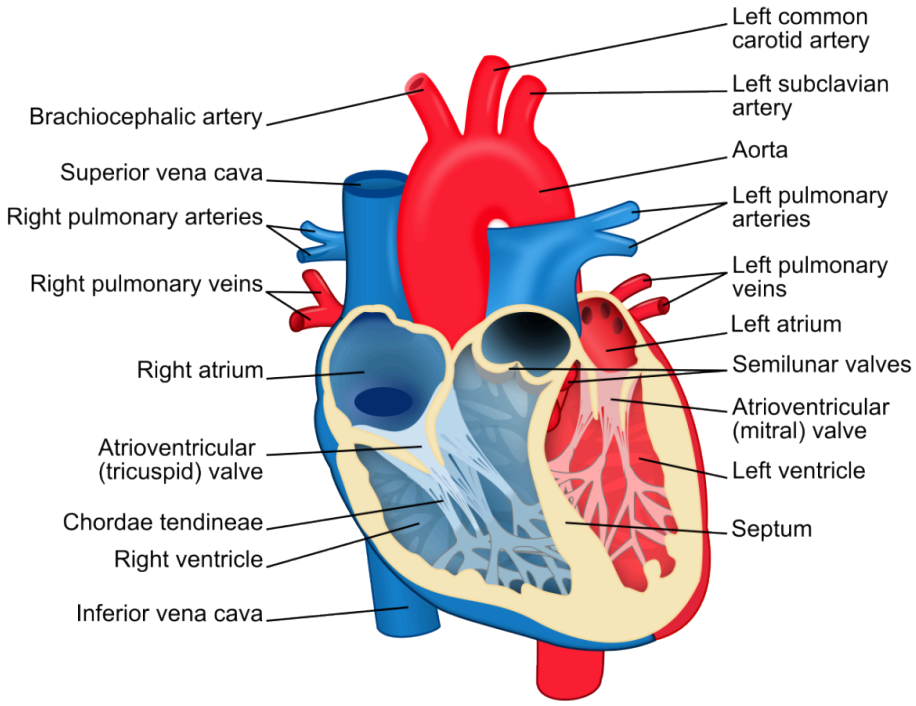

Figure 9.2 Anatomy of the Heart

BLOOD VESSELS

After blood is pumped out of the left ventricle through the aorta, it is carried throughout the body via systemic arteries. An **artery** (AR-tĕr-ē) is a blood vessel that carries blood away from the heart. Arteries branch into ever-smaller vessels called **arterioles** (ar-TĒR-ē-ōlz) and eventually into tiny vessels

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