

The Language of Medical Terminology

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Introduction

Welcome to the *Language of Medical Terminology* OER

It is very exciting to learn a new language, and medical terminology, which is the focus of this textbook, is essentially its own language. This resource was designed for an introductory medical terminology course for medical office assistants and hospital unit clerks at NorQuest College; however, it is likely to be useful for individuals in other healthcare professions as well.

To assist with learning the complex language of medical terminology, each chapter has embedded H5P activities, including a final chapter review. We have also included content on abbreviations, diagnostic procedures, medical professionals, and body systems. We hope that this textbook will provide a thorough overview of not only medical terminology, but also other topics in the healthcare setting.

How to Use This OER

Learning medical terminology requires a lot of commitment. In order to get the full benefits of this textbook, daily review is important, and using the review exercises and activities in the chapters will help you learn and remember the content. In addition, we suggest creating flashcards with suffixes, prefixes, and combining forms to help you recall what you have learned.

For instructors, our hope is that you can use the content and adapt it as necessary for your own programs and courses.

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- Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2013). *Anatomy and physiology*. OpenStax. <https://openstax.org/details/books/anatomy-and-physiology> licensed under [CC BY 4.0](#)
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CHAPTER I

BASIC WORD STRUCTURE

1.1 Introduction to Basic Word Structure

Learning Objectives

By the end of this chapter, you should be able to

1. Define the component parts of medical terms
2. Identify combining forms in medical terms
3. Identify prefixes and define their meaning
4. Identify suffixes and define their meaning
5. Apply an understanding of component parts to define medical terms

Chapter Overview

Medical language may appear to be very complex; however, most medical terms can be understood through a process of breaking them down into their component parts. Being able to identify the component parts, understand their meaning, and bring the terms together will demystify medical language and make it much easier to understand. Many healthcare professions use medical language on a daily basis, whether to diagnose a patient, interpret test results, or consult with other healthcare professionals. If you are working in health care, it is essential that you understand common medical terms so you know what is being communicated.

This chapter will introduce you to common medical terms used in various healthcare settings. We will begin with the basic component parts of medical terms, language rules, combining forms, and prefixes and suffixes. Then we will bring it all together with some review activities at the end of the chapter.

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1.2 Basic Word Structure

Word Parts

Medical terms are built from word parts, which are also called **component parts**. These parts are **prefix**, **word root**, **suffix**, and **combining form vowel**. When a word root is put together with a combining form vowel, the word part is referred to as a **combining form**.

Below you will see definitions of the component parts of medical terms. Throughout this chapter, and the book as a whole, you will learn many different examples of these word parts and apply that knowledge through the activities provided.

Key Concept

- A **prefix** goes at the front of the term and changes the meaning.
 - Example: **dys-** means “bad,” “painful,” “difficult,” or “abnormal”
 - Notice that a prefix always has a “-” after it when not in a medical term. This lets you know that the prefix needs something after it. Not all medical terms have a prefix.
- A **suffix** goes at the end of the term and changes the meaning.
 - Example: **-logy** means “study of”
 - Notice that a suffix always has a “-” before it when not in a medical term. This lets you know that the suffix needs something before it. All medical terms have a suffix.
- The **root** gives the essential meaning of the term.
 - Example: **cardi** means “heart”
 - A medical term may have one or more roots. In some rare cases, a term may not have a root because the root is embedded in the suffix.
- A **combining vowel** has no meaning but connects roots to suffixes and roots to other roots.
 - A combining vowel is almost always an **o**, but in some rare cases, it is an **i**.
- A **combining form** is the combination of the root and the combining vowel.
 - Example: Combining the root **cardi** with a combining vowel creates **cardi/o**.

Once you become more familiar with all the common word parts, you will be able to use this knowledge to break

down any medical term into its component parts and determine its meaning. Although you have just started learning medical terminology, the example below demonstrates how a medical term can be broken apart so you can understand its meaning.

Example

The medical term, **pericardium** can be broken into the following components parts:

peri/cardi/um

The prefix **peri-** means “surrounding,” the root **cardi** means “heart,” and **-um** is a suffix that means “structure.” If you put it all together, the term **pericardium** means “a structure surrounding the heart.”

Exercise



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1.3 Medical Language Rules

Language Rules for Building Medical Terms

There are a few rules that should be followed when interpreting and writing medical terms. It is important to memorize these rules in order to prevent errors. It is also important to note that with any language, there are always exceptions to the rules. Once you start to build a medical vocabulary and become proficient at using it, understanding medical terminology will become much easier.

Since you are at the beginning of building your medical terminology knowledge base, it is best to be literal when learning medical terms. Later, when you become more proficient at using medical terminology, the initial awkwardness will disappear. For example, suffixes will no longer be stated and will be assumed, like the literal definition of **intravenous**, which is “pertaining to within the vein.” As you become more familiar with medical terminology, you will read this as “within the vein.” So let’s begin by learning the language rules for medical terminology.

Language Rules

Rule 1: When joining two combining forms, **keep the combining form vowel**.

Rule 2: When joining a combining form with a suffix that begins with a consonant, **keep the combining form vowel**.

Example

gastr/o/enter/o/logy – “the study of the stomach and intestines”

- Following **Rule 1**, when we join the combining form **gastr/o** (meaning “stomach”) with the combining form **enter/o** (meaning “intestines”), we keep the combining form vowel **o**.
- Following **Rule 2**, when we join the combining form **enter/o** (meaning “intestines”) with the suffix **-logy** (which starts with a consonant and means “the study of”), we keep the combining form vowel **o**.

Rule 3: When joining a combining form with a suffix that begins with a vowel, **drop the combining form vowel**.

Rule 4: A prefix goes at the beginning of the word, and **no combining form vowel is used**.

Example

intra/ven/ous – “pertaining to within the vein”

- Following **Rule 3**, notice that when combining the combining form **ven/o** (meaning “vein”) with the suffix **-ous** (which starts with a vowel and means “pertaining to”), we drop the combining form vowel **o**.
- Following **Rule 4**, the prefix **intra-** (meaning “within”) is at the beginning of the medical term with no combining form vowel used.

Rule 5: When defining a medical word, **start with the suffix** (end of the term), then **work from left (the start of the term) to right**, stating the word parts. You may need to add filler words. As long as the filler word does not change the meaning of the term, you may use it for the purpose of building a medical vocabulary. Once you start to apply the word in the context of a sentence, it will be easier to decide which filler word(s) to choose.

Example

intra/ven/ous – “pertaining to within the vein” or “pertaining to within a vein”

- Following **Rule 5**, start with the suffix **-ous** (meaning “pertaining to”), then work from left to right starting with the prefix **intra-** (meaning “within”) and the combining form **ven/o** (meaning “vein”).
- Notice that we have used two different definitions that mean the same thing.
- In these examples, we do not have the context of a full sentence. For the purpose of building a medical terminology foundation, either definition of **intravenous** is acceptable.

Exercises





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1.4 Combining Forms

Combining forms are the combination of the root and the combining vowel. The root gives the essential meaning of the medical term. The combining vowel is usually an **o** but occasionally an **i**.

The following tables go through some of the most common combining forms, their meaning, and an example of a medical term that uses the combining form. Illustrations, key concept textboxes, and review questions are included to help you better understand the combining forms. It is very important that you become familiar with all of them. Making flashcards and reviewing them daily is very important when learning a new language.

Table 1.1. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
abdomin/o	abdomen	abdominal
aden/o	gland	adenoma
amni/o	amnion sac	amniocentesis
an/o	anus	anal
append/o	appendix	appendectomy
angi/o	vessel	angiogram
arteri/o	artery	arteriosclerosis
ather/o	plaque	atherosclerosis
arthr/o	joint	arthritis
axill/o	armpit	axillary
bi/o	life	biology
bronch/o	bronchial tube	bronchitis
bronchi/o	bronchial tube	bronchiectasis
carcin/o	cancer	carcinoma
cardi/o	heart	cardiology
carp/o	wrist	carpals
cephal/o	head	cephalic
cerebr/o	cerebrum	cerebrovascular accident

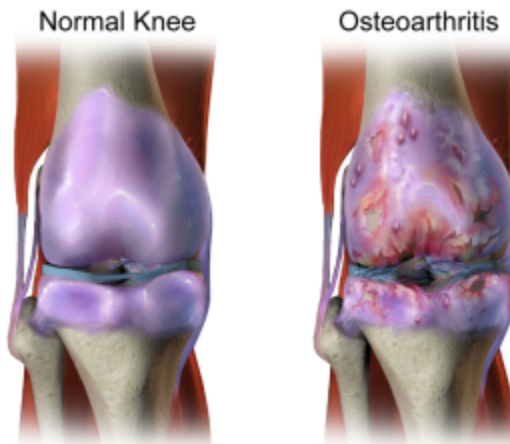


Fig. 1.1

Key Concept

Fig. 1.1 is an image of a normal knee and a knee that has **osteoarthritis**. If you break this term apart, it means “inflammation” (**-itis**) of the “bone” (**oste/o**) and “joint” (**arthr/o**). Note that the combining vowel is dropped because the suffix starts with a vowel.

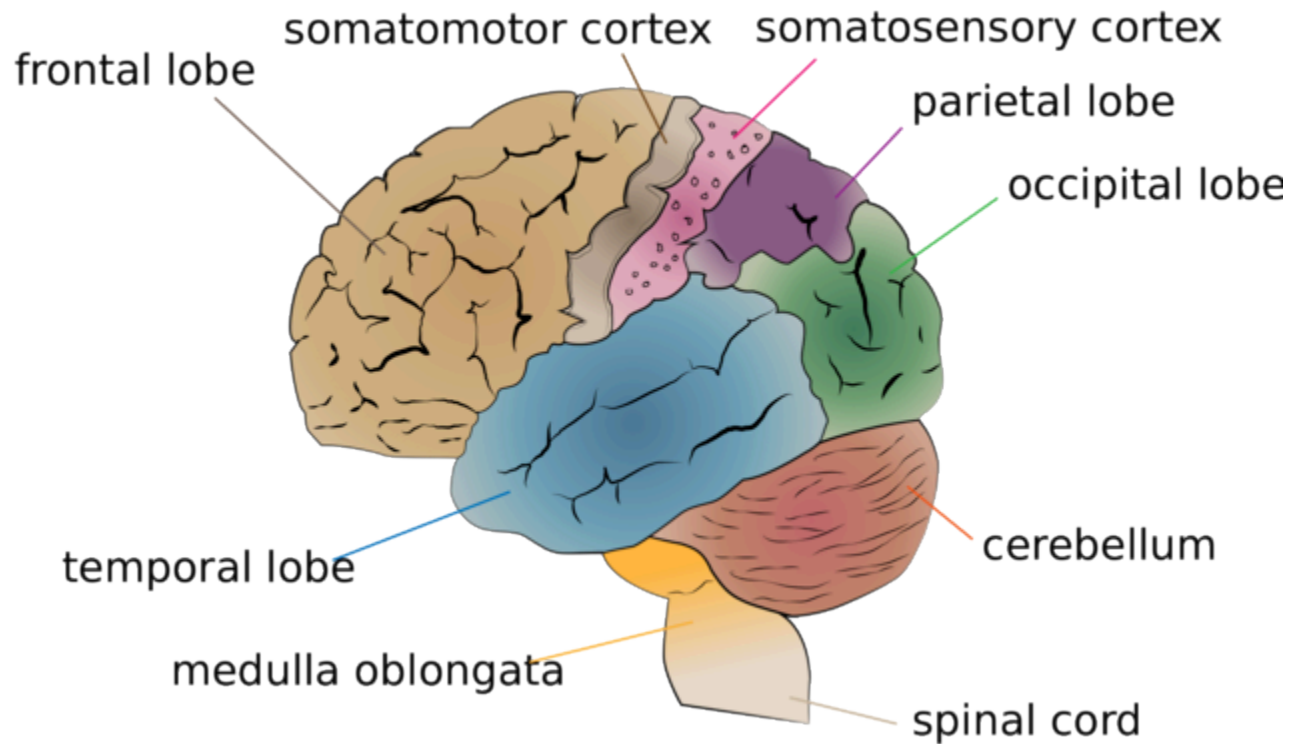


Fig. 1.2

Key Concept

Fig. 1.2 identifies the lobes of the **cerebrum**. If you break down this term, it means a “structure” (**-um**) surrounding the “cerebrum” (**cerebr/o**). Note that you drop the combining vowel because the suffix begins with a vowel.

Exercises



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Table 1.2. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
chem/o	drug	chemotherapy
cholecyst/o	gallbladder	cholecystectomy
chron/o	time	chronic
col/o	colon	colitis
cost/o	ribs	intercostal
crani/o	skull	craniotomy
cry/o	cold	cryotherapy
cutane/o	skin	cutaneous
cyst/o	urinary bladder, sac with fluid	cystoscope
cyt/o	cell	cytology
derm/o	skin	dermal
dermat/o	skin	dermatology
dur/o	dura mater	epidural
electr/o	electricity	electrocardiogram
encephal/o	brain	electroencephalogram
enter/o	intestine (usually small)	enteritis
erythr/o	red	erythrocyte
esophag/o	esophagus	esophageal

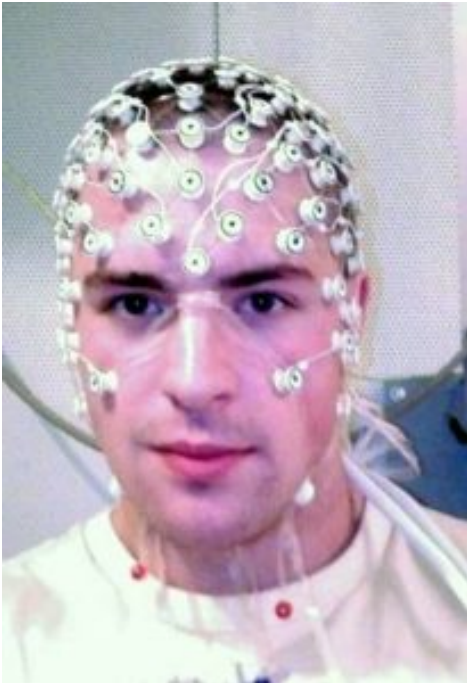


Fig. 1.3

Key Concept

An **electroencephalogram (EEG)** is a common

diagnostic test that looks at the electrical activity of the brain. This term means “to record” (**-gram**) “electricity” (**electr/o**) in the “brain” (**encephal/o**). Fig. 1.3 shows a patient getting an electroencephalogram.

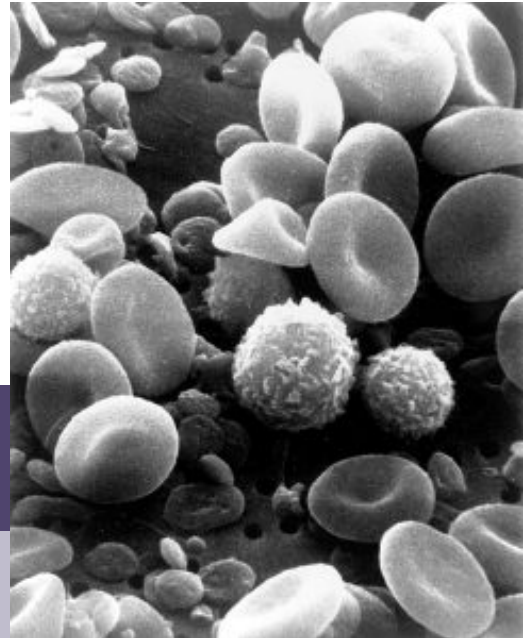


Fig. 1.4

Fig. 1.4 is an image of several different types of blood cells. The larger disc-shaped ones are **erythrocytes** (red blood cells), the round, fuzzy cells are **leukocytes** (white blood cells), and the tiny disc-shaped cells are **thrombocytes** (platelets). The term **erythrocyte** comes from the suffix **-cyte**, meaning “cell,” and the combining form **erythr/o**, meaning “red.” Literally, it means “cell that is red” or, more commonly, “red blood cell.”

Exercises



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Table 1.3. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
gastr/o	stomach	gastralgia
glyc/o	sugar	hyperglycemia
gnos/o	knowledge	diagnosis
gynec/o	women, female	gynecology
hem/o	blood	hemoglobin
hemat/o	blood	hematology
hepat/o	liver	hepatitis
hyster/o	uterus	hysterectomy
inguin/o	groin	inguinal
isch/o	to hold back	ischemia
lapar/o	abdomen	laparotomy
laryng/o	voice box	laryngitis
later/o	side	lateral
leuk/o	white	leukocyte



Fig. 1.5

Key Concept

A **laparotomy** scar is shown above in Fig. 1.5. This term means “to cut” (**-tomy**) into the “abdomen” (**lapar/o**).

Exercises



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Table 1.4. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
mamm/o	breast	mammography
mast/o	breast	mastectomy
men/o	menses	menorrhea
mening/o	meninges	meningitis
my/o	muscle	myalgia
myel/o	spinal cord, bone marrow	myeloma
nat/i	birth	neonatal
necr/o	death	necrosis
neph/r/o	kidney	nephritis
neur/o	nerve	neuralgia
onc/o	tumour	oncology
oophor/o	ovary	oophorectomy
ophthalm/o	eye	ophthalmoscopy
oste/o	bone	osteoarthritis
ot/o	ear	otalgia



Fig. 1.6

Key Concept

Fig. 1.6 is an image of an **ophthalmoscope**, an instrument used to view and assess the eye. The term means an “instrument” (**scope**) to view the “eye” (**ophthalm/o**). In this term, you keep the combining vowel because the suffix starts with a consonant.

Also, notice the combining form **nat/i**, meaning “birth,” in the table above. It is one of the few combining forms where the vowel is an **i**, not an **o**.

Exercises



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Table 1.5. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
path/o	disease	pathology
pelv/o	pelvis	pelvic
peritone/o	peritoneum	peritoneal
phleb/o	vein	phlebitis
plas/o	formation, growth, development	neoplastic
pneumon/o	lung	pneumonitis
psych/o	mind	psychosis
pulmon/o	lung	pulmonary
radi/o	X-ray	radiotherapy
ren/o	kidney	renal
rhin/o	nose	rhinorrhea
salping/o	fallopian tube	salpingectomy
sarc/o	flesh	sarcoma
scapul/o	shoulder blade	subscapular
septic/o	infection	septicemia
son/o	sound	ultrasonography
thorac/o	chest	thoracic

Key Concept

Septicemia means “blood infection,” or literally “blood condition,” from the suffix **-emia**, and the combining form **septic/o**, which means “infection.” Septicemia is one of the most serious infections you might see in patients. Depending on when it is identified and the type of infection, the mortality rate can be up to 50% (John Hopkins Medicine, 2022a).



Fig. 1.7

Key Concept

Fig. 1.7 is an image of a fetus created using ultrasonography. An ultrasound can be completed on many locations of the body for diagnostic purposes. The term **ultrasonography** means “process of recording” (**-graphy**) “beyond” (**ultra-**) “sound” (**son/o**).

Exercises



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Table 1.6. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
thyroid/o	thyroid gland	hyperthyroidism
tonsill/o	tonsil	tonsillitis
top/o	to put, to place, to position	ectopic
thromb/o	clotting	thrombocyte
trache/o	windpipe (trachea)	tracheotomy
ur/o	urine or urea, urinary tract	uremia
urethr/o	urethra	urethritis
uter/o	uterus	intrauterine
vascul/o	blood vessel	vascular
ven/o	vein	intravenous

Key Concept

The combining form **ur/o** means “urine” or “urea.” In the term **uremia**, **ur/o** means “urea.” This term means “blood condition” (**-emia**) with “urea” (**ur-**). Urea is a waste product in blood that builds up when the kidneys are not functioning properly (Betts et al., 2013).

The term **uremia** often gets confused with the term **hematuria**; however, **hematuria** means “a condition of urine” (**-uria**) with “blood” (**hemat-**) (Ansorge, 2022).



Fig. 1.8

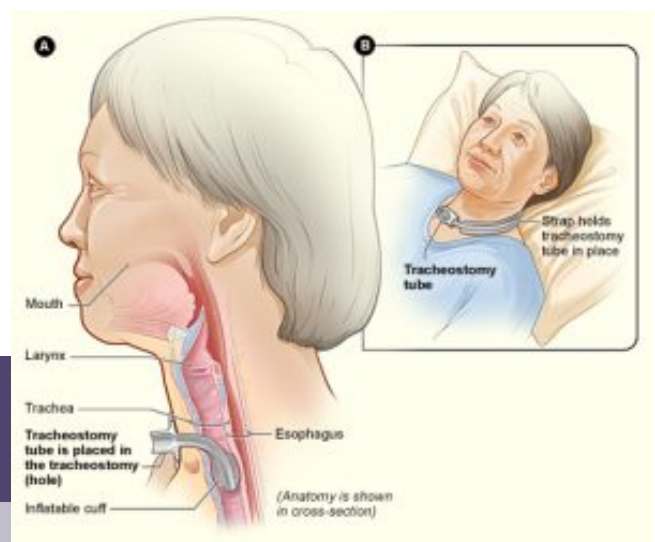


Fig. 1.9

Key Concepts

Fig. 1.8 is an image of inflamed tonsils, or **tonsillitis**. This term means “inflammation” (**-itis**) of the “tonsils” (**tonsill/o**).

Fig. 1.9 is an image of a **tracheostomy**. This term means an “opening” (**-stomy**) into the “trachea” (**trache/o**). There are a number of medical conditions that require a patient to have a tracheostomy, including major burns, long-term comas, and certain types of tumours (John Hopkins Medicine, 2022b).

Exercises



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John Hopkins Medicine. (2022b). Tracheostomy service. <https://www.hopkinsmedicine.org/tracheostomy/about/reasons.html#:~:text=A%20tracheostomy%20is%20usually%20done,deliver%20oxygen%20to%20the%20lungs>

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1.5 Suffixes

A **suffix** is a word part that is located at the end of a word. It can alter the meaning of a medical term. It is important to spell and pronounce suffixes correctly. When writing a suffix, if it is not in a medical term, you must place a “-” before the suffix.

Suffixes are not always explicitly stated in the definition of a word, and it is common that suffixes are not explicitly stated when defining a medical term in the workplace. However, when transcribing or reading a medical report, the suffix is always clearly written. In order to properly spell and pronounce medical terms, it is helpful to learn the suffixes. We will review a few common suffixes and terms related to them, and then continue learning about suffixes in Chapter 2.

Table 1.7. Suffixes

SUFFIXES	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-algia	condition of pain	arthralgia
-cision	process of cutting	incision
-dipsia	thirst	polydipsia
-ectomy	removal, excision, cutting out	appendectomy
-gram	record	mammogram



Fig. 1.10

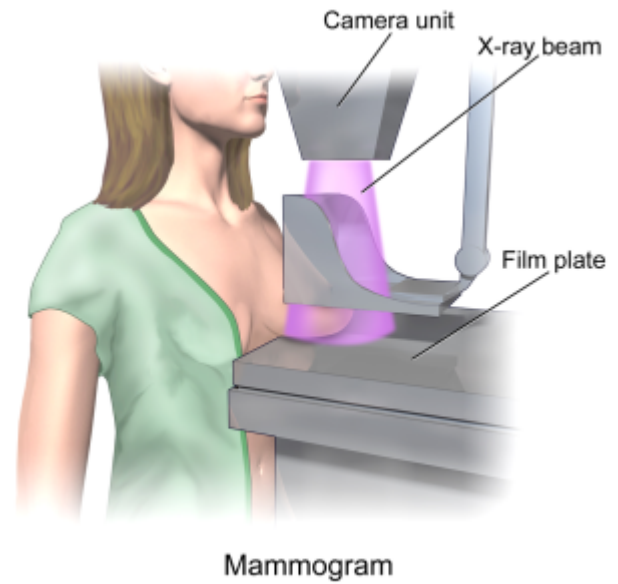


Fig. 1.11

Key Concepts

Incisions are done for many reasons, and Fig. 1.10 is an image of surgeon making an abdominal incision. The surgeon could possibly be doing an exploratory laparotomy or some form of resection. **Incision** has the suffix **-cision**, which means “process of cutting.”

Mammograms are a common diagnostic procedure, and Fig. 1.11 is an image of a mammogram being performed. Breast tissue goes on the film plate, then the X-ray machine above produces an image of the breast tissue. Mammograms are done routinely as a way of diagnosing, or ruling out, breast cancer. The term **mammogram** has the suffix **-gram**, meaning “record” and **mamm/o**, meaning “breast,” so the term means “record of the breast.”

Table 1.8. Suffixes

SUFFIXES	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-graphy	process of recording	electrocardiography
-ic	pertaining to	gastric
-ine	pertaining to	intrauterine
-ism	condition, process	hypothyroidism
-itis	inflammation	arthritis
-lysis	breakdown, separate	dialysis

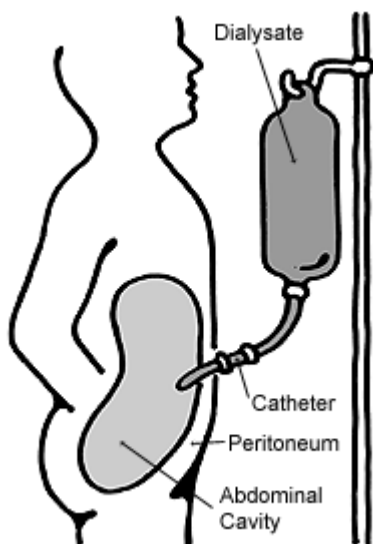


Fig. 1.12

Key Concepts



Fig. 1.13

When a patient's kidneys are not working effectively, the patient may be placed on

dialysis (Kidney Foundation of Canada, 2022). **Dialysis** literally means “breakdown or separation complete,” which refers to the process of completely breaking down a patient’s blood, removing wastes, and then returning the blood to the patient’s body.

Peritoneal dialysis is shown in Fig. 1.12. This type of dialysis is performed by inserting a catheter into the peritoneal cavity, then instilling a fluid into the area so that wastes can move from the patient’s body into the fluid. Then the fluid is drained back into the bag (Kidney Foundation of Canada, 2022).

Patients undergo dialysis because their kidneys can no longer remove wastes from the body. It is typically used until the patient finds a suitable kidney for transplant (Kidney Foundation of Canada, 2022).

Table 1.9. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-mission	to send	remission
-mortem	death	postmortem
-oma	tumour, mass	hepatoma
-opsy	to view	biopsy
-osis	abnormal condition	nephrosis
-ous	pertaining to	intravenous
-partum	birth	antepartum



Fig. 1.14

Biopsies are common diagnostic tests. Biopsy samples can be taken from many parts of the human body and are then sent to a lab for analysis; an example is shown in Fig. 1.14. The term **biopsy** has the suffix **-opsy**, meaning “to view.”

Fig. 1.15 shows an image of a pregnant women. In medical terms, the time before a women delivers the baby is called **antepartum**. This term literally means “birth before” or “before birth.” The time after a women delivers a baby is called **postpartum**, or “after birth.” Both terms have the suffix **-partum**, meaning “birth.”

Key Concepts



Fig. 1.15

Table 1.10. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
-pnea	breathing	apnea
-rrhea	flow, discharge	rhinorrhea
-scope	instrument to visually examine	laparoscope
-scopy	process of visual examination	colonoscopy
-section	to cut	resection
-sis	state of	prognosis
-stasis	to stand, to place, to stop	metastasis
-stomy	opening	tracheostomy
-tension	pressure	hypertension
-tomy	process of cutting into	craniotomy
-um	structure	pericardium
-y	process, condition	dysentery

Key Concepts

Notice that the suffix **-ectomy** has the suffix **-tomy** within it, but they have very different meanings. The suffix **-ectomy** means “removal of,” whereas the suffix **-tomy** means “to cut into.”

If a term has the suffix **-ectomy**, then it always has the meaning “removal of”; for example, **nephrectomy** means “removal of the kidney.” If you change the suffix to **-tomy**, making the term **nephrotomy**, it would mean “to cut into the kidney.” Note that changing the suffix results in the term having two very different meanings.

It is also important to note the difference between **-tomy** and **-stomy** because they are both similar. As stated above, the suffix **-tomy** means “to cut into,” but the suffix **-stomy** means “opening.” Openings such as a tracheostomy, an opening into the trachea to assist with breathing, or a colostomy, which is often done to assist with conditions such as bowel obstructions, are usually permanent or semi-permanent.

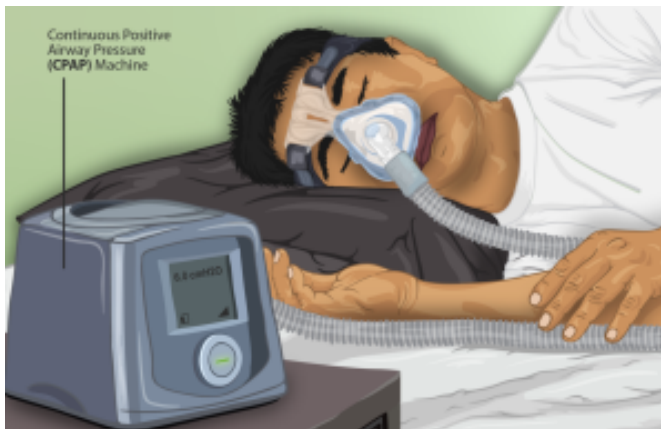


Fig. 1.16

Key Concepts

The term **apnea** has the suffix **-pnea**, meaning “breathing.” Fig. 1.16 is an image of a person who has a particular kind of apnea called sleep apnea. If a person has sleep apnea, they sometimes stop breathing while they are sleeping and often awake feeling very tired. A CPAP machine is often prescribed for people who have sleep apnea to ensure that they continue to breathe normally during sleep.

Fig. 1.17 shows an **arthroscope**. Patients often have procedures done with scopes to visually examine parts of the body. The suffix **-scope** means “an instrument to visually examine,” and in this case, it is being used to examine a “joint” (**arthr/o**).

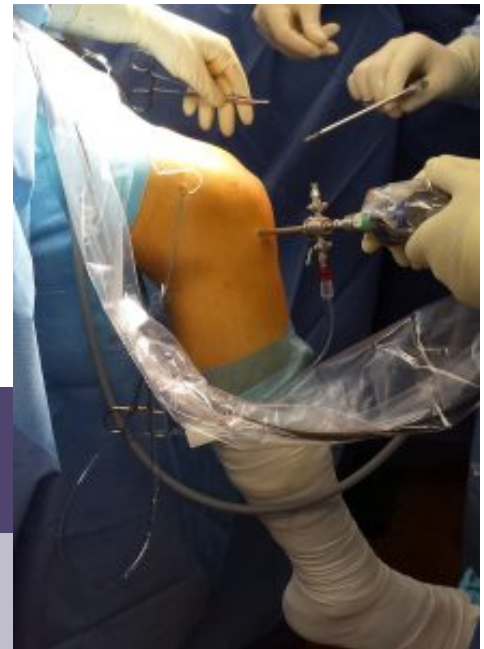


Fig. 1.17

Exercise



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Exercise



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Kidney Foundation of Canada. (2022). Dialysis. <https://kidney.ca/Kidney-Health/Living-With-Kidney-Failure/Dialysis>

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1.6 Prefixes

A **prefix** is located at the beginning of a medical term and alters the meaning of the term. It is important to spell and pronounce prefixes correctly. When writing a prefix, if it is not in a medical term, you must place a “-” after the prefix. Not all medical terms have a prefix, but many do.

The following is a good technique to help you memorize prefixes:

- Start by reviewing the most common prefixes. We will look at more prefixes in Chapter 3.
- Compare the prefixes to the examples of use in medical terms in the tables below.
- Try to relate the prefixes below to common terms you hear in everyday life.

Table 1.11. Prefixes

Prefixes	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
a- , an-	no, not	anemia
aut-	self	autopsy
dia-	complete, through	diagnosis
dys-	bad, painful, difficult, abnormal	dyspnea
endo-	within	endoscope
exo-	outside	exocrine
hyper-	too much, excessive	hypertension
hypo-	too little, less than normal	hypotension
intra-	within	intravenous

Key Concept

The following is a list of some common anemias:

Aplastic anemia: A condition in which the body does not produce enough red blood cells

Thalassemia: An inherited disorder in which the body does not produce enough hemoglobin

Sickle cell anemia: An inherited disorder where the red blood cells are crescent-shaped; Fig. 1.19 below shows the difference between healthy red blood cells and the crescent-shaped red blood cells that occur with sickle cell anemia

Vitamin deficiency anemia or **pernicious anemia:** A condition in which the body lacks vitamin B12, which is required to produce red blood cells

Iron deficiency anemia: A condition in which the body lacks iron, which is carried on the red blood cells and allows the red blood cells to carry oxygen

Hemolytic anemia: A condition that can either be inherited or develop later in life and is caused by the body destroying red blood cells faster than they can be produced

(Mayo Clinic, 2022)

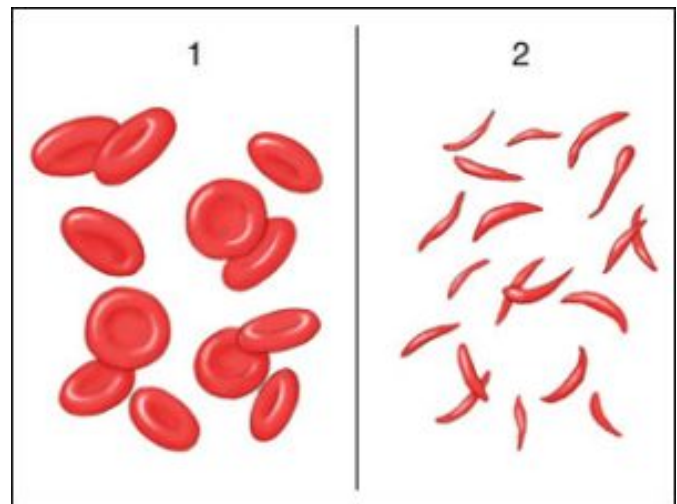
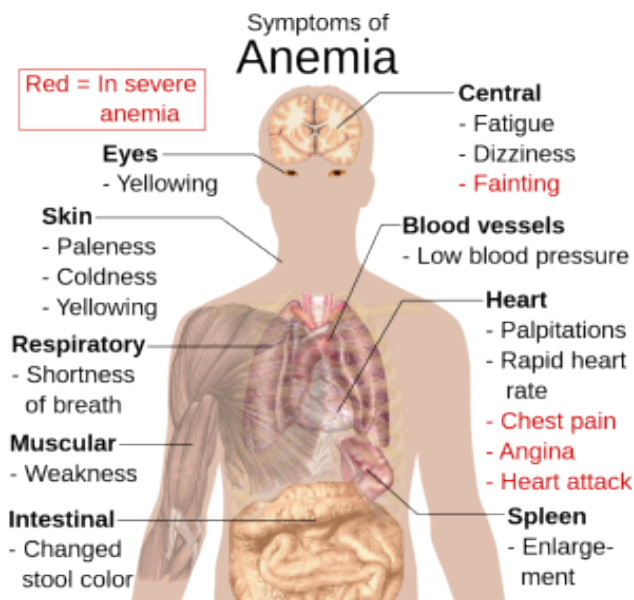


Fig. 1.19

Fig. 1.18

Key Concept

Simply changing the prefix can change the meaning of a medical term entirely.

The prefixes **hyper-** and **hypo-** are used in many medical terms and usually mean the opposite of each other. See the examples below:

- **hypertension** (high blood pressure) and **hypotension** (low blood pressure)
- **hyperthyroidism** (condition of high thyroid) and **hypothyroidism** (condition of low thyroid)
- **hyperglycemia** (high blood sugar) and **hypoglycemia** (low blood sugar)

Table 1.12. Prefixes

PREFIXES	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
peri-	surrounding	pericardium
pro-	before, forward	prognosis
re-	back	resection
retro-	behind	retroperitoneal
sub-	below, under	subhepatic
trans-	across, through	transdermal

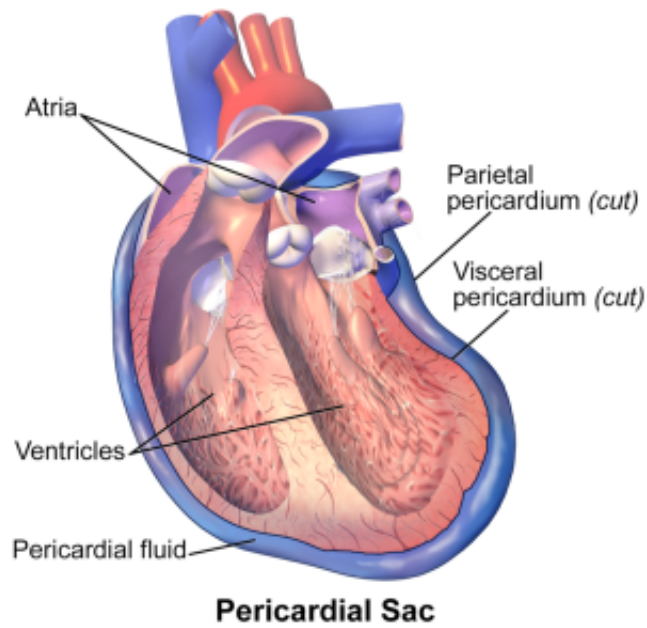


Fig. 1.20

Key Concept

The **pericardium** (Fig. 1.20) surrounds the heart. Its function is to protect, lubricate, and keep the heart in the correct position in the chest cavity (Healthline, 2022). The term can be broken down as follows: **peri-** (“surrounding”), **cardi** (“heart”), and **-um** (“structure”), which gives you “a structure surrounding the heart.”

Exercise



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Healthline. (2022). Pericardium. <https://www.healthline.com/health/pericardium>
Mayo Clinic. (2022). Anemia. <https://www.mayoclinic.org/diseases-conditions/anemia/symptoms-causes/syc-20351360>

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1.7 Identifying Word Parts in Medical Terms

Word Parts

As discussed at the beginning of this chapter, medical terms are composed of prefixes, suffixes, combining vowels, and root words. At this point, you should be starting to be a little more familiar with all these individual parts. When trying to interpret the meaning of a medical term, it can be easier to break it up into its individual parts, which we call **component parts**.

Below you will see examples of terms broken down into their component parts. When you are asked to break down medical terms into their components, you should put a slash between the word parts. You should be able to identify each word part based on the previous content in this chapter. Remember that not all terms have prefixes and some root words are embedded (hidden) in the suffixes.

Examples

osteoarthritis

oste/o/arthr/itis – “inflammation of bone and joint”

oste/o- is a combining form that means “bone”

arthr/o- is a combining form that means “joint”

-itis is a suffix that means “inflammation”

intravenous

intra/ven/ous – “pertaining to within a vein”

intra- is a prefix that means “within”

ven/o- is a combining form that means “vein”

-ous is a suffix that means “pertaining to”

Notice that when you break down a word, you place slashes between the word parts and a slash on each side of a combining form vowel.

Exercise



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1.8 Review Exercises

The exercises below review the content in this chapter. Some of the prefixes, suffixes, and combining forms might not be covered in the exercises, so it is important that you review all the material in this chapter on your own in addition to this final review.

Suffix Review



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Prefix Review



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Combining Form Review



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CHAPTER II

SUFFIXES

2.1 Introduction to Suffixes

Learning Objectives

By the end of this chapter, you should be able to

1. Define the term “suffix”
2. List common symptom-related suffixes
3. List common treatment-related suffixes
4. Identify key medical concepts discussed in this chapter
5. Define common medical terms related to suffixes discussed in this chapter
6. Describe common excisions, infections, pathologies, and procedures related to suffixes discussed in this chapter

Chapter Overview

This chapter covers the most common suffixes used in medical terminology, including their meaning and purpose. You were introduced to suffixes in Chapter 1, and because of the common and sometimes complex nature of their use in medical terminology, you will see some of those suffixes again in this chapter. These suffixes will be elaborated on and applied in medical terms that you will often see in healthcare settings. You will also be introduced to treatment- and symptom-related suffixes and concepts. There will be ample practice throughout this chapter to solidify this knowledge and prepare you for further chapters where these concepts will be used.

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2.2 Suffixes for Symptoms

Suffixes are often used when describing signs and symptoms that individuals are experiencing. There is much variation in how they are used, and examples will be provided to illustrate how suffixes are applied to medical terms to explain signs and symptoms. As stated in the introduction to this chapter, some of the suffixes were introduced in Chapter 1 but will be explained in further detail here.

Table 2.1. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-algia	condition of pain, pain	neuralgia
-cele	hernia, protrusion, swelling	hydrocele

How bad is your pain?

- 1: Huh, I guess it's there...
- 2: It's mildly distracting
- 3: I can usually ignore it
- 4: It's there, but I can do stuff
- 5: It interferes with some things
- 6: It disrupts daily life
- 7: I can barely do anything
- 8: It's hard to talk & listen
- 9: I can barely move
- 10: I am bedridden. Help!



Key Concept

Fig. 2.2

Pain is a common symptom in healthcare settings. There are various ways to assess pain, and the chart in Fig. 2.1 is an example of one way. There are a number of places in and on the body where a person can experience pain, and pain can also vary greatly in severity (Fig. 2.2). Table 2.2 below provides some examples of the use of the suffix **-algia**, which means “pain” or “condition of pain.” It lists the more common usages; there are of course more, and on specialty units in a hospital, there are likely others that will be commonly heard as well.

Table 2.2. Examples of -algia

MEDICAL TERM	MEANING
arthralgia	condition of pain in the joint (Fig. 2.2)
brachialgia	condition of pain in the arm
cephalgia	condition of pain in the head (headache)
cervicalgia	condition of pain in the neck
dentalgia	condition of pain in the tooth
fibromyalgia	condition of pain in the fibrous tissue and muscle
hepatalgia	condition of pain in the liver
mammalgia	condition of pain in the breast
myalgia	condition of pain in the muscle
neuralgia	condition of pain in the nerve
otalgia	condition of pain in the ear
rhinalgia	condition of pain in the nose
spondylalgia	condition of pain in the spine
thoracalgia	condition of pain in the thorax

Table 2.3. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-dipsia	thirst	polydipsia
-emesis	vomiting	hematemesis



Fig. 2.3

Key Concept

The medical term **polydipsia**, which means “much thirst,” comes from the prefix **poly-** (“much” or

“many”) and the suffix **-dipsia** (“thirst”). A number of medical conditions can cause polydipsia (Fig. 2.3), including diabetes mellitus.

Nausea and vomiting (Fig. 2.4) are common symptoms for patients in a hospital and can result from many causes. As such, it would not be uncommon to see medical terms with the suffix **-emesis** (“vomiting”) and have it combined with other terms, as with **-algia** in Table 2.2 above; for example, the term **hematemesis** means there is blood in the vomit.



Fig. 2.4

Table 2.4. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-emia	blood condition	ischemia
-ia	condition	pneumonia
-itis	inflammation	appendicitis

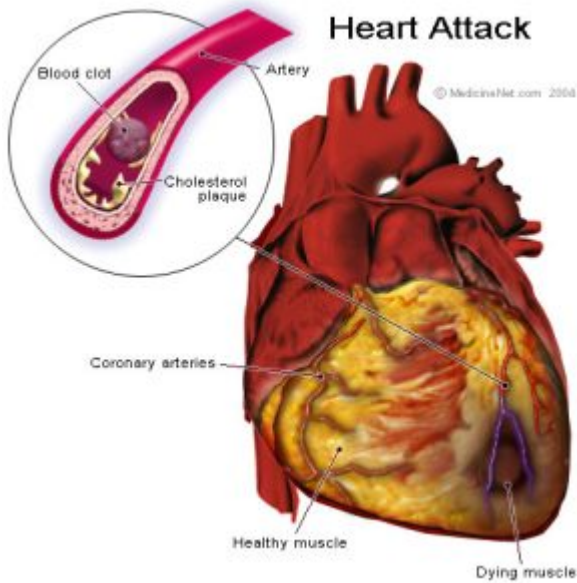


Fig. 2.5

Key Concept

Fig. 2.5 shows a heart during a **myocardial**



Fig. 2.6

infarction, also known as a **heart attack**. When this occurs, blood is held back from part of the heart. The medical term for this is **ischemia**, meaning “blood condition of holding back,” which has the suffix **-emia** (“blood condition”) and the combining form **isch/o** (“to hold back”). When ischemia occurs and is not corrected right away, it results in **necrosis**. In this case, it would be the death of cardiac muscle.

Inflammation is also a common symptom because many parts of the human body can become inflamed. Fig. 2.6 shows an ear that has become inflamed; the medical term for this is **otitis** (“inflammation of the ear”). Table 2.5 below provides some examples of medical terms with **-itis** (“inflammation”), but there are many more that you may hear in a medical setting.

Table 2.5. Examples of -itis

MEDICAL TERM	MEANING
adenoiditis	inflammation of the adenoids
appendicitis	inflammation of the appendix
bronchitis	inflammation of the bronchi
bursitis	inflammation of the bursae
cholecystitis	inflammation of the gallbladder
cystitis	inflammation of the urinary bladder
dermatitis	inflammation of the skin
encephalitis	inflammation of the brain
enteritis	inflammation of the intestines
esophagitis	inflammation of the esophagus
gastroenteritis	inflammation of the stomach and intestines
hepatitis	inflammation of the liver
nephritis	inflammation of the kidney
neuritis	inflammation of the nerve
otitis	inflammation of the ear (Fig. 2.6)
thrombophlebitis	inflammation with clots in the vein

Table 2.6. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-lapse	to fall, slide	prolapse
-megaly	enlargement	cardiomegaly

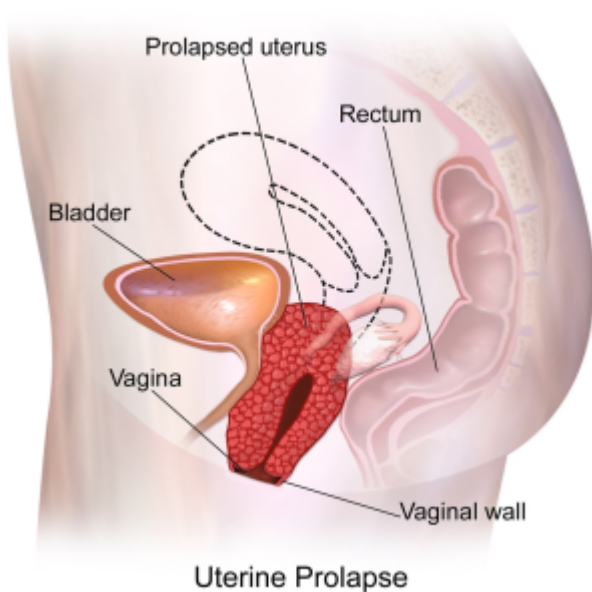


Fig. 2.7

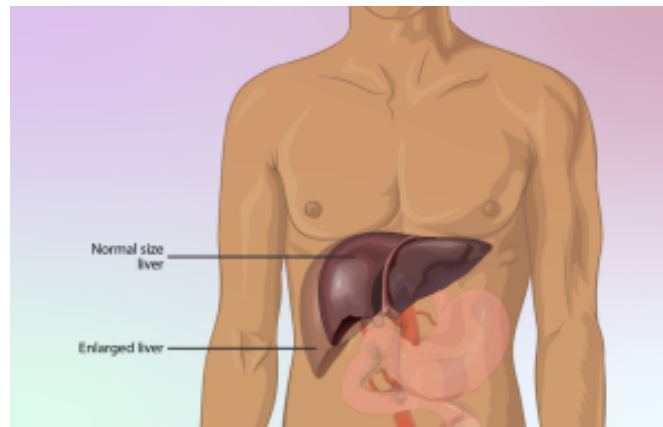


Fig. 2.8

Key Concept

Fig 2.7 is an image of a **uterine prolapse**. Prolapses can occur in other parts of the body as well, and the literal meaning of **prolapse** is “to slide or fall forward,” from the suffix **-lapse** (“to fall or slide”) and the prefix **pro-** (“before” or “forward”). When a prolapse occurs, it can be corrected surgically and with physiotherapy treatment. Uterine prolapses are more common with increased age and a history of pregnancy.

Various organs in the body can become enlarged owing to different pathologies and conditions. **Cardiomegaly** is enlargement of the heart, and Fig. 2.8 shows enlargement of the liver, which is referred to as **hepatomegaly**. Both types of enlargements often result from chronic conditions such as congestive heart failure (CHF) or hepatitis.

Table 2.7. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-oma	tumour, mass	hematoma
-osis	condition, abnormal condition	psychosis



Fig. 2.9

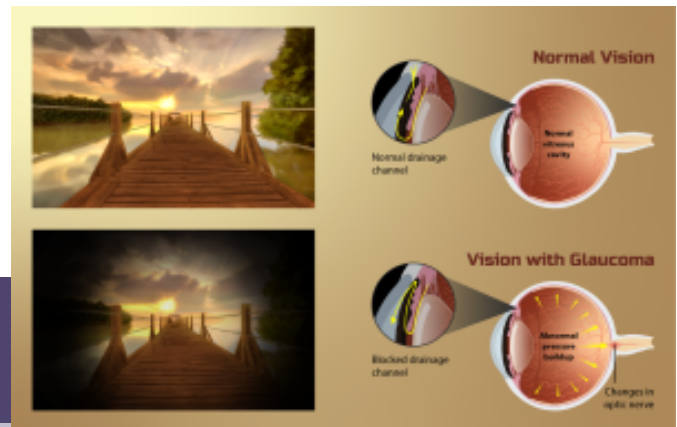


Fig. 2.10

Key Concept

Hematomas, shown in Fig. 2.9, are very common in the general population and among patients in hospitals or clinics. Hematomas are often referred to as **bruises**, and the term literally mean “mass of blood,” from the suffix **-oma** (“mass” or “tumour”) and the combining form **hemat/o** (“blood”).

Another type of **-oma** is **glaucoma**, which is medical condition that causes increased pressure within the eye and results in narrowed vision, as seen in Fig. 2.10. Glaucoma literally means “mass that is grey,” from the suffix **-oma** and the combining form **glauco/o** (“grey” or “opaque”) (Global RPH, 2021). This refers to the grey mass in the field of vision that patients experience and that can be seen in the figure above.

Table 2.8. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-penia	deficiency	pancytopenia
-phagia	eating	dysphagia
-phasia	speech	aphasia



Fig. 2.11

Key Concepts

Speaking and eating are, for most of us, a part of everyday life. Difficulty or the inability to eat or speak can be extremely confusing and frustrating for those who are affected. The medical terms that describe these conditions are **dysphagia** (“difficulty eating”) and **dysphasia** (“difficulty speaking”). Even more detrimental conditions would be **aphagia** and **aphasia**; with the prefix **a-** (“no”), the terms mean “no eating” and “no speaking.”

Table 2.9. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-pathy	disease condition	cardiomyopathy
-pepsia	digestion	dyspepsia
-phobia	aversion, abnormal fear	arachnophobia
-plegia	paralysis	paraplegia

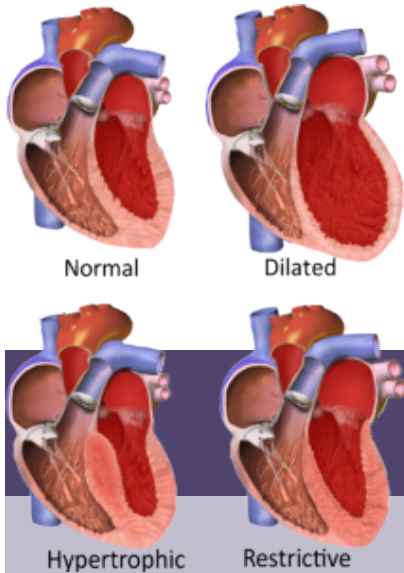


Fig. 2.12

Key Concept



Fig. 2.13

The suffix **-pathy** (“disease condition”) is very common in medical settings.

Fig. 2.12 shows various forms of **cardiomyopathy**. This condition can result from an **acute condition**, such as a heart attack, or a more **chronic condition**, such as congestive heart failure. Acute conditions come on quickly, whereas chronic ones can last a lifetime.

Another example of the use of the suffix **-pathy** would be the term **homeopathy**. Fig. 2.13 shows a homeopathy set that was once used to treat ailments. This term has the combining form **home/o**, which means “similar,” “same,” or “alike.” Homeopathy originated in the 18th century from the idea that “like cures like,” meaning that a small concentration of a toxin could be used to treat the symptoms that it would cause when taken in larger doses (Wanjek, 2013); for example, using the active ingredient in poison ivy to treat a rash (Wanjek, 2013). This thinking resulted in the development of the first vaccines, which use small doses of viruses to treat or prevent illness (Wanjek, 2013).

Table 2.10 below provides some examples of medical terms with **-pathy**, but there are many more used in medical settings.

Table 2.10. Examples of -pathy

MEDICAL TERM	MEANING
adenopathy	disease condition of the glands
adrenopathy	disease condition of the adrenal gland
arthropathy	disease condition of the joint
cardiopathy	disease condition of the heart
cardiomyopathy	disease condition of the heart and muscle
encephalopathy	disease condition of the brain
hepatopathy	disease condition of the liver
lymphadenopathy	disease condition of the lymph nodes
myopathy	disease condition of the muscle
neuropathy	disease condition of the nerve
psychopathy	disease condition of the mind
retinopathy	disease condition of the retina

Table 2.11. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-rrhea	flow, discharge	menorrhea
-rrhage	excessive discharge of blood	hemorrhage
-rrhagia	excessive discharge of blood	menorrhagia

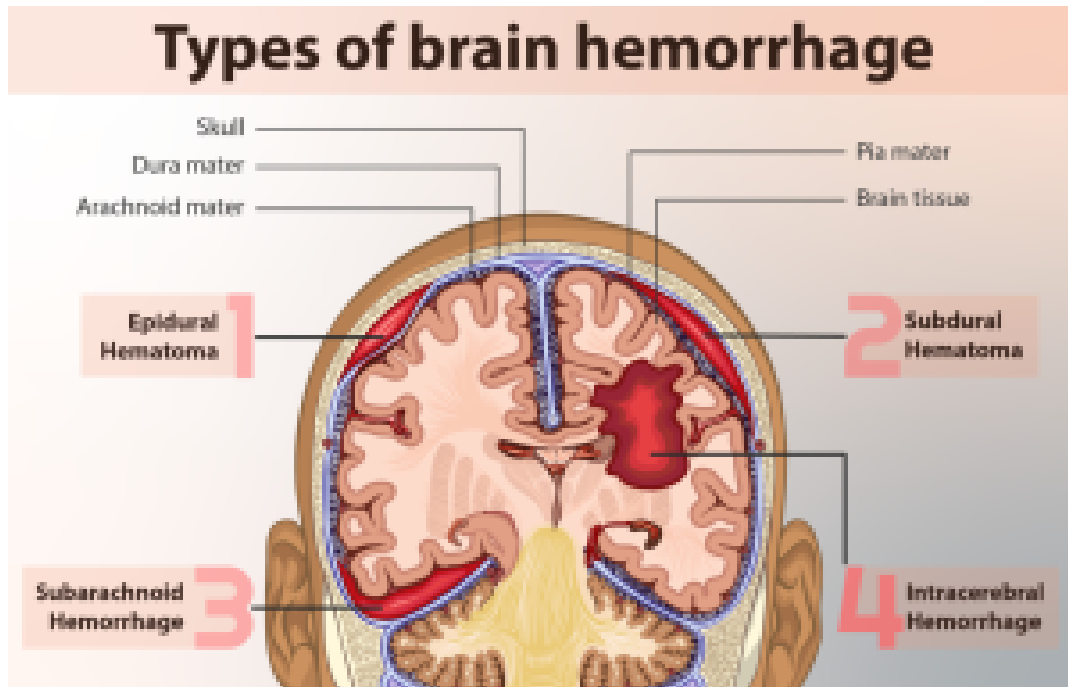


Fig. 2.14

Key Concept

Although very similar, the three suffixes in Table 2.11 are used in different ways. It is important to note the manner in which the suffixes are used and when one is used over the other. For example, look at the terms **dysmenorrhea**, **amenorrhea**, **menorrhagia**, **menorrhea**, and **hemorrhage**. The first four have to do with menstrual flow, the first term meaning “painful,” then “lack of,” “excessive,” and, finally, “normal menstrual flow.” The last term means “excessive discharge of blood,” which could be from anywhere in the body. Fig. 2.14 shows some examples of hemorrhages in the brain, and many of the prefixes you see in the terms used will be discussed further in Chapter 3.

Table 2.12. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-sclerosis	hardening	arteriosclerosis
-uria	condition of urine	glycosuria

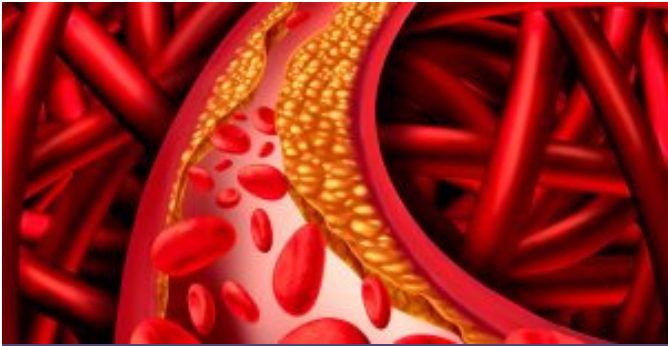


Fig. 2.15

Key Concept

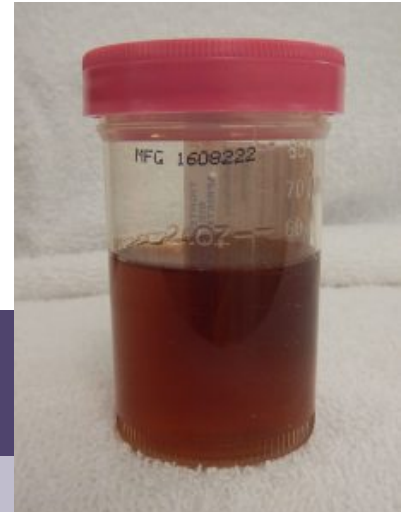


Fig. 2.16

Arteri/o, meaning “artery,” can be seen in the term **arteriosclerosis**, which literally means “hardening of an artery.” **Ather/o** means “plaque” and is part of the term **atherosclerosis**, a condition that results from an accumulation of plaque within an artery and causes hardening of the artery. As such, it is a type of arteriosclerosis that is specifically caused by plaque build-up (Fig. 2.15).

You were introduced to the term **hematuria** (Fig. 2.16) in Chapter 1, and it means “a condition of urine(-**uria**) with blood (**hemat-**)” (Ansorge, 2022). A urinalysis examines various factors in urine, including blood, sugar, protein, and white blood cells. The results of a urinalysis are a good indicator of how a person’s kidneys are functioning. Kidneys play a key role in the urinary system.

Exercises



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2.3 Suffixes for Treatment Procedures

Suffixes are often used when describing procedures that patients might receive during their course of treatment. Once again, there is high level of variation between how suffixes are used, and this will be elaborated upon below. Examples will be provided that illustrate the manner in which these suffixes are used in various terms related to procedures. As stated in the introduction to this chapter, some of these will be suffixes that were introduced in the previous chapter, but in this chapter their use will be explained in further detail.

Table 2.13. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-centesis	surgical puncture to remove fluid	abdominal paracentesis

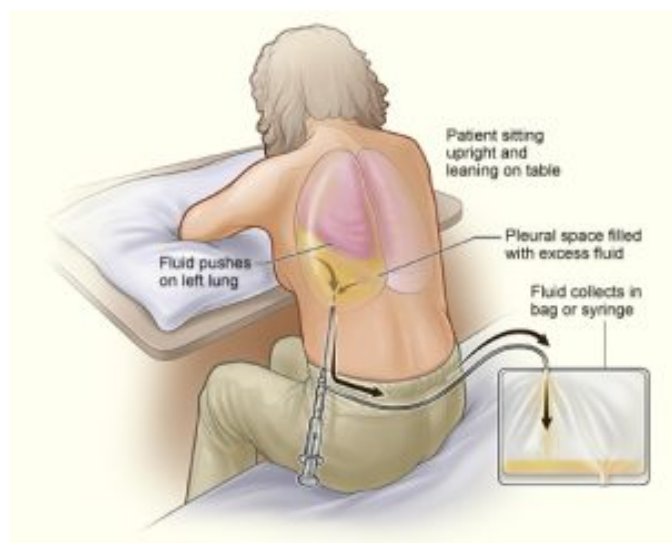


Fig. 2.17

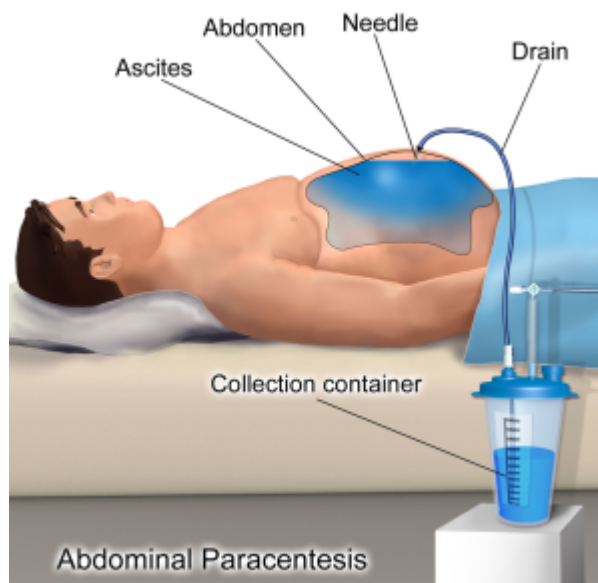


Fig. 2.18

Key Concept

Amniocentesis was introduced in Chapter 1, but it is just one form of a “surgical puncture to remove fluid,” or **-centesis**. Another common procedure is **thoracentesis**, as shown in Fig. 2.17, which involves removing fluid from the pleural space around the lungs. Fluid accumulating in this area is called **pleural effusion** and can make it difficult for patients to breathe because the fluid compresses their lungs (Cleveland Clinic, 2022).

Fig. 2.18 shows another common procedure called **paracentesis**, a surgical puncture to remove fluid from the peritoneal cavity. Fluid accumulation in this area is called **ascites**, and as more fluid develops, the patient will become increasingly uncomfortable (John Hopkins, 2022a). Often this condition can be chronic and is associated with liver failure.

Table 2.14. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-ectomy	removal, resection, excision	hysterectomy



Fig. 2.19



Fig. 2.20

Key Concept

The suffix **-ectomy** is used in medical terms that refer to the removal of an organ, tissue, tumour, or gland. Fig. 2.19 is an image of the different types of hysterectomies that a patient might need to have, depending on their diagnosis. The term **hysterectomy** includes the combining form **hyster/o**, meaning “uterus,” and the suffix **-ectomy**, meaning “removal.” Fig. 2.20 is an image of a surgeon in an operating room performing an **appendectomy**, the removal of the appendix.

Table 2.15 provides an extensive list of surgical procedures that patients might have to undergo. Note that the term **excision** means “to cut out” or “to remove.” It includes the suffix **-cision**, meaning “to cut,” and the prefix **ex-**, meaning “out.”

Table 2.15. Excisions

MEDICAL TERM	MEANING
adenectomy	excision of a gland
adenoidectomy	excision of the adenoids
appendectomy	excision of the appendix
cholecystectomy	excision of the gallbladder
colectomy	excision of the colon
gastrectomy	excision of the stomach
hysterectomy	excision of the uterus
laminectomy	excision of a piece of backbone
lobectomy	excision of a single lobe of the lung
mastectomy	excision of the breast
myomectomy	excision of a muscle tumour
oophorectomy	excision of the ovaries
pneumonectomy	excision of lung tissue
prostatectomy	excision of the prostate gland
salpingectomy	excision of the fallopian tubes
splenectomy	excision of the spleen
tonsillectomy	excision of the tonsils
total pneumonectomy	excision of a whole lung

Table 2.16. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-gram	record	arthrogram
-graph	instrument used to record	electrocardiograph
-graphy	process of recording	electrocardiography

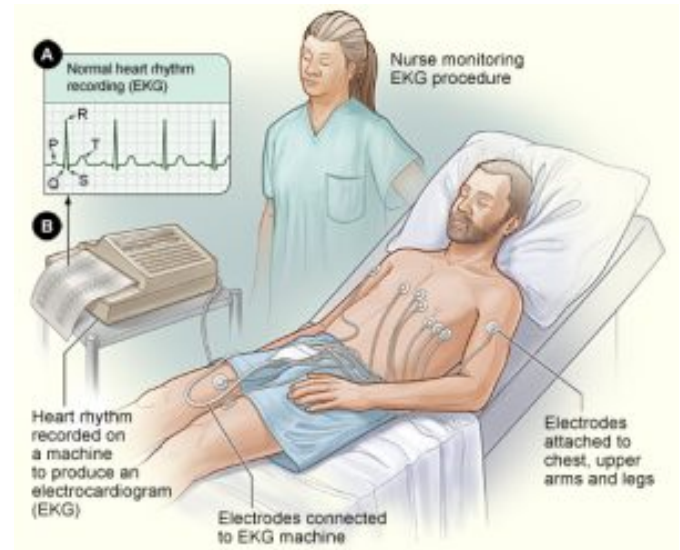


Fig. 2.22



Fig. 2.21

Key Concept

The three suffixes in Table 2.16 are similar; however, they are very different in the way they are used in reference to tests or procedures. When discussing the record that is made as a result of a test, for example, an **electrocardiogram** as shown in Fig. 2.21, then suffix would be **-gram** (“record”). However, when discussing the process of actually completing the record, as illustrated in Fig. 2.22, then the suffix **-graphy** (“process of recording”) would be used. The instrument itself, in this case, would be the **electrocardiograph**. It is important to differentiate between the three suffixes and how they are used in medical terminology.

Table 2.17. Examples of -gram

MEDICAL TERM	MEANING
arthrogram	record of the joint
audiogram	record of hearing
cystogram	record of the urinary bladder
echocardiogram	record of heart with sound
electrocardiogram	record of the electrical activity of the heart
electroencephalogram	record of the electrical activity of the brain
electromyogram	record of the electrical activity in muscles
esophagogram	record of the esophagus
hysterosalpingogram	record of the uterus and fallopian tubes
mammogram	record of the breast
myelogram	record of the spinal cord
pyelogram	record of the renal pelvis
urogram	record of the kidney and urinary tract

Table 2.18. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-lysis	separation, breakdown, destruction	hemodialysis
-meter	instrument used to measure	audiometer
-metry	process of measuring	audiometry

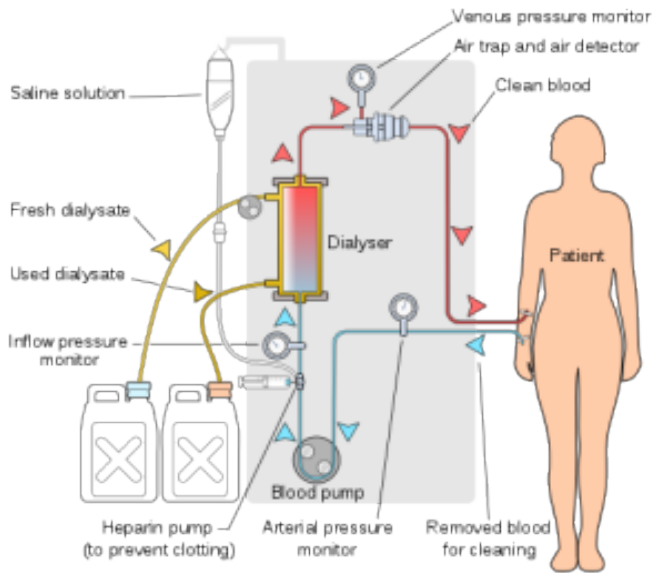


Fig. 2.23



Fig. 2.24

Key Concept

When a patient's kidneys begin to fail, they have a few options, including peritoneal dialysis, hemodialysis, or a kidney transplant. **Peritoneal dialysis** was explained in Chapter 1 and is a procedure in which a tube is inserted through the abdominal wall. A solution is then instilled to help filter the blood. This type of dialysis can be completed in a patient's home on a daily basis. The other type of dialysis is called **hemodialysis** and is shown in Fig 2.23 (Kidney Foundation of Canada, 2022). It involves using a dialysis machine to filter a patient's blood and then return the blood to the patient's body with the wastes removed. Dialysis is often used until a suitable kidney is found for transplant (Kidney Foundation of Canada, 2022).

Audiometry is an assessment of a person's hearing. This term has the suffix **-metry** ("process of measuring") and the combining form **audi/o** ("hearing"). Fig. 2.24 shows one manner in which audiometry can be completed.

Table 2.19. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-opsy	process of viewing	biopsy
-plasty	surgical repair, surgical correction	angioplasty
-scope	instrument used to visually exam	colonoscope
-scopy	process of visual examination	gastroscope

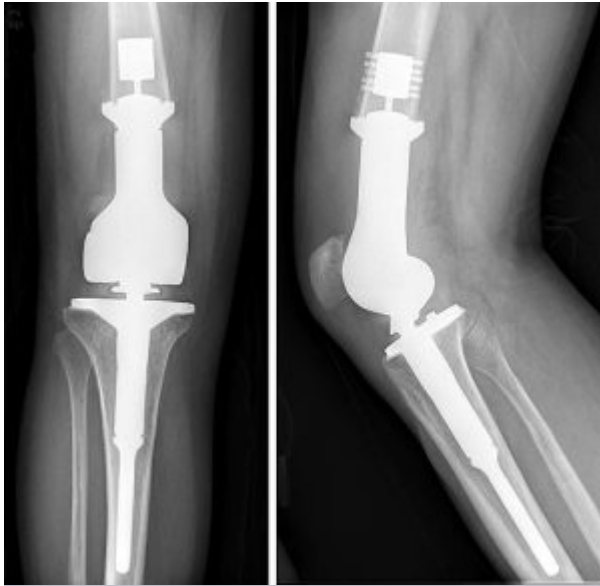


Fig. 2.25

Key
Concept



Fig. 2.26

Surgical corrections can be completed for mobility reasons, such as an **arthroplasty** (Fig. 2.25), or for cosmetic reasons, such as a **rhinoplasty** (Fig. 2.26). A rhinoplasty can also be done for medical reasons, depending on the patient's history and pathologies.

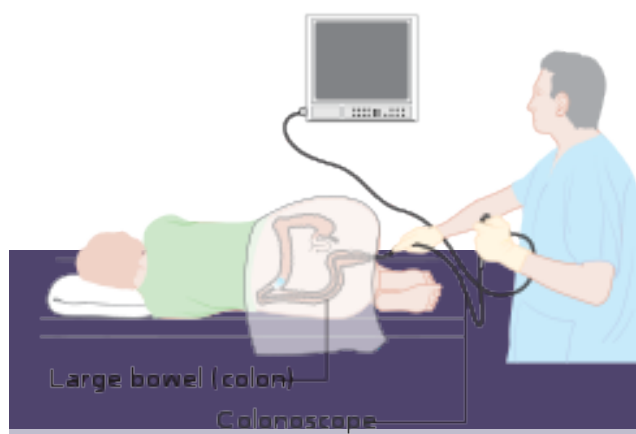


Fig. 2.27

Key
Concept

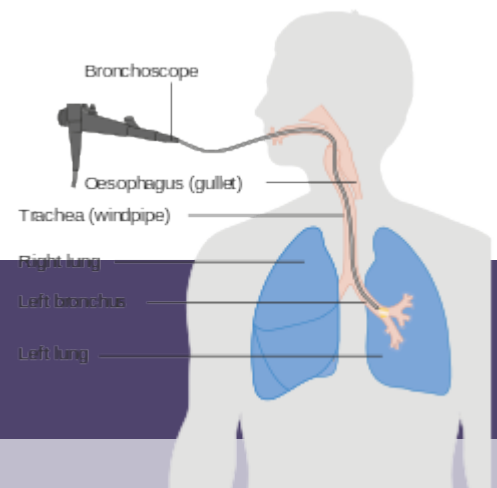


Fig. 2.28

There are many different types of **-scopy** procedures, and a few are listed in Table 2.20 below. It is important to differentiate between how the suffix **-scopy** ("process of visual examination") and **-scope** ("instrument used to visually examine") are used. The images in Fig. 2.27 and Fig. 2.28 show a **colonoscopy** and a **bronchoscopy**, the processes of visualizing the colon and bronchi. These would be performed using a **colonoscope**, as shown in the first image, and a **bronchoscope**, as shown in the second image—the instruments used to complete the procedures.

Table 2.20. Examples of -scopy

MEDICAL TERM	MEANING
anoscopy	process of visual examination of the anus
arthroscopy	process of visual examination of the joint
bronchoscopy	process of visual examination of the bronchi
colonoscopy	process of visual examination of the colon
colposcopy	process of visual examination of the vagina and cervix
cystoscopy	process of visual examination of the urinary bladder
endoscopy	process of visual exam of a body cavity or organ with a narrow, tube-like instrument (endoscope)
esophagogastroduodenoscopy	process of visual examination of the esophagus, stomach, and first part of the small intestine
esophagoscopy	process of visual examination of the esophagus
gastrosocopy	process of visual examination of the stomach
hysteroscopy	process of visual examination of the uterus
laparoscopy	process of visual examination of the abdominal cavity
laryngoscopy	process of visual examination of the larynx
proctoscopy	process of visual examination of the rectum and anus
sigmoidoscopy	process of visual examination of the sigmoid colon
thoracoscopy	process of visual examination of the surface of the lungs (thoracic cavity)

Table 2.21. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-stomy	opening	colostomy
-therapy	treatment	cryotherapy



Fig. 2.29

Key Concept

Fig. 2.29 shows one type of **-stomy** (“opening”), a **colostomy** that was created for a patient with colon cancer. This procedure can also be done for patients with bowel obstructions. An opening into the colon is created, and a stoma is formed on the abdomen to allow bowel movements to exit the body into a colostomy bag. The opening can be permanent, or if the patient’s condition permits, may be only semi-permanent.



Fig. 2.30



Key Concept

Fig. 2.31

Below are three examples of very different ways of the using the suffix **-therapy** (“treatment”):

- **chemotherapy**: Treatment with drugs (**chem/o**)
- **cryotherapy**: Treatment with cold (**cry/o**)
- **radiotherapy**: Treatment with X-rays (**radi/o**)

Fig 2.30 shows a cryogun, a common device used in **cryotherapy**. The cold contents are sprayed on a wart or skin tag, and through a series of treatments, the wart or skin tag is slowly removed. Fig. 2.31 has a patient about to receive a **chemotherapy** treatment, which is used to treat various forms of cancer.

Table 2.22. Suffixes

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-tripsy	surgical crushing	Extracorporeal shock wave lithotripsy
-tomy	incision, cutting into	phlebotomy



Fig. 2.32

Key Concept

Phlebotomy, withdrawing a blood sample for analysis (Fig. 2.32), is a common procedure that many, if not most, people experience during their lifetime. Another example of the use of the suffix **-tomy** (“incision” or “cutting into”) would be a **craniotomy**, a procedure often done to release pressure during brain surgery.

Extracorporeal shock wave lithotripsy (ESWL) is used to assist patients who have stones in their kidneys, ureters, pancreatic, or bile ducts (John Hopkins, 2022b). This procedure is not invasive and breaks down the stones using shock waves with the assistance of X-rays or ultrasound (Fig 2.33). Once broken down, the stones can pass through the urinary system and out of the patient’s body (John Hopkins, 2022b).



Fig. 2.33

Exercises



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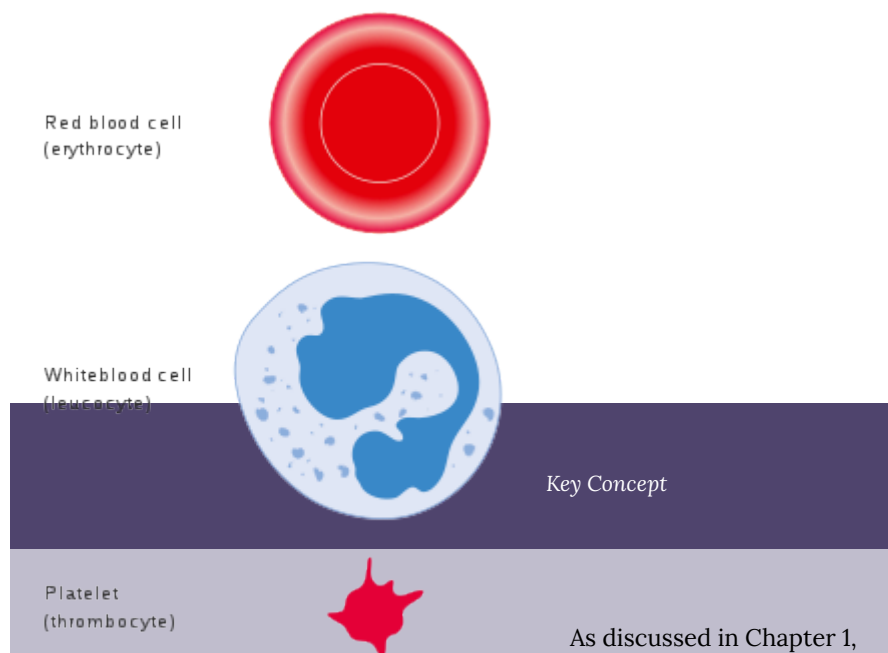
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2.4 Additional Suffixes

Suffixes are used in several other medical terms that do not fit the previous categories discussed. This page will review several suffixes and provide examples of terms. Note that there are a few suffixes that are very close in spelling but have slightly different meanings. It is important to be aware of these differences.

Table 2.23. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
-crine	secretion	endocrine
-cyte	cell	thrombocyte
-globin	protein	hemoglobin



Key Concept

Fig. 2.34

As discussed in Chapter 1, there are different types of cells in the human body. Fig. 2.34 provides a review of the three most common cell

types: **erythrocyte**, **leukocyte**, and **thrombocyte**. Note that all the cell names end with the suffix **-cyte**, meaning “cell,” and begin with a combining form that indicates the type of cell.

The term **hemoglobin** means “protein (**-globin**) in the blood (**hem/o**).” Hemoglobin is the part of the red blood cell that carries oxygen throughout the body and transports carbon dioxide back to the lungs (Mayo Clinic, 2022). Fig. 2.35 is an image of the complex hemoglobin cell structure. If you have low hemoglobin, you would be diagnosed with **anemia**. Various types of anemia were discussed in Chapter 1.

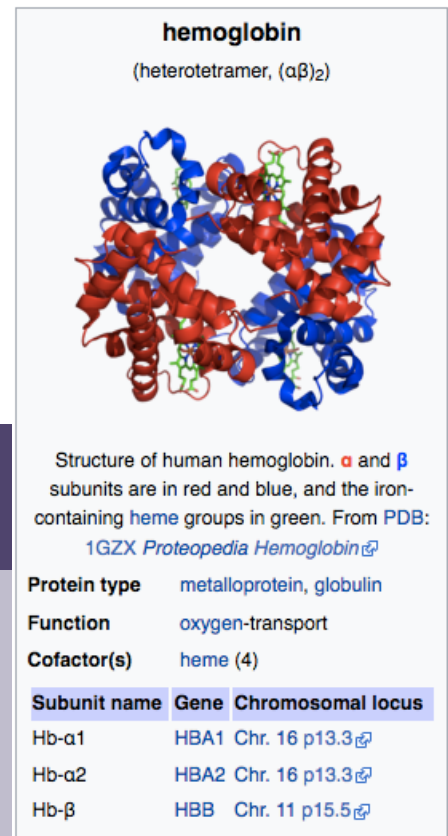


Fig. 2.35

Table 2.24. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
-gen	substance or agent that produces or causes	antigen
-genic	producing, originating, causing	carcinogenic

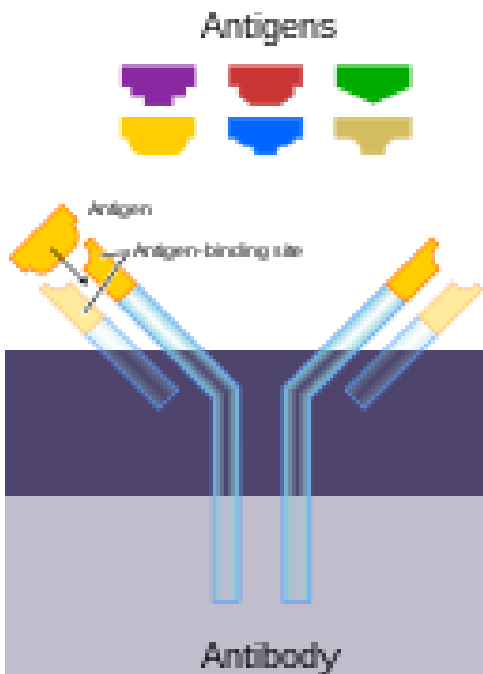


Fig. 2.36



Fig. 2.37

Key Concept

The term **antigen** literally means “to produce against.” Some examples of antigens are bacteria, viruses, and fungi. When an antigen enters the body, the immune system responds by producing **antibodies** to fight the antigen.

There are various ways to detect antigens in the body. An example is the rapid test for COVID-19 (Fig. 2.37), which is used to detect the presence of certain proteins on the COVID-19 virus found in a sample of bodily fluid.

Table 2.25. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
-plasia	formation (condition)	hyperplasia
-plasm	formation (tissue)	neoplasm

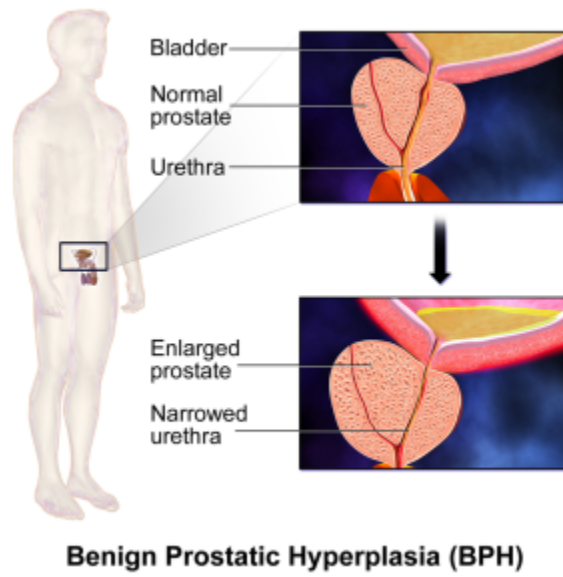


Fig. 2.38

Key Concept

Fig. 2.38 provides a comparison of a normal prostate and an enlarged prostate. When the prostate becomes enlarged and is non-cancerous, the individual is diagnosed with **benign prostatic hyperplasia (BPH)**. **Hyperplasia** means “formation (**-plasia**) that is excessive (**hyper-**).”

Fig. 2.41 below shows examples of several cell types, including hyperplasia. A physician may first treat BPH with medication, but if that does not work, they might perform a surgical procedure called a **transurethral resection of the prostate (TURP)** (WebMD, 2020).

Table 2.26. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
-iatrist	specialist	psychiatrist
-iatry	specialty, treatment	psychiatry
-logist	specialist who studies or treats	psychologist
-logy	study of	psychology



Fig. 2.40



Fig. 2.39

Key Concept

It is important to note that all the suffixes in Table 2.26 (**-iatrist**, **-iatry**, **-logist**, **-logy**) are very similar but have slightly different meanings. The context determines which suffix is used in a medical term. For example, **nephrology** means “the study of the kidneys,” whereas a **nephrologist** is a specialist who treats kidney disease. In fig. 2.39 and 2.40 there are different specialists at work in clinical and laboratory settings.

Table 2.27. Examples of -logy

MEDICAL TERM	MEANING
cardiology	study of the heart
dermatology	study of the skin
endocrinology	study of the endocrine system and hormones
gastroenterology	study of the stomach and intestines
gynecology	study of women
hematology	study of blood
immunology	study of immunity
neurology	study of nerves
oncology	study of tumours
ophthalmology	study of the eye
pathology	study of disease
pharmacology	study of medication
proctology	study of the anus and rectum
psychology	study of the mind
pulmonology	study of the lungs
radiology	study of X-rays
rheumatology	study of disease of the joints
urology	study of the urinary tract

Table 2.28. Suffixes

Suffix	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
-thesis	to put, to place	prosthesis
-troph	nourishment, development	atrophy
-al, -eal, -ar, -ary, -ic, -ior, -tic	pertaining to	renal, esophageal, vascular, pulmonary, pelvic, anterior, antibiotic

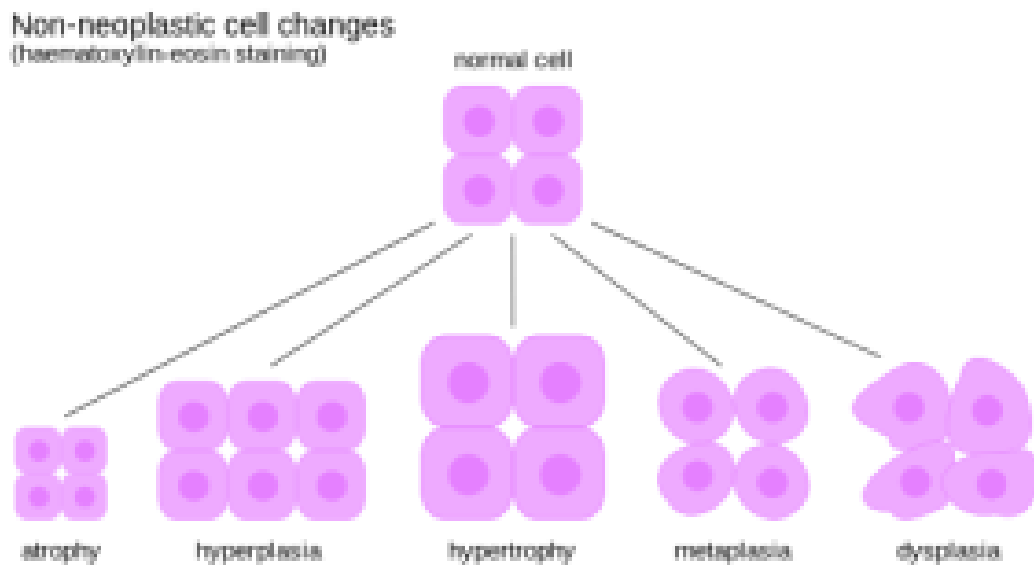


Fig. 2.41

Key Concept

There are a number of changes that cells can undergo, and Fig. 2.41 illustrates several of these using the suffixes **-trophy** (“nourishment” or “development”) and **-plasia** (“formation”).

- **atrophy**: No development; for example, when a cast is removed and the affected limb has decreased in size
- **dysplasia**: Formation that is abnormal; for example, children who have abnormal hip formation such as hip dysplasia (Medical News Today, 2022)
- **hyperplasia**: Formation that is excessive; for example BPH, seen in Fig. 2.38 (WebMD, 2020)
- **hypertrophy**: Development that is excessive; for example, the large muscles of a bodybuilder (Healthline, 2019).
- **metaplasia**: Cell formation that has changed; for example, lungs exposed to cigarette smoke may have cells that have changed shape (Giroux & Rustgi, 2017)

Exercises



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2.5 Review Exercises

The following final review exercises cover most of the suffixes and common medical terms in this chapter. It is important that you review all the content in this chapter in addition to completing this review to have a full understanding of all the concepts covered in Chapter 2.

Final Review



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CHAPTER III

PREFIXES

3.1 Introduction to Prefixes

Learning Objectives

By the end of this chapter you should be able to

1. Define the term “prefix” and list common prefixes
2. List common prefixes related to location
3. List common prefixes related to diagnostic tests and patient symptoms
4. List common prefixes related to numbers and size
5. Identify key medical concepts discussed in this chapter
6. Define common medical terms related to prefixes discussed in this chapter

Chapter Overview

Although prefixes are not present in all medical terms, their use is important in medical terminology because they provide an added layer of detail when discussing aspects of health care. We will explore the use of prefixes in terms that describe patient symptoms, diagnostic procedures, numbers, size, location, and other medical concepts. As has been done in the previous chapters, examples and explanations will be provided throughout. The exercises and review activities are designed to strengthen your knowledge of prefixes and medical terminology as a whole. Extra review of combining forms and suffixes that were introduced earlier in the book will also be provided. A solid foundation of knowledge concerning prefixes, suffixes, and combining forms is needed before we go on to other chapters and more detail about body systems, tests and procedures, and hospital-specific content.

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3.2 Prefixes for Location

Prefixes are often used for terms related to locations both within and outside the body. It is important to note that although some prefixes are very similar in meaning and spelling, the way they are used varies greatly. Examples will be provided that demonstrate the proper use of prefixes in medical terms related to location. Some of these prefixes were introduced earlier in the book; however, the their use can be complex, and it is important to understand these concepts fully.

Table 3.1. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
ab-	away from	abduction
ad-	toward, near	adrenal

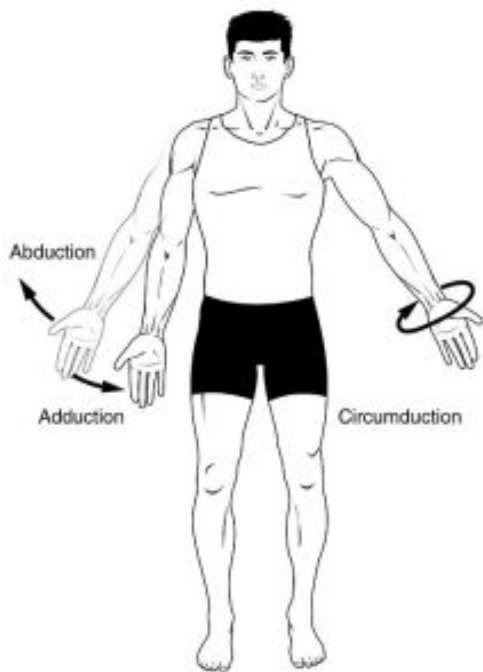


Fig. 3.1

Key Concept

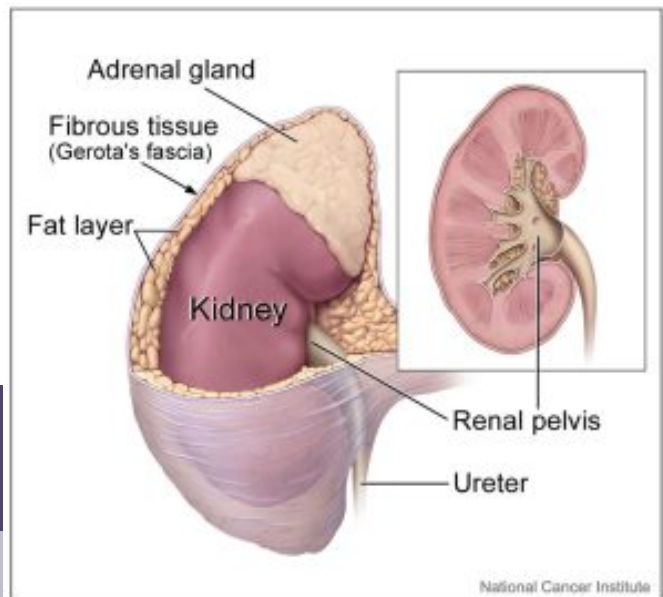


Fig. 3.2

Abduction and **adduction** are two very similar terms that mean the opposite of each other. Both include the suffix **-duction**, which means “leading, bringing, or conducting” (RxList, 2021). Fig. 3.1 shows how the two terms are different in that abduction involves moving a limb away from the midline of the body, and adduction means bringing a limb inward toward the midline.

Adrenal glands are a part of the endocrine system, and, as the name indicates, they are located “near” (**ad-**) the “kidneys” (**ren/o**). Fig. 3.2 provides the exact location of the adrenal glands—one lies on top of each kidney.

Table 3.2. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
endo-	within, in, inner	endocrine
exo-	out	exocrine

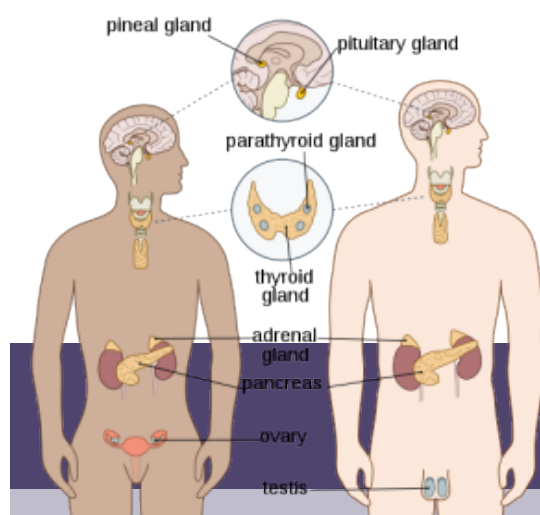


Fig. 3.3

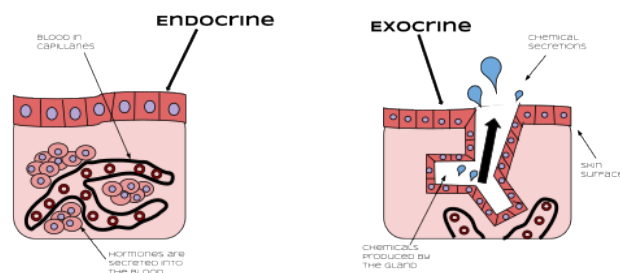


Fig. 3.4

Key Concept

The **endocrine system** is made up of a series of glands that regulate hormones throughout the body; all the endocrine glands are shown in Fig. 3.3. It is important to differentiate between **endocrine glands** and **exocrine glands** (Fig. 3.4). Endocrine glands secrete hormones within the body and the blood, whereas exocrine glands secrete chemicals outside the body (Betts et al., 2013). Their names suggest their function in that **endo-** means “within” and **exo-** means “out” (Betts et al., 2013).

Table 3.3. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
ec-	out, outside	ectopic
ex-	out	excision
extra-	outside	extravascular

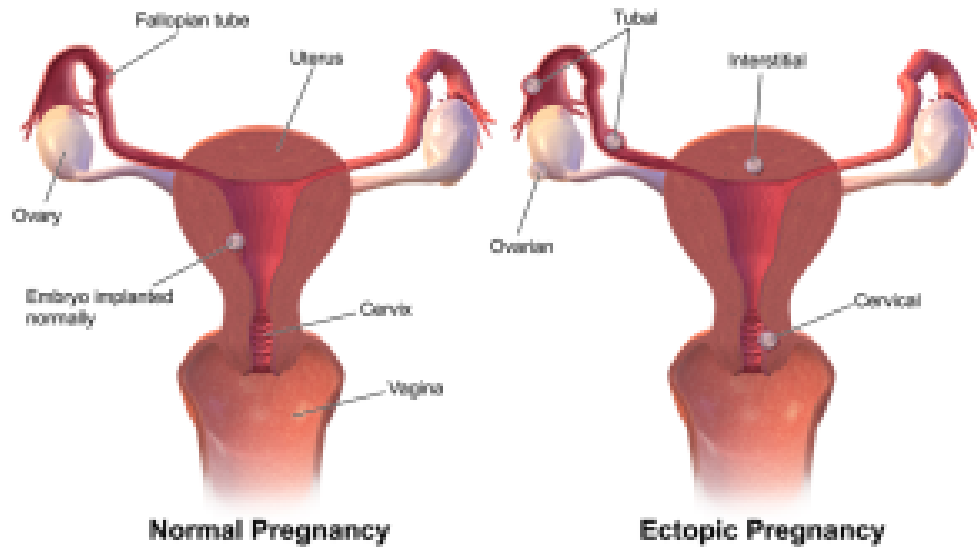


Fig. 3.5

Key Concept

An **ectopic pregnancy** is a pregnancy outside its normal location. Fig. 3.5 shows the normal location of a pregnancy within the uterus and an ectopic pregnancy in an ovary, cervix, fallopian tubes, or abdomen. An ectopic pregnancy can be life threatening because the developing embryo has no room to grow. This condition can result in the surrounding area rupturing and causing the individual to **hemorrhage** internally (Betts et al., 2013).

As can be seen from Table 3.3, there are a number of prefixes with similar meanings. They are, however, used very differently in medical terminology. With practice and familiarity, it will become easier to know which prefix to use for a particular term.

Table 3.4. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
epi-	above, upon	epidural

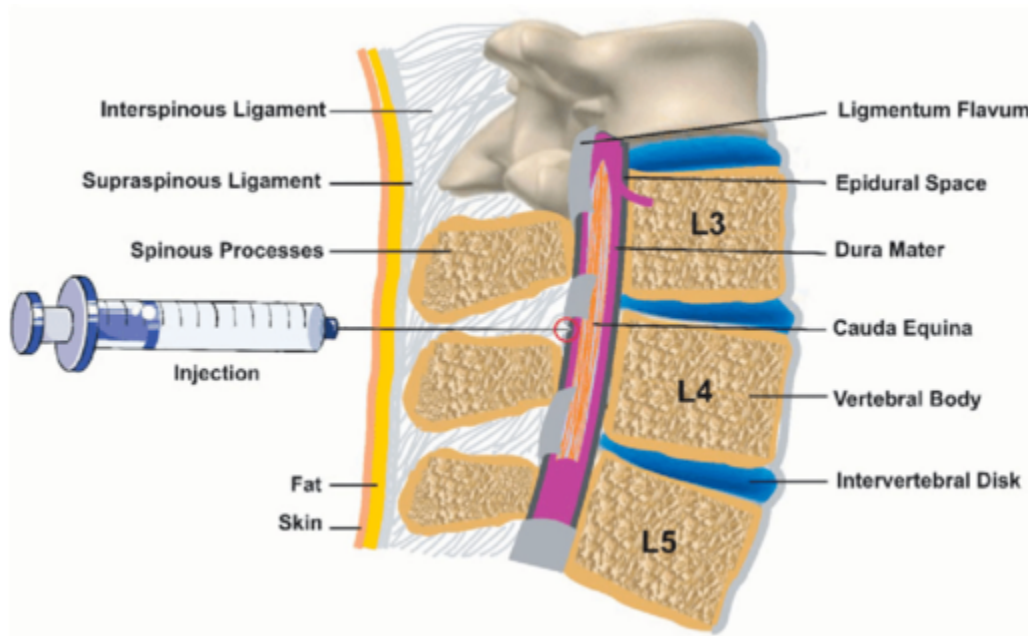


Fig. 3.6

Key Concept

An **epidural** (Fig. 3.6) involves some form of injection into a patient's spine to stop feeling to the area of the body below that point in the spinal cord. Epidurals are performed on patients in labour or for surgery to the lower extremities (NHS, 2020). A similar procedure is called a **lumbar puncture** or **spinal tap**, which involves taking a sample spinal fluid for analysis.

Table 3.5. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
in-	in, into	incision
inter-	between	intercellular
intra-	within	intradermal



Fig. 3.7

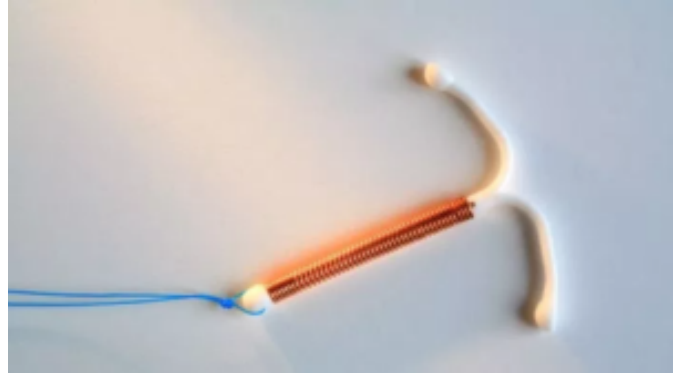


Fig. 3.8

Key Concept

Intradermal injections are commonly used for tuberculosis testing, analgesics, anesthetics, and allergy testing. An intradermal injection is placed just below the skin surface, as seen in Fig. 3.7. Another use of the prefix **intra-** (“within”) is seen in the medical term **intrauterine device** (Fig. 3.8), which is a means of birth control that is placed within the uterus.

Table 3.6. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
para-	beside, near, along the side of	parathyroid
peri-	surrounding	pericardium

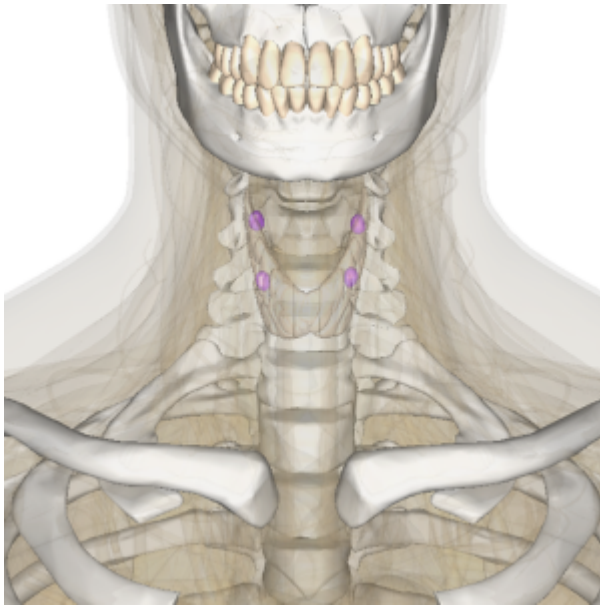


Fig. 3.9

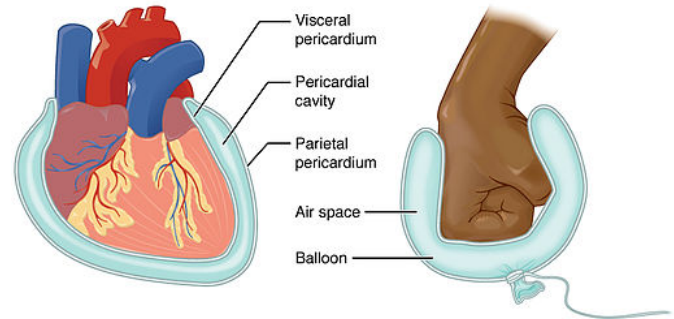


Fig. 3.10

Key Concept

The **parathyroid glands** are located “along the side of” (**para-**) the thyroid gland. There are four of them, two on each side of the thyroid, and they are a part of the endocrine system. Fig 3.9 shows the location of the parathyroid glands (in pink) with the thyroid gland beneath.

The **pericardium** “surrounds” (**peri-**) the heart, and it both holds the heart in place and protects it (Medline Plus, 2022a). In Fig. 3.10, you can see that the pericardium provides cushioning for the heart, similar to the manner that the balloon in the figure is cushioning the fist.

Table 3.7. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
pro-	before, forward	prothrombin
pros-	before, forward	prosthesis

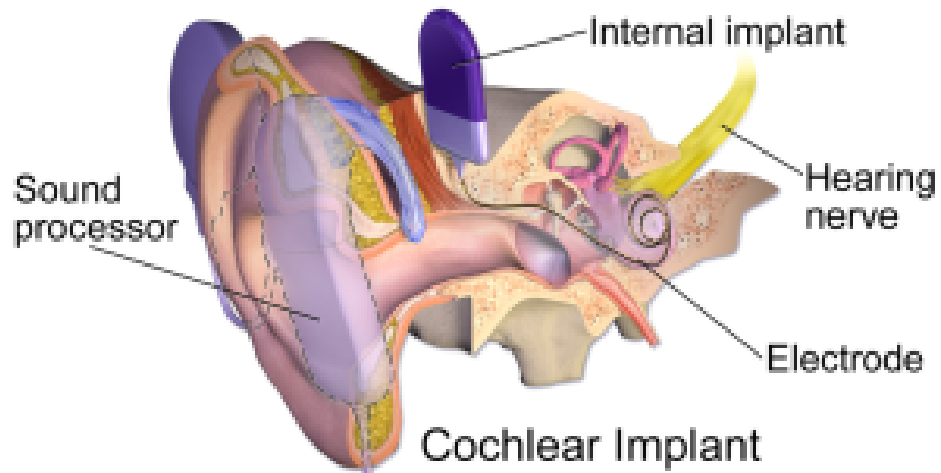


Fig. 3.11

Key Concept

There are various types of **medical prostheses**, and the term **prosthesis** comes from the suffix **-thesis** (“put” or “place”) and the prefix **pros-** (“before” or “forward”); it literally means “to place before,” as in replacement. Prostheses, or prosthetic implants, can be used to replace a missing body part or function and are intended to restore normal function. A **cochlear implant** (Fig. 3.11) is an example of a medical prosthesis and is used to treat sensorineural deafness (Yawn et al., 2015).

Table 3.8. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
re-	back, behind	relapse
retro-	back, behind	retroperitoneal

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
sub-	under, less than	subdural
supra-	above	suprapubic

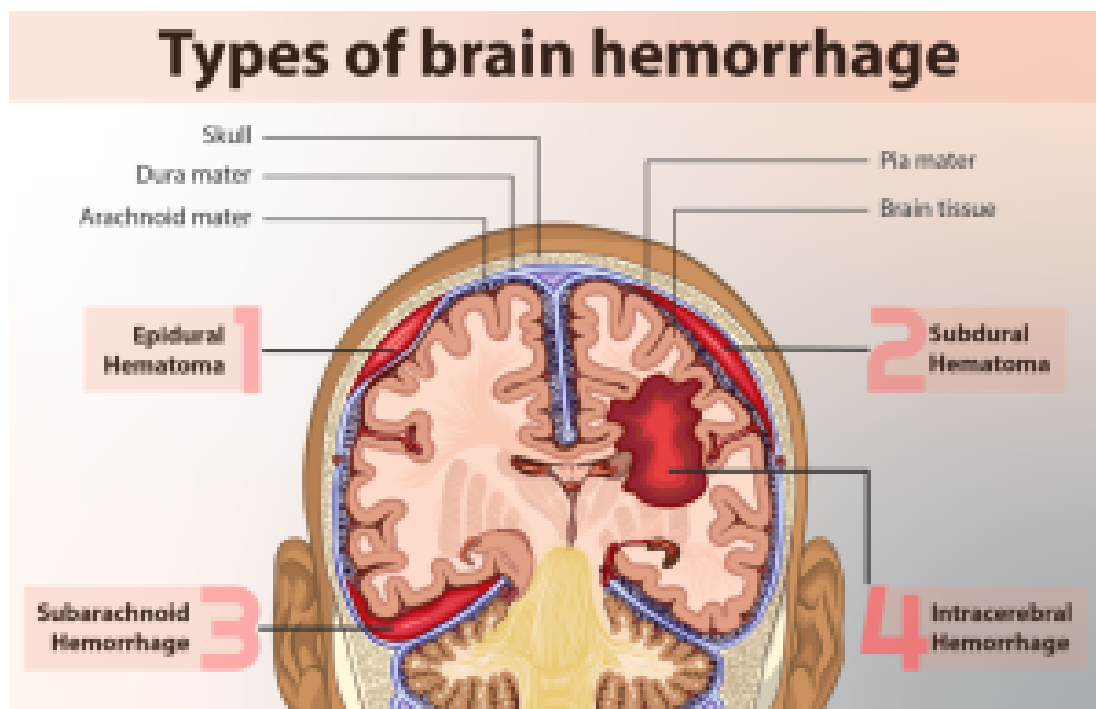


Fig. 3.13

Key Concept

Figure 3.13 above was introduced earlier in the book and shows four different types of brain **hematomas** and **hemorrhages**. Now that you have a better understanding of prefixes, it is possible to interpret the different types shown in the diagram:

- An **epidural hematoma** is a mass of blood “above” (**epi-**) the dura mater.
- A **subdural hematoma** is a mass of blood “below” (**sub-**) the dura mater.
- A **subarachnoid hemorrhage** is excessive bleeding “below” (**sub-**) the arachnoid, which is a thin layer of tissue on the dura mater (Cleveland Clinic, 2022).
- The final type of hemorrhage in this figure is the **intracerebral hemorrhage**, which literally means “pertaining to” (**-al**) “withi”n (**intra-**) “the cerebrum” (**cerebr/o**).

Table 3.10. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
trans-	across, through	transdermal



Fig. 3.14

Key Concept

A



Fig.3.15

transdermal patch is an effective route for giving medication to a patient. The medication is absorbed “through” (**trans-**) the skin. Nicotine patches are a common example of this medication route. Other common uses for transdermal patches include birth control, nitroglycerin for angina, and analgesics for pain. Fig. 3.14 shows an example of a transdermal patch being applied to a patient.

Transurethral resection of the prostate (TURP) is a procedure often used to treat **benign prostatic hyperplasia (BPH)** (Johns Hopkins, 2022). Fig. 3.15 shows the procedure being completed using an instrument that is placed “through” (**trans-**) the urethra to remove some of the enlarged prostate.

Exercises



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3.3 Prefixes for Diagnostic Procedures and Symptoms

Prefixes are often used for terms related to diagnostic tests and to symptoms that patients might be experiencing. Examples will be provided that illustrate the manner in which prefixes are used for such terms. Some of these prefixes were introduced in the first chapter, but their use will be explained in further detail here.

Table 3.11. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
a-, an-	no, not, without	amenorrhea
ana-	up, apart	analysis



Fig. 3.16

Key Concept

The term **analysis** literally means “to separate” (**-lysis**) “apart” (**ana-**). Fig. 3.16 is an image of a urine specimen ready for analysis, a procedure called **urinalysis**. The urine is closely analyzed for specific contents such as sugar, protein, bacteria, and blood (Mayo Clinic, 2022b). The information from the analysis is then used to monitor a person’s overall health and assist with diagnosing certain diseases or infections such as diabetes, kidney disease, and urinary tract infections (UTIs).

In health care, pretty much any type of specimen can be analyzed to assist with the diagnosis of a medical condition, disease, or infection. For example, a semen specimen can be analyzed to look at the size, motility, and amount of sperm (Cleveland Clinic, 2022). Other bodily fluids can be analyzed as well, including sputum, wound drainage, and stool.

Table 3.12. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
ante-	before, forward	ante ^{partum}
brady-	slow	brady ^{cardia}



Fig. 3.17

Key Concept

As discussed previously, the term **antepartum**, meaning “before” (**ante-**) “birth” (**-partum**), is the period of time before a woman delivers their baby. In some hospitals, there is an antepartum unit in which mothers stay if they are having complications with their pregnancy. The time after a woman gives birth is called **postpartum**, meaning “after” (**post-**) “birth” (**-partum**). Once again, some hospitals will have a postpartum unit where patients will stay for as little as a day or much longer depending on how their birthing experience went.

Bradycardia, meaning “condition” (**-ia**) of a “slow” (**brady-**) “heart” (**cardi/o**), refers to a heart beating more slowly than normal (Mayo Clinic, 2022a). This can occur for several reasons, including damage to the heart tissue, medications, birth defect, and thyroid disorders. Fig. 3.17 is an image of a **pulse oximeter**, a device that measures heart rate and oxygen level.

Bradypnea meaning “breathing” (**-pnea**) “slowly” (**brady-**). This is a condition in which a person breathes at a slower than normal rate (Smith, 2020). **Sleep apnea**, which was discussed in a previous chapter, is a condition in which a person may stop breathing (**apnea**) in addition to breathing more slowly than normal (**bradypnea**) and therefore not get enough oxygen. Bradypnea can also occur with a drug overdose or in carbon monoxide poisoning.

Table 3.13. Prefixes

Prefix	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
dys-	painful, difficult, abnormal	dyspnea

Key Concept

The prefix **dys-**, which means “painful, difficult or abnormal,” is used in a number of medical terms, usually relating to a symptom that a patient might be experiencing. Table 3.14 below lists some of the more common terms that use this prefix. There are, of course, more, and on specialty units in a hospital, there are likely others that will be commonly heard as well.

Dysuria, meaning “a urine condition” (**-uria**) that is “painful” (**dys-**), is often one of the symptoms of a **urinary tract infection (UTI)**. As mentioned above, a patient will likely have a **urinalysis** to help diagnose a UTI (Mayo Clinic, 2022c).

Table 3.14. Examples of dys-

MEDICAL TERM	MEANING
dysentery	condition of painful intestines
dyspepsia	digestion that is painful
dysphagia	difficulty swallowing
dysphasia	difficulty with speech
dysplasia	abnormal formation
dyspnea	difficulty breathing
dysmenorrhea	painful menstrual flow
dysuria	painful urination

Table 3.15. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
hyper-	excessive, too much, above	hypertension
hypo-	deficient, too little, below	hypotension

Key Concept

The prefixes **hyper-** and **hypo-** are used in many medical terms, and it is critical to use the correct prefix because they mean the exact opposite of one another. The list below demonstrates this concept:

- **hyperglycemia** (blood sugar that is **high**)
- **hypoglycemia** (blood sugar that is **low**)

- **hypertension** (pressure that is **high** or **high** blood pressure)
- **hypotension** (pressure that is **low** or **low** blood pressure)

- **hyperthyroidism** (condition of **high** thyroid)
- **hypothyroidism** (condition of **low** thyroid)

- **hyperkalemia** (blood condition with **high** potassium)
- **hypokalemia** (blood condition with **low** potassium)

Table 3.16. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
mal-	bad	malignant
meta-	change, beyond	metastasis
neo-	new	neoplasm



Fig. 3.18

Key Concept

Fig. 3.18 is an image of a **neoplasm**. This term has the prefix **neo-** (“new”) and the suffix **-plasm** (“formation”). A neoplasm occurs when cells reproduce more than they should. It can be **benign** (non-cancerous) or **malignant** (cancerous), and if the cancer spreads to another place, such as other tissues or organs, it is called **metastasis**, meaning “place” (**-stasis**) that has “changed” (**meta-**) (National Cancer Institute, 2022).

Table 3.17. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
pre-	before	precancerous
post-	after	postmortem
tachy-	fast	tachycardia

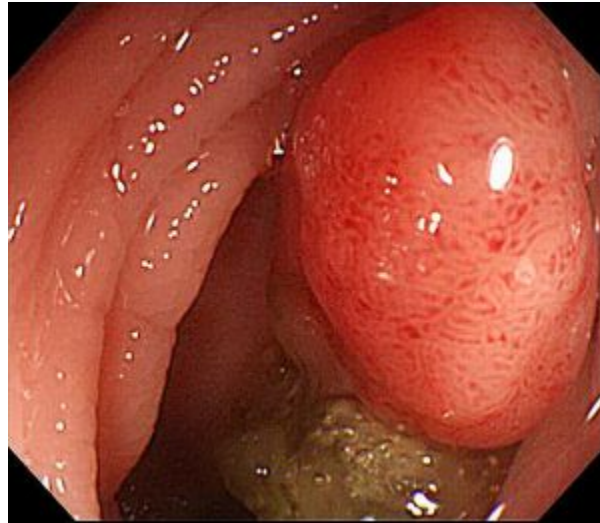


Fig. 3.19

Key Concept

The prefix **pre-**, meaning “before,” is used in a number of medical terms; for example:

- **precancerous** (“pertaining to before cancer”; for example, a precancerous colonic polyp, shown in Fig. 3.19)
- **prenatal** (“pertaining to before birth”; for example, prenatal care)

The prefix **tachy-** (“fast”) is the opposite of the prefix **brady-** (“slow”). **Tachycardia** means a “condition” (**-ia**) of a “fast” (**tachy-**) “heart” (**cardi/o**) and can occur during exercise or can be a serious medical conditions such as an **arrhythmia**.

Tachypnea, meaning “breathing” (**-pnea**) that is “fast” (**tachy-**), is the opposite of **bradypnea**, which was discussed earlier on this page. Tachypnea can occur when a person is exercising vigorously or with certain medical conditions such as **asthma**, **chronic obstructive pulmonary disease (COPD)**, and **pneumonia** (Berry & Fletcher, 2022).

Exercises



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3.4 Prefixes for Number and Size

Prefixes are often used to provide details concerning numbers and size. They provide added detail and specifics concerning the topic at hand. Although there are not many of these prefixes, they are still very important aspects of medical terminology. They will be discussed below with examples and practice questions to solidify your knowledge.

Table 3.18. Number Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
nulli-	none	nulliparous
uni-	one	unilateral
bi-	two, both	bilateral
bin-	two	binocular
tri-	three	triceps
quadri-	four	quadriplegia

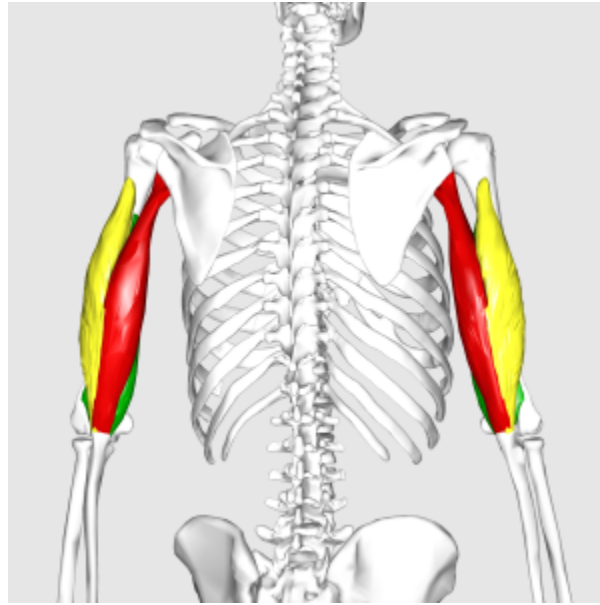


Fig. 3.20

Key Concepts

Numbers are often used in medical terminology, especially in the form of prefixes. For example, the terms **unilateral** and **bilateral** make it clear whether one side of the body or both sides are being discussed.

The **triceps**, shown in Fig. 3.20, is a large, thick muscle on the dorsal part of the upper arm. It often appears as a horseshoe shape on the posterior aspect of the arm, and the main function of the triceps is the extension of the elbow joint (Physiopedia, 2022). The prefix **tri-** (“three”) refers to the muscle’s three attachment points—the medial head, lateral head, and long head.

Table 3.19. Prefixes for Amounts

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
hemi-	half	hemiplegia
multi-	many	multipara
oligo-	few, very little	oliguria
pan-	all	pancytopenia
poly-	many, much	polydactyly



Fig. 3.21

Key Concept

When a baby is born with one or more extra fingers or toes, it is referred to as **polydactyly** (“pertaining to many digits”). It is a common condition, and approximately one out of every 500 to 1,000 babies is born with the condition (Boston’s Children’s Hospital, 2022). This is one of the most common **congenital** (“present at birth”) hand abnormalities and often runs in families.

Other medical terms with the prefix **poly-** are listed in Table 3.20 below.

Table 3.20. Examples of poly-

MEDICAL TERM	MEANING
polydipsia	pertaining to much thirst
polydactyly	pertaining to many digits
polycystic	pertaining to many cysts
polymyositis	inflammation of many muscles
polyuria	pertaining to much urine
polyneuropathy	disease condition of many nerves
polyposis	state of many polyps

Table 3.21. Prefixes for Size

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
macro-	large, long	macrophage
micro-	small	microscope

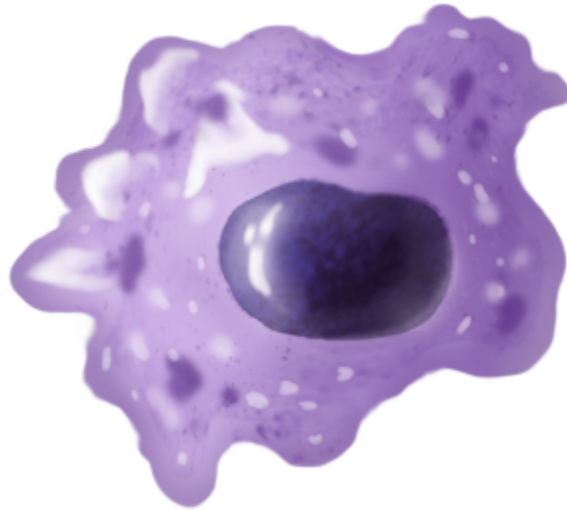


Fig. 3.22

Key Concept

A **macrophage**, shown in Fig. 3.22, is a type of white blood cell (WBC) that works by surrounding and killing microorganisms (National Cancer Institute, n.d.). It also removes dead cells and stimulates the action of other immune system cells.

Exercises



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3.5 Additional Prefixes

This page focuses on prefixes not covered in the previous sections. Some of these prefixes were introduced earlier in the book; however, their use can be complex, and it is important to understand these concepts fully. Examples and review exercises will be provided to help you learn and remember these important concepts.

Table 3.22. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
anti-	against	antibiotic

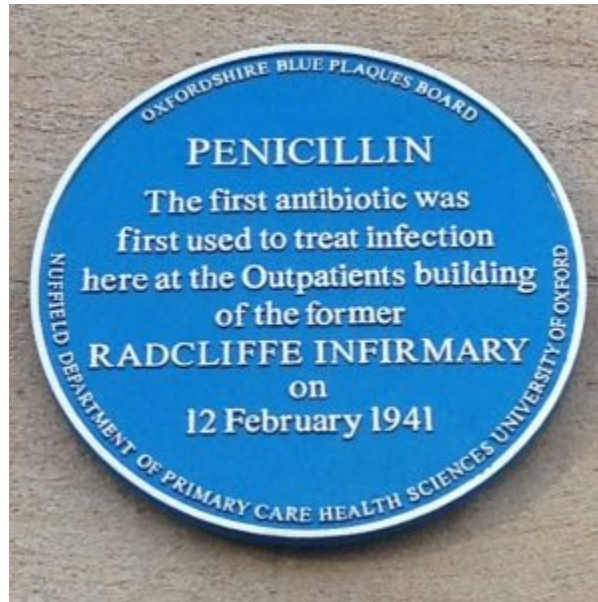


Fig. 3.23

Key Concept

As discussed in Chapter 2, **antigens**, which means “producing against,” are foreign substances such as bacteria, viruses, or fungi that enter the body. When a foreign substance enters the body, the body reacts by producing **antibodies**, a term that means “working against the bodies of the foreign substance.” If the foreign substance is a bacteria, your doctor would likely prescribe an **antibiotic**, a term that means “pertaining to” (**-tics**) “against” (**anti-**) “life” (**bi/o**). Fig. 3.23 is a plaque commemorating the use of the first antibiotic, **penicillin** (NHS, 2019).

Table 3.23. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
dia-	complete, through	diagnosis

Key Concepts

The prefix **dia-** (“complete”) is frequently used in medical terms; for example, in the term **diagnosis**, which most people are familiar with. **Diagnosis** means “pertaining to knowledge” (**gnos/o -is**) that is “complete” (**dia-**), or “complete knowledge.” Once a physician has all the necessary information to provide a patient with a proper diagnosis, they will often tell the patient their **prognosis**. This term literally means “knowledge before,” and in this situation, prognosis refers to how the physician feels a patient’s outcome will be with or without treatment.

There are several other medical terms that use the prefix **dia-**. The list below provides some examples, but you may hear others, especially in hospital specialty units:

- **diaphragm:** The muscle separating the abdominal and thoracic cavities
- **dialysis:** Separation that is complete; as discussed previously, there are two types—peritoneal dialysis and hemodialysis
- **diameter:** Measure completely
- **diarrhea:** Flow completely

Table 3.24. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
de-	from, down, away from	dehydration
eu-	good, normal	euphoria

Key Concept

The term **dehydration** means “condition” (**-ation**) of “down” (**de-**) “water” (**hydr/o**). On average, a person requires four to six cups of water a day to avoid dehydration, but this may vary depending on a person’s activity level, the climate, and whether or not they have other health conditions that require them to drink more or less water based on a physician’s advice (Harvard Medical School, 2020).

Table 3.25. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
hemi-	half	hemiplegia

Key Concepts

The prefix **hemi-** (“half”) is used in a number of terms, especially those related to surgical procedures; for example:

- **hemigastrectomy:** Removal of half the stomach
- **hemicolectomy:** Removal of half the colon
- **hemiarthroplasty:** Surgical repair of half a joint

The prefix **hemi-** is also used in terms related to symptoms that a patient might be experiencing; for example, **hemiplegia**, meaning “paralysis” (**-plegia**) of “half” (**hemi-**), might refer to paralysis of the right or left side of the body as a result of a cerebrovascular accident (CVA), or stroke. If a patient is experiencing paralysis of the lower half of their body, the term used is **paraplegia**. When a person has paralysis of all four extremities, this is called **quadriplegia**.

Table 3.26. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
sym-	together, with, joined	symbiotic
syn-	together, with, joined	syndrome

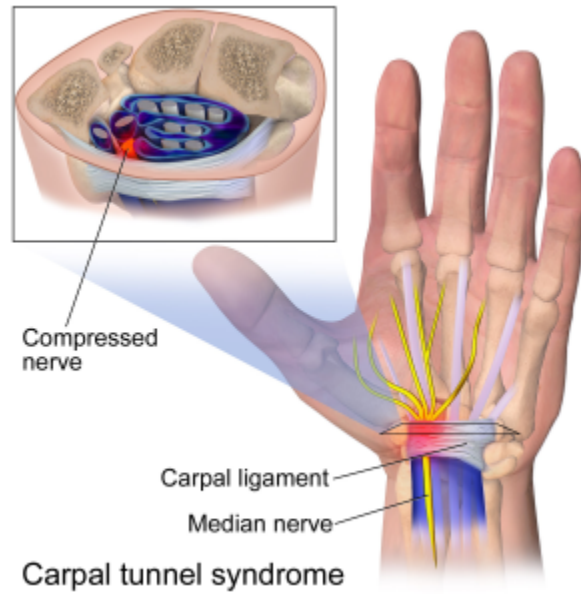


Fig. 3.24

Key Concept

Fig. 3.24 is an illustration of a common **syndrome** that may affect healthcare workers, **carpal tunnel syndrome**, from the suffix **-al** (“pertaining to”) and **carp/o** (“wrist”). This condition is a type of **repetitive strain injury (RSI)** and can be caused by such activities as typing, overexertion, and various clinical tasks that require the use of fine motor skills (ReliasMedia, 2012).

Table 3.27. Prefixes

PREFIX	MEANING	EXAMPLE OF USE IN A MEDICAL TERM
ultra-	beyond	ultrasonogram



Fig. 3.25



Fig. 3.26

Key Concept

Ultrasonography, which means “process of recording” (-graphy) “beyond” (**ultra-**) “sound” (**son/o**), is commonly used to help diagnose the cause of pain or to assess for abnormalities or infections

(RadiologyInfo.org, 2020). Fig. 3.25 is an image of ultrasound equipment that would be used by an ultrasound technician or radiologist. Fig. 3.26 is an obstetrical ultrasound that is used to assess the health of a fetus.

Exercises



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3.6 Review Exercises

The following review exercise covers most of the prefixes, combining forms, and suffixes used in the medical terms related to the prefixes in this chapter. It is important that you review all the content in this chapter in addition to completing this review to have a full understanding of all the concepts covered in Chapter 3.

Exercises



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CHAPTER IV

ABBREVIATIONS

4.1 Introduction to Abbreviations

Learning Objectives

By the end of this chapter, you should be able to

1. Define abbreviations pertaining to patient medications
2. Define abbreviations pertaining to patient activity and nutrition orders
3. Define abbreviations pertaining to patient diseases and symptoms
4. Define abbreviations pertaining to patient diagnostic tests and procedure orders
5. Define abbreviations pertaining to laboratory obstetrical and psychiatric orders
6. Describe the use of the 24-hour clock

Chapter Overview

Abbreviations are commonplace in medical settings. Because of the possibility of errors, certain abbreviations are not allowed in some facilities, so it is important to review which abbreviations are, and are not, allowed in any medical setting you may find yourself working in. This chapter will provide a thorough overview of abbreviations, their meanings, and key concepts to consider when you see or use abbreviations in your future work setting. Although there are a number of abbreviations covered in this chapter, you may see others in your practice. This is especially true in more specialized settings and hospital units. The tables, pictures, exercises, and final chapter review will give you a solid foundation of knowledge about abbreviations. As you progress through future chapters in this book, you will see some of these abbreviations again as they relate to body systems, tests, and medical concepts.

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4.2 Activity and Nutrition Orders

Activity and nutrition orders are often seen in a hospital setting and even in some clinics. **Activity orders** describe what a patient can do to mobilize within the hospital, and **nutrition orders** focus on what, or whether or not, a patient can eat or drink. Certain units, such as those that perform surgery, often make changes to patients' nutrition and activity orders. If a patient is waiting for surgery or has just had surgery, their ability to eat or mobilize will be affected. The most common activity and nutrition orders are shown below, and examples of their use are provided.

Activity Orders

Table 4.1. Activity Orders

ABBREVIATION	MEANING
AAT	activity as tolerated
ad lib	freely as desired
ADL	activities of daily living
BR	bedrest
BRP	bathroom privileges
PWB	partial weight-bearing

Key Concept

Although some of the abbreviations and their meanings above are clear, others are more complicated. For example, **activities of daily living (ADL)** are anything we complete on a daily basis and include tasks such as brushing teeth, showering, changing clothes, and brushing one's hair. **Freely as desired (Ad lib)** means that the patient can get up and out of bed whenever they so choose, and **activity as tolerated (AAT)** means that the patient can mobilize whenever they feel comfortable and stop when the activity becomes painful or uncomfortable.

Examples of activity orders:

1. BR with BRP
2. Pt to progress to AAT x 2 days post-op

Explanation of the activity orders:

1. Bedrest with bathroom privileges (patient is to stay in bed except to use the bathroom).
2. Patient to progress to activity as tolerated two days after surgery.

Nutrition Orders

Table 4.2. Nutrition Orders

ABBREVIATION	MEANING
CDA	Canadian Diabetes Association
CL flds	clear fluids
DAT	diet as tolerated
FDA	Food and Drug Administration
H2O	water
NPO	nothing by mouth
WDW	when drinking well

Key Concepts

Often abbreviations in nutrition orders are used progressively. For example, if a patient has had surgery, they may be **NPO (nothing by mouth)** immediately following surgery, then progress to **Cl. flds (clear fluids)**. Afterwards, they may be assessed and ordered **WDW (when drinking well)**, which means they are tolerating fluids, and progress to **DAT (diet as tolerated)**. At that point, they can eat and drink as much as they can tolerate without becoming uncomfortable or experiencing nausea.

Examples of nutrition orders:

1. For possible surgery in am, NPO after midnight
2. Cl. flds today then progress to DAT WDW

Explanation of the nutrition orders:

1. For possible surgery in morning, nothing by mouth after midnight.
2. Clear fluids today, then progress to diet as tolerated when drinking well.

Exercise



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4.3 Diagnostic Tests

There are several diagnostic test abbreviations used in various healthcare settings. The tables below list abbreviations followed by key concepts and some example orders to help you understand the terms and the ways in which they could be used. Some abbreviations are very similar, with just a change in a capital or lowercase letter, but this change totally alters the meaning of the abbreviation.

Table 4.3. Diagnostic Tests

ABBREVIATION	MEANING
Angio	angiography
A&P	auscultation and percussion
Alb	albumin
Alk phos	alkaline phosphatase
Ba	barium
BaE	barium enema
BMR	basal metabolic rate
bs	blood sugar
BUN	blood urea nitrogen

Key Concepts



Fig. 4.1

The abbreviation **A&P (auscultation and percussion)** is a form of assessment in which the healthcare provider **auscultates**, or listens, to a body part, usually with a stethoscope. In Fig. 4.1, the physician is listening to a patient's lungs with a stethoscope. When performing **percussion**, the physician uses their hand in a striking movement to a body part, then listens to the sound that occurs. A lower-pitched sound indicates that there could be a mass in that area, whereas a higher-pitched sound indicates air in the space.

What is barium, anyway? **Barium** is a liquid contrast medium that can be taken orally (**barium swallow**) or through the rectum (**barium enema**). It helps visualize the organs when certain types of imaging are performed; for example, X-rays or CT scans.

Examples of diagnostic test orders:

1. BaE tomorrow am
2. bs to be taken at 0800 and 1600 today
3. Coronary Angio to rule out blockage ASAP

Explanation of diagnostic test orders:

1. Barium enema tomorrow morning.
2. Blood sugar to be taken at 8 o'clock in the morning and 4 o'clock in the afternoon today.
3. Coronary angiogram to rule out blockage as soon as possible.

Table 4.4. Diagnostic Tests

ABBREVIATION	MEANING
C&S	culture and sensitivity test
Ca	calcium
CBC	complete blood count
CO2	carbon dioxide
CSF	cerebrospinal fluid
C-spine	cervical spine films
CT	computerized tomography
CXR	chest X-ray
DI	diagnostic imaging
diff	differential

Key Concepts



Fig. 4.2

Fig. 4.2 is an image of a **culture and sensitivity (C&S)** test used to help determine which antibiotics the bacteria being tested are sensitive to and which they are resistant to. In the dish on the left, the bacteria are all sensitive to the antibiotic, and in the dish on the right, most of the bacteria are resistant to the antibiotic, so it would not be an effective treatment. A culture and sensitivity test can be done on any specimen if an infection is suspected; for example, wound tissue, stool, or urine.

What is a diff? A **diff (differential)** is a blood test that measures the percentage of all the different types of blood cells in your blood, such as monocytes, basophils, and eosinophils. It is used to look for infections, allergic reactions, and certain diseases (Whitten, 2021).

Examples of diagnostic test orders:

1. Urine for C&S STAT
2. CBC with diff
3. CXR ASAP

Explanation of diagnostic test orders:

1. Urine for culture and sensitivity immediately.
2. Complete blood count with differential.
3. Chest X-ray as soon as possible.

Table 4.5. Diagnostic Tests

ABBREVIATION	MEANING
DRE	digital rectal exam
ECG	electrocardiogram
Echo	echocardiogram
EEG	electroencephalogram
EMG	electromyogram
ERCP	endoscopic retrograde cholangiopancreatography (test of the pancreas and gallbladder)
ESR	erythrocyte sedimentation rate
ESWL	extracorporeal shock wave lithotripsy
ETOH	level of alcohol consumption or ethyl alcohol
ETT	exercise tolerance test

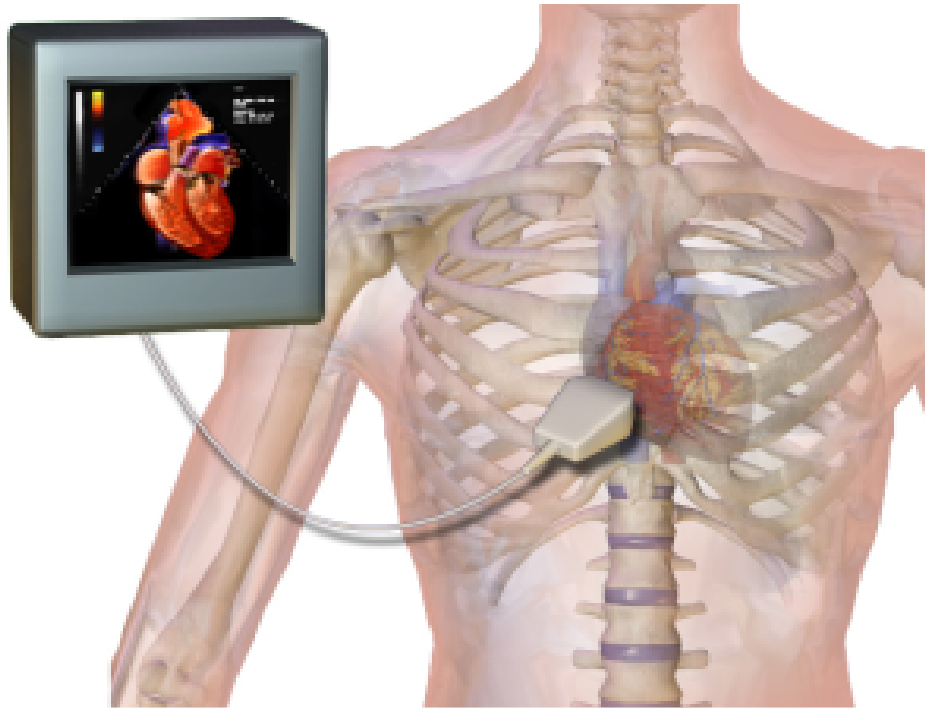


Fig. 4.3

Key Concept

An **ECG (electrocardiogram)**, as discussed in a previous chapter, records the electrical activity of the heart. An **Echo (echocardiogram)**, on the other hand, uses sound waves to create an image of the heart, its structures, and how it is functioning to ensure that it is working correctly.

Examples of diagnostic test orders:

1. ECG and Echo @ 0900
2. Diagnostic EEG for seizure activity
3. Patient to have ETT tomorrow am due to increased angina

Explanation of diagnostic test orders:

1. Electrocardiogram and echocardiogram at 9 o'clock in the morning.
2. Diagnostic electroencephalogram for seizure activity.
3. Patient to have exercise tolerance test tomorrow morning due to increased angina.

Table 4.6. Diagnostic Tests

ABBREVIATION	MEANING
FBS	fasting blood sugar
Fe	iron
Ga scan	gallium scan
GTT	glucose tolerance test
H	hydrogen
HCG	human chorionic gonadotropin (pregnancy test)
Hct	hematocrit
HDL	high density lipoprotein
Hg	mercury
Hgb	hemoglobin

Fasting blood sugar (FBS) is a test performed to determine a person's blood sugar level after fasting (not eating) for eight hours. This test is usually performed to determine whether or not a person has diabetes (Alberta Health Services, 2022a).

The **glucose tolerance test (GTT)** measures the body's ability to process and use certain sugars, such as glucose. During an oral glucose tolerance test, a patient will drink a small amount of a very concentrated sweetened drink, then their glucose level is measured one to three hours later (Alberta Health Services, 2022a). Most of the time, FBS is taken prior to this test, and the results are compared. This test is most commonly used to detect gestational diabetes in pregnant women.

Examples of diagnostic test orders:

1. FBS in AM NPO at 2400
2. Add Hgb and Fe to routine lab tests
3. HCG on arrival to unit

Explanation of diagnostic test orders:

1. Fasting blood sugar in the morning and nothing to eat or drink at midnight.
2. Add hemoglobin and iron to routine laboratory tests.
3. Pregnancy test on arrival to unit.

Table 4.7. Diagnostic Tests

ABBREVIATION	MEANING
I	iodine
IVC	intravenous cholangiogram
IVP	intravenous pyelogram
K	potassium
KUB	kidneys, ureters, bladder
lab	laboratory
LDL	low-density lipoprotein
LFT	liver function test
Lymphs	lymphocytes
Lytes	electrolytes

Key Concepts

Fig 4.4 is an image of a **KUB (kidneys, ureters, bladder) X-ray**, which is used to visualize the urinary system and to assess the causes of lower abdominal structure pain, as well as to view the healthy functioning of the urinary system (Johns Hopkins, 2022).

The abbreviation **lab (laboratory)** is used for laboratory tests related to all specimens from the body, including blood, urine, feces, and other bodily specimens.



Fig. 4.4

Examples of diagnostic test orders:

1. HDL, LDL, and Lytes
2. KUB tomorrow to assess left lower abdominal pain
3. Add K to labs today

Explanation of diagnostic test orders:

1. High-density lipoproteins, low-density lipoproteins, and electrolytes.
2. Kidneys, ureter, and bladder tomorrow to assess left lower abdominal pain.
3. Add potassium to laboratory tests today.

Table 4.8. Diagnostic Tests

ABBREVIATION	MEANING
Mg	magnesium
MRI	magnetic resonance imaging
MUGA	multigated acquisition scan (heart function test)
N	nitrogen
Na	sodium
O2	oxygen
P	phosphate
PCV	packed cell volume
PET	positron emission tomography

Key Concept

Fig. 4.5 is an image of a **MUGA (multigated acquisition)** scan. The MUGA scan is used to assess the heart to determine how well it functions and, more specifically, how well it pumps blood to the organs in the body (Alberta Health Services, 2022b).

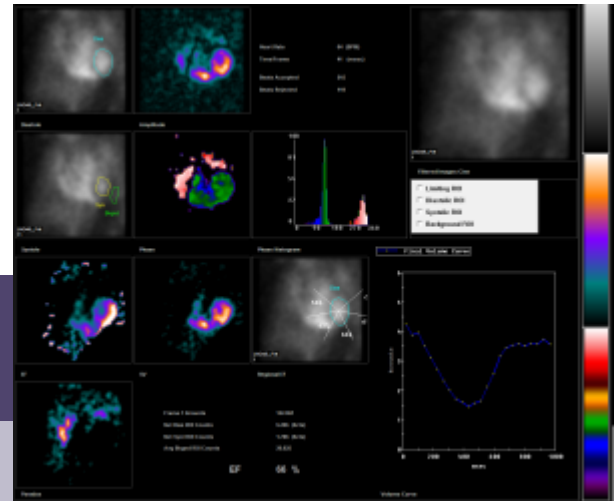


Fig. 4.5

Examples of diagnostic test orders:

1. Keep O2 level greater than or equal to 90%
2. Add Mg, Na, and P to labs tomorrow

Explanation of diagnostic test orders:

1. Keep oxygen level greater than or equal to 90 percent.
2. Add magnesium, sodium, and phosphorus to laboratory tests tomorrow.

Table 4.9. Diagnostic Tests

ABBREVIATION	MEANING
PFT	pulmonary function test
PSA	prostate-specific antigen
PT/INR	prothrombin time/international normalized ratio
PTT	partial thromboplastin time
rbc	red blood cell
RBC	red blood count
Sed rate	sedimentation rate
spec	specimen
T	temperature
TENS	transcutaneous electrical nerve stimulation

Key Concepts

A **PT (prothrombin time)** blood test is done to determine how long it takes blood to clot. This test might be ordered to determine whether a person has a bleeding disorder or if medications, such as coumadin, are working correctly. This test is also called **INR (international normalized ratio)** and is used to ensure that no matter how the test is completed, the results will all always be standardized (Alberta Health Services, 2022c).

PTT (partial thromboplastin time) is another test used to determine how long it takes blood to clot, and it is often done at the same time as a PT blood test. This test is also used to assess whether a person has a bleeding disorder such as hemophilia or if certain medications, such as heparin, are working effectively (Alberta Health Services, 2022c).

Examples of diagnostic test orders:

1. Patient to have PFT to assess treatment effectiveness
2. PT level 0800 call for coumadin orders after results

Explanation of diagnostic test orders:

1. Patient to have pulmonary function test to assess treatment effectiveness.
2. Prothrombin time level at 8 o'clock in the morning, call for coumadin orders after results.

Table 4.10. Diagnostic Tests

ABBREVIATION	MEANING
U/A	urinalysis
U/O	urine output
UGI	upper gastrointestinal
US	ultrasound
VQ scan	ventilation-perfusion scan of the lungs
wbc	white blood cell
WBC	white blood count



Fig. 4.6

Key Concept

Fig. 4.6 is an image of a **UGI (upper gastrointestinal)** series, and Fig 4.7 is an image of a **BaE (barium enema)** lower

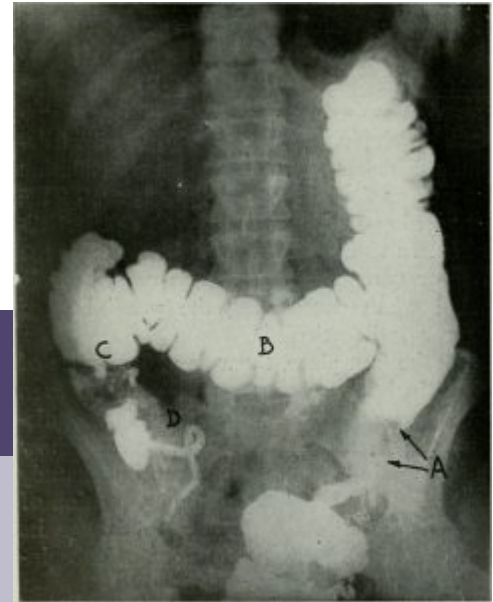


Fig. 4.7

gastrointestinal series. Both of these diagnostic procedures involve the introduction of the contrast medium barium. For a UGI series, the barium would be swallowed, and for the lower gastrointestinal series, it would be given as an enema. X-rays are then taken of the upper and lower gastrointestinal system structures (Johns Hopkins, 2020).

Examples of diagnostic test orders:

1. Throat swab for C&S
2. 24 hr urine spec for Ca
3. CBC, diff, Hgb & ESR

Explanation of diagnostic test orders:

1. Take a throat swab for culture and sensitivity testing.
2. Collect all the urine voided in a 24-hour period to be tested for calcium.
3. Complete blood count, differential test for white blood cells, hemoglobin, and erythrocyte sedimentation rate.

Exercises



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4.4 Procedures

Medical procedures and their abbreviations are often discussed and written in hospital and clinic settings. Later in the book, many of these procedures will be explained in detail, but for now, the most common abbreviations are listed below. Examples are provided along with a very basic explanation of the procedures to help you understand and remember them.

Table 4.11. Procedures

ABBREVIATION	MEANING
AB	abortion
BP	blood pressure
BSE	breast self-exam
BSO	bilateral salpingo-oophorectomy
Bx	biopsy
cath	catheter
chemo	chemotherapy

Key Concept

A few different forms of catheterization are used in hospitals, but one of the most common is urinary catheterization (Doyle & McCutcheon, 2020). The abbreviation for **catheter** is **cath**. Urinary catheterization is often used with patients in the hospital when they have difficulty voiding urine or are immobilized, often after surgery. Fig. 4.8 shows a type of catheter that is placed through the patient's urethra and into the bladder. It is then attached to a bag that collects the patient's urine (Doyle & McCutcheon, 2020).



Fig. 4.8

Examples of orders with procedures:

1. Pt scheduled for Bx in am, take BP prior to Bx
2. BSO this afternoon, Pt requires a cath in am

Explanation of orders with procedures:

1. Patient scheduled for biopsy in the morning, take blood pressure prior to biopsy.
2. Bilateral salpingo-oophorectomy this afternoon. Patient requires a catheter in the morning.

Table 4.12. Procedures

ABBREVIATION	MEANING
CPR	cardiopulmonary resuscitation
cysto	cystoscopy
D&C	dilation and curettage
drsg	dressing
E	enema
ECT	electroconvulsive therapy
H&P	history and physical
HD	hemodialysis



Key Concepts

Fig. 4.9

Electroconvulsive therapy (ECT) is a controversial and misunderstood treatment for mental illness. It is in fact very safe and effective for treating various mental illnesses, including severe depression, mania, and schizophrenia (Centre for Addiction and Mental Health, 2022). It is a useful therapy when patients have symptoms that have not responded well to medication, counselling, or any other psychosocial treatments.

Dilation and curettage (D&C) is a surgical procedure in which the cervix is dilated and a device called a curette is used to scrape the uterine lining (Stuart, 2022). It can be performed for a few reasons, such as diagnosing or treating uterine fibroids, hormonal imbalances, or cancer, and after a miscarriage.

Examples of orders with procedures:

1. Pt requires H&P prior to D&C in am
2. Drsg to R arm needs to be reapplied. E in pm prior to cysto in am

Explanation of orders with procedures:

1. Patient requires history and physical prior to dilation and curettage in the morning.
2. Dressing to the right arm needs to be reapplied. Enema in the afternoon prior to cystoscopy in the morning.

Table 4.13. Procedures

ABBREVIATION	MEANING
HRT	hormone replacement therapy
I&D	incision and drainage
I&O	intake and output
lap	laparotomy
LP	lumbar puncture
SBFT	small bowel follow-through
T&A	tonsillectomy and adenoidectomy

Key Concepts



Fig. 4.10

Some women may take **hormone replacement therapy (HRT)** to ease menopausal symptoms (Canadian Cancer Society, 2022). This is because in women of a certain age, the ovaries produce lower amounts of hormones, especially when a woman reaches menopause. HRT helps to supplement the lack of hormones.

A **lap (laparotomy)** scar is shown in Fig. 4.10. The term laparotomy means “cutting into the abdomen,” a procedure that can be done for exploratory reasons or to remove an organ or some form of anomaly, such as a tumour.

Examples of orders with procedures:

1. I&O q2h
2. T&A in am. LP at 1200 today

Explanation of orders with procedures:

1. Intake and output every two hours (intake includes all fluids, such as IV, oral, feeding tubes, etc., and output is urine, diarrhea, wound drains, etc.).
2. Tonsillectomy and adenoidectomy in the morning. Lumbar puncture at noon today.

Table 4.14. Procedures

ABBREVIATION	MEANING
TAB	therapeutic abortion
TAH-BSO	total abdominal hysterectomy–bilateral salpingo-oophorectomy
TPR	temperature, pulse, respirations
TURP	transurethral resection of the prostate gland
VS	vital signs
XRT	radiation therapy

Key Concepts



Fig. 4.11

TAH-BSO (total abdominal hysterectomy–bilateral salpingo-oophorectomy) is a complex medical term;

however, if you look at the word parts, you can understand what procedure is being completed—“removal of” (**-ectomy**) something, and the combining forms (**hyster/o**, **salping/o**, and **oophor/o**) in the terms make it clear what is being removed. The surgery is removal of the uterus, both fallopian tubes, and both ovaries.

Vital signs (VS) are a combination of various medical assessments, including blood pressure, temperature, pulse, pulse oximetry, and breathing rate (Doyle & McCutcheon, 2020). Depending on the patient’s condition and hospital unit, vital signs can also include neurological vital signs, pain measurement, circulation, and other factors that may be relevant (Doyle & McCutcheon, 2020).

Radiation therapy (XRT), as shown in Fig. 4.11, can be used to treat various forms of cancer as well as some other pathologies.

Examples of orders with procedures:

1. Pt in for TURP today, VS q2h post-op
2. Hx of TAH-BSO and XRT in past yr

Explanation of orders with procedures:

1. Patient in for transurethral resection of the prostate gland today. Vital signs every two hours after surgery.
2. History of total abdominal hysterectomy–bilateral salpingo-oophorectomy and radiation therapy in the past year.

Exercise



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4.5 Medications and Medication Orders

Medication orders are common in both hospital and clinic settings. It is imperative to have a solid foundation of knowledge about medication-related abbreviations for almost any career in health care. Also, it is advantageous for the general population to understand these abbreviations because most people will be given a prescription at some time in their lives, and it helpful if they can understand the meaning behind the abbreviations used.

Medications

Table 4.15. Medications

ABBREVIATION	MEANING
2/3-1/3	2/3 dextrose, 1/3 saline
ac	before meals
am	morning
ASAP	as soon as possible
bid	twice a day
C	Celsius
caps	capsule(s)
cm	centimetre

Key Concept

2/3 dextrose, 1/3 saline (2/3-1/3) is an intravenous solution that may be ordered for patients. There are a number of different types of IV solutions, and this one is a mix of dextrose (a type of sugar) and normal saline. The intravenous solution ordered for a patient may vary from day to day depending on the patient's condition, so the medication order will be updated regularly. Intravenous solutions will be discussed in more detail in Chapter 7.

Examples of medication orders:

1. IV 2/3-1/3 at 100 mL/hr ASAP
2. Humalog insulin sc ac as per sliding scale

Explanation of medication orders:

1. Intravenous 2/3 dextrose, 1/3 saline at 100 millilitres per hour as soon as possible.
2. Humalog insulin subcutaneous before meals as per sliding scale (see Key Concept below).

Key Concept



Fig.4.12

Sliding scale means that a patient's insulin dose will vary depending on their blood sugar level. For patients in a hospital, there will be orders in the chart for the nurse to check and provide the correct dose of insulin to the patient. A blood sugar reading is taken before any ordered insulin dose is given, and the amount of insulin is determined by the orders provided in the sliding scale.

Table 4.16. Medications

ABBREVIATION	MEANING
D/S, D/W	dextrose in saline or water
D5W	5% dextrose in water
g	gram
gtt	drop or drops
h, hr	hour
h.s.	at bedtime
H2O	water
i, ii, iii, iv	one two three four
ID	initial dose
IM	intramuscular

Key Concepts

The abbreviation for **drops (gtt)** may be seen in a few different situations. It could potentially be used for eye drops, but it could also be seen with intravenous medications. If a programmable intravenous machine is not used to administer IV fluids, then often **drops (gtt)** is used to determine the rate at which fluids are to be given.

D5W (5% dextrose in water) is just one example of an abbreviation for IV fluids, and others will vary depending on the amount of dextrose in the fluid. For example, you may see **D10W (10% dextrose in water)** or **D5S (5% dextrose in saline)**, with the number indicating the percentage of dextrose and W or S indicating water or saline.

Examples of medication orders:

1. D5W at 150mL/hr to begin at h.s.
2. 2 gtt Bimatoprost to each eye bid, ID tomorrow am

Explanation of medication orders:

1. 5% dextrose in water at 150 millilitres per hour to begin at bedtime.
2. Two drops Bimatoprost to each eye twice a day, initial dose tomorrow morning.

Table 4.17. Medications

ABBREVIATION	MEANING
INH	Isoniazid (medication used to treat tuberculosis)
IV	intravenous
kg	kilogram
kJ	kilojoule
L	litre
Lax	laxative
LD	last dose
m	metre

IV (intravenous) is a very common abbreviation in medical settings. As stated above, there are a number of different IV solutions, and many, if not most, patients within the hospital will have an IV at some point during their admission.

The abbreviation **LD (last dose)** pertains to patients' medication. It is a warning to medical professionals that this is the last dose of a medication to be given to a patient. In some cases, the medication is reordered, but in other instances, the patient's condition is simply monitored after they finish their last dose.

Examples of medication orders:

1. Gravol 50 mg IV bid prn
2. Morphine 2-10 mg sc qid, LD May 18/2022 1800

Explanation of medication orders:

1. Gravol 50 milligrams intravenous two times a day as needed.
2. Morphine 2-10 milligrams subcutaneous four times a day. Last dose is May 18, 2022, at 6 o'clock in the evening.

Table 4.18. Medications

ABBREVIATION	MEANING
MAR	medication administration record
mcg	microgram
mg	milligram
ml	millilitre
mm	millimetre
NG	nasogastric
NKA	no known allergies
NS	normal saline
NSAID	nonsteroidal anti-inflammatory drug

Key Concepts

The **medication administration record (MAR)** can be found on hospital units and is the record of the medications ordered and given to a patient. Unit clerks update the MAR, and nurses make notes in it when medication is given to a patient.

NG (nasogastric) tubes are seen on many units in a hospital. An NG tube is inserted through the patient's nose and down into the stomach (Carter & Rutherford, 2020). The nurse is often the medical professional who inserts the NG tube and fixes it in place. An NG tube can be attached to suction to remove stomach contents, or it can be used to provide nutrition or medication. The medication would be crushed and then added to some form of liquid to be administered through the NG tube.

Examples of medication orders:

1. NS 500 mL/hr
2. NG to low Gomco suction (a suction device on the wall in the hospital)

Explanation of medication orders:

1. Normal saline 500 millilitres per hour.
2. Nasogastric tube to low Gomco suction.

Table 4.19. Medications

ABBREVIATION	MEANING
pc	after a meal
pm	evening
po	orally, by mouth
PPN	partial parenteral nutrition
pr	per rectum
prn	as necessary
p/v	per vagina
qh.s.	every night at bedtime

Key Concept

Parenteral nutrition is often used to help patients with Crohn's disease, cancer, short bowel syndrome, or ischemic bowel (Healthline, 2022). It is administered from a bag containing the nutrients that the patient needs through tubing attached to either a needle or catheter. If parenteral nutrition is only needed temporarily, then **partial parenteral nutrition (PPN)** is used. This type of parenteral nutrition is given through an intravenous line and provides all the nutrition the patient requires (Healthline, 2022).

Examples of medication orders:

1. Zantac 10 mg po pc prn
2. PPN q.h.s. x 7 days

Explanation of medication orders:

1. Zantac 10 milligrams by mouth after meals as needed.
2. Partial parenteral nutrition every night at bedtime for seven days.

Table 4.20. Medications

ABBREVIATION	MEANING
q1h, q2h, q3h, ...	every hour, every two hours, every three hours, ...
qam	every morning
qid	four times a day
RL	ringers lactate
Rx	prescription
sc	subcutaneous
sl	sublingual, under the tongue

Key Concept

Sublingual (sl) is a common medication route, and it is important to differentiate this from **po (orally)** because the two are different. Medication that is given sublingually is specifically designed to dissolve under the tongue and is processed faster through the body compared to oral medication, which dissolves in the stomach or intestines.

Examples of medication orders:

1. 2 mg Ativan sl q2h prn
2. Morphine 5 mg sc qid prn

Explanation of medication orders:

1. 2 milligrams Ativan sublingual every two hours as needed.
2. Morphine 5 milligrams subcutaneous four times a day as needed.

Table 4.21. Medications

ABBREVIATION	MEANING
STAT	immediately
supp	suppository
tab	tablet
tid	three times a day
TKVO	to keep vein open
TPN	total parenteral nutrition
ungt	ointment
v/o	verbal order

Key Concepts

Another form of parenteral nutrition is **total parenteral nutrition (TPN)**. With TPN, a catheter is placed in a large vein, the superior vena cava, that goes to the heart (Healthline, 2022). A port, such as a needleless access port, may also be placed, which makes intravenous feeding easier so it can be done at home (Healthline, 2022).

Orders in the hospital that are labelled **STAT (immediately)** must be processed right away. These orders are time sensitive and are a priority in the hospital.

Examples of medication orders:

1. NS 100 mL/hr until 1800 TKVO
2. 500 mg tab Tylenol tid STAT

Explanation of medication orders:

1. Normal saline 100 millilitres per hour until six o'clock in the evening to keep the vein open.
2. 500 milligram tablet of Tylenol three times a day immediately.

COMPONENTS OF A MEDICATION ORDER

Medication orders are written by doctors and use specific components, including directions for the person giving the drug.

The components of a medication order are the following:

1. Medication name

Examples of medication orders that indicate a specific form of medication:

- Neosporin ointment *ophthalmic*
- Aspirin EC
- Aspirin *supp*

Note that medication name may also include the **form** of the drug, as can be seen in the example above (given in italics).

2. Administration route

Medications may be given through different routes, though any medication may be prepared to be administered by different methods. Examples include **po (oral)**, **sl (sublingual)**, **sc (subcutaneous)**, and **IV (intravenous)**.

3. Administration frequency

All hospitals have a schedule of hours for the administration of medications. You must learn the schedule for your particular hospital unit. Military time (the 24-hour clock) is used in place of standard time in the healthcare system.

4. Medication dose

This is the amount of medication to be given. Quantities can be specified in many different forms; for example, in L, mL, mg, and mcg, among others.

5. Qualifying phrases

Qualifying phrases are used when the doctor wants the medication to be administered for a specific reason or condition.

Examples of qualifying phrases:

- For severe pain
- For stomach spasm
- For N&V (nausea and vomiting)
- For insomnia
- While awake only

Examples of medication orders:

1. Ampicillin 500 mg bid po x 10 days for toe infection
2. Benadryl 50 mg bid po

Explanation of medication orders:

1. Ampicillin 500 milligrams twice a day by mouth for 10 days for a toe infection
2. Benadryl 50 milligrams twice a day by mouth

Types of Medication Orders

Scheduled medication orders: These orders must be recorded on the medication administration record (MAR) and have times or frequencies assigned. The orders specify that medications are to be given once a day, twice a day, or at a certain time.

PRN orders: These orders do not have times or frequencies assigned. They are given as needed; for example, when the patient is in pain or experiencing nausea.

One time or short series orders: These orders are for medication that is given one time only or for a limited number of doses; for example, two doses in 24 hours.

STAT orders: This type of order is for medications that are ordered right away from the pharmacy by phone or computer and followed up with a pharmacy requisition.

Verbal orders: These are orders given by a physician over the phone or sometimes in person, usually to a charge nurse, who then documents the order to be signed by the physician at a later time. Often this occurs in the evening, when the physician is away, so that the medication can be ordered and given to the patient prior to the physician returning to the unit.

Standing/Preprinted orders: These orders vary among units and are created for common procedures or patient conditions so that a physician can simply check off their desired order and sign the document. This helps to make ordering medications easier for both the physician and other medical professionals who process the orders.



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4.6 Diseases and Symptoms

This section focuses on abbreviations related to diseases and symptoms. The tables below list the more common abbreviations that you might see in a healthcare setting. The key concepts and some example orders are provided to help you understand the terms by explaining how they could be used.

Table 4.22. Diseases and Symptoms

ABBREVIATION	MEANING
AD	Alzheimer's disease
ASHD	arteriosclerotic heart disease
BPH	benign prostatic hypertrophy
CA	cancer
CF	cystic fibrosis
CHF	congestive heart failure
COPD	chronic obstructive pulmonary disease
CP	cerebral palsy
CVA	cerebrovascular accident

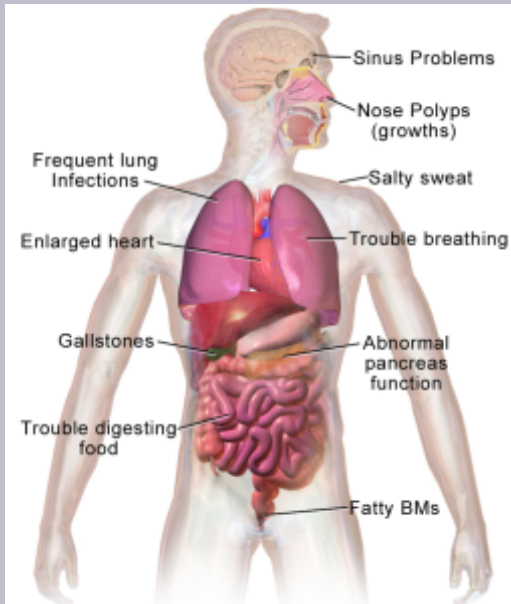


Fig. 4.13

Cerebral palsy (CP), which literally means “weakness pertaining to the brain,” is one of the most common childhood disorders that affects

mobility (CDC, 2022). It is caused either by some sort of trauma to the brain or abnormal brain development. The severity of the disorder varies from person to person. Some individuals will rely on equipment to assist with mobility, whereas others do not use aids but might find ambulating a little more difficult.

Cystic fibrosis (CF) is one of the most common genetic diseases that affects children. It predominantly affects the digestive system and the lungs (Cystic Fibrosis Canada, 2020). Fig. 4.13 shows some additional effects of CF on the body’s organs. Some of the common complications of CF include poor nutrition related to the inability to digest fats and recurring lung infections that in turn lead to lung damage.

Examples of orders related to diseases and symptoms:

1. Dx L side CVA
2. Hx of ASHD

Explanation of orders related to diseases and symptoms :

1. Diagnosis of left-side cerebral vascular accident.
2. History of arteriosclerotic heart disease.

Table 4.23. Diseases and Symptoms

ABBREVIATION	MEANING
DT	delirium tremens
DVT	deep vein thrombosis
GERD	gastroesophageal reflux disease
HBV	hepatitis B virus
HCV	hepatitis C virus
HIV	human immunodeficiency virus
HPV	human papilloma virus
HTN	hypertension

Key Concept

Delirium tremens (DT) is a form of severe withdrawal from alcohol in which symptoms typically appear two to three days after a person has stopped drinking alcohol (Bernstein, 2020). Possible symptoms include confusion, major changes in behaviour, and seizures. Most hospitals have a protocol that they follow if they suspect that a patient is dependent on alcohol.

Examples of orders related to diseases and symptoms:

1. Heparin 5000 units sc bid due to Hx of DVT
2. Head MRI today to determine if patient had a CVA

Explanation of orders related to diseases and symptoms:

1. Heparin 5000 units subcutaneous twice a day due to a history of deep vein thrombosis.
2. Head magnetic resonance imaging today to determine if patient has had a cerebrovascular accident.

Table 4.24. Diseases and Symptoms

ABBREVIATION	MEANING
IBD	inflammatory bowel disease
IBS	irritable bowel syndrome
MI	myocardial infarction
MS	multiple sclerosis
N&V	nausea and vomiting
NYD	not yet diagnosed
OA	osteoarthritis
ORIF	open reduction internal fixation

Key Concept

Open reduction internal fixation (ORIF) is a surgery performed to any fracture that cannot be repaired by casting or other non-surgical methods (Healthline, 2018). “Open” means that an incision needs to be performed, and “internal fixation” means that the bones must be realigned using some sort of hardware (screws, wires, or plates) to keep them in place. This is a common surgery on an orthopedic unit. Fig. 4.14 is an image of an ORIF of fractures to the left radius and ulna that have been repaired using screws to realign each bone.

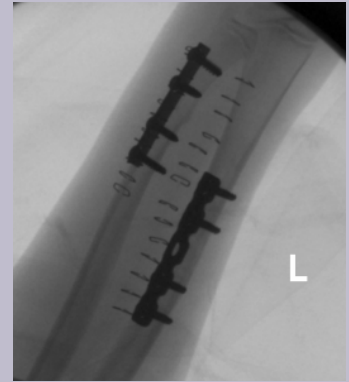


Fig. 4.14

Examples of orders related to diseases and symptoms:

1. Patient has abdominal pain, NYD
2. ORIF to L wrist Fx

Explanation of orders related to diseases and symptoms:

1. Patient has abdominal pain, not yet diagnosed.
2. Open reduction internal fixation to left wrist fracture.

Table 4.25. Diseases and Symptoms

ABBREVIATION	MEANING
PVD	peripheral vascular disease
SARS	severe acute respiratory syndrome
SIDS	sudden infant death syndrome
SOB	shortness of breath
Staph	bacterial infection (<i>Staphylococcus</i>)
STD/STI	sexually transmitted disease/infection
Strep	bacterial infection (<i>Streptococcus</i>)
TB	tuberculosis
TIA	transient ischemic attack
UTI	urinary tract infection
VT, V tach	ventricular tachycardia

Key Concept

Sudden infant death syndrome (SIDS) occurs when a baby dies unexpectedly, usually during sleep. Infants are often under the age of one year and the cause is unknown (Mayo Clinic, 2022). Researchers have found that putting a baby to sleep on their back may help prevent SIDS.

Examples of orders related to diseases and symptoms:

1. Keep head of bed elevated due to SOB
2. Hx of PVD and TIA

Explanation of orders related to diseases and symptoms:

1. Keep head of bed elevated due to shortness of breath.
2. History of peripheral vascular disease and transient ischemic attack.

Exercise



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4.7 Obstetrics

Obstetrics is a medical specialty, and there are medical terms specifically related to this area. This section will focus on common abbreviations related to obstetrics. The most common abbreviations are listed, but there are more that are not covered here. As well as obstetrics-related abbreviations and definitions, some key concepts related to the abbreviations will be covered here.

Table 4.26. Obstetrics

ABBREVIATIONS	MEANING
C-section	caesarean section
EDC	estimated date of confinement

Key Concept



Fig. 4.15

A **C-section**, or **caesarean section**, is a surgical procedure used in certain circumstances to deliver babies (Mayo Clinic, 2022). Sometimes a patient may have a planned C-section, but in certain circumstances, an emergency C-section is required. Typically a horizontal incision is made to the lower abdomen and uterus, then the baby is delivered through this incision (Mayo Clinic, 2022). Fig. 4.15 shows a C-section being performed.

Example of orders related to obstetrics:

1. Scheduled C-section at 1000

Explanation of orders related to obstetrics:

1. Scheduled caesarean section at 10 o'clock in the morning.

Table 4.27. Obstetrics

ABBREVIATIONS	MEANING
FHR	fetal heart rate
G	gravida (number of pregnancies may be given)
IUD	intrauterine device
LMP	last menstrual period
multigravida	pregnant more than once
multipara	given birth to more than one child

Key Concept

Fig. 4.16 is an image of a fetal heart monitor, which provides the **fetal heart rate (FHR)** and rhythm for a fetus in utero (Johns Hopkins, 2022). The average fetal heart rate is 110–160 beats per minute, but the rate can vary depending on the situation. For example, if the umbilical cord is being compressed, the FHR may decrease, and if the situation worsens, it could result in the patient having a C-section (Johns Hopkins, 2022).



Fig. 4.16

Example of orders related to obstetrics:

1. Monitor FHR q2h

Explanation of orders related to obstetrics:

1. Monitor fetal heart rate every two hours.

Table 4.28. Obstetrics

ABBREVIATIONS	MEANING
NB	newborn
OB	obstetrics
Pap smear	test done on cervical cells for cancer
P	number of viable births
PID	pelvic inflammatory disease
PKU	phenylketonuria

Key Concept



Fig. 4.17

PKU (phenylketonuria) is an inherited disorder, and a **PKU test** is used to determine whether a baby has the enzyme required to help digest phenylalanine (Alberta Health Services, 2022). This enzyme plays a role in normal growth and development, and if it is missing from the body and the baby is not treated early on, the infant is at risk of developing seizures and brain damage and becoming intellectually delayed. This blood test is typically done 24 hours to a couple of days after birth (Alberta Health Services, 2022). Fig. 4.17 shows a healthcare provider collecting a sample of blood from the heel of a newborn to complete the PKU test.

Example of orders related to obstetrics:

1. Hx of PID

Explanation of orders related to obstetrics:

1. History of pelvic inflammatory disease.

Table 4.29. Obstetrics

ABBREVIATIONS	MEANING
PPD	postpartum depression
PPH	postpartum hemorrhage
primigravida	first pregnancy
primipara	first birth
PTL	preterm labour
umb	umbilical
VBAC	vaginal birth after C-section

Key Concept

Most mothers will have the “baby blues” for the first few days after birth, but if the feelings of emptiness, sadness, or hopelessness do not go away after two weeks, then a new mother may have **postpartum depression (PPD)** (Office on Women’s Health, 2021). It is really important for new mothers to contact their healthcare provider if they think they have PPD.

Example of orders related to obstetrics::

1. Patient arriving at 1300 for VBA

Explanation of orders related to obstetrics:

1. Patient arriving at one o'clock in the afternoon for a vaginal birth after a C-section.

Exercise



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Johns Hopkins. (2022). Fetal heart monitoring. <https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/fetal-heart-monitoring>

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Office on Women's Health, U.S. Department of Health & Human Services. (2021). Postpartum depression. <https://www.womenshealth.gov/mental-health/mental-health-conditions/postpartum-depression>

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Infant's head emerging during C-section by Engin Akyurt, Pixabay licence

Sonoline B by Baby Doppler by Cognito 100, CC BY-SA 4.0

Phenylketonuria testing by Staff Sgt. Eric T. Sheler, U.S. Air Force, Public domain

4.8 Psychiatry

Psychiatry is another specialty area that uses a wide range of abbreviations. This section will introduce you to some of the more common abbreviations used on a psychiatric unit. The focus is on the most common abbreviations, but there may be more used in this specialty area that are not covered here. As well as psychiatry-related abbreviations and definitions, some key concepts related to the abbreviations will be discussed.

Table 4.30. Psychiatry

ABBREVIATIONS	MEANING
ADHD	attention-deficit hyperactivity disorder
ADD	attention deficit disorder
BAD	bipolar affective disorder
CA	chronological age
CBT	cognitive behavioural therapy
IQ	intelligence quotient

Key Concept

Cognitive behavioural therapy (CBT) is a form of treatment that is thought to be effective in treating such conditions as anxiety, depression, drug and alcohol use, and severe mental illness, among others (American Psychological Association, 2017). This therapy works to help patients by changing their thinking and behavioural patterns.

Example of orders related to psychiatry :

1. Patient to attend CBT today at 1200

Explanation of orders related to psychiatry:

1. Patient to attend cognitive behavioural therapy today at noon.

Table 4.31. Psychiatry

ABBREVIATIONS	MEANING
M.A.	mental age
MDD	major depressive disorder
OCD	obsessive-compulsive disorder
PTSD	post-traumatic stress disorder
SAD	seasonal affective disorder
SSRI	selective serotonin reuptake inhibitor

Key Concept

Seasonal affective disorder (SAD), also known as the “winter blues,” is a form of depression that usually occurs in late fall and early winter. The cause is not truly known, but it is thought that the lack of sunlight, biological clock changes, and vitamin D deficiency could play a role. The symptoms can range from feelings of sadness and lack of energy to suicidal thoughts. There are several treatments that can be used, including CBT, light therapy, vitamin D, and antidepressants. Fig. 4.18 shows a person using light therapy for SAD.



Fig. 4.18

Example of orders related to psychiatry :

1. Dx OCD and MDD

Explanation of orders related to psychiatry:

1. Diagnosis of obsessive-compulsive disorder and major depressive disorder.

Exercise



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References

American Psychological Association (APA). (2017). *What is cognitive behavioral therapy?* <https://www.apa.org/ptsd-guideline/patients-and-families/cognitive-behavioral>

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[Light Therapy for SAD](#) by [Lou Sander](#), [CC BY-SA 4.0](#)

4.9 Common Medical Terms

This final section covers abbreviations for common medical terms. Essentially, it is a collection of abbreviations that are commonplace but do not fit into the other categories in this chapter. Once again, the more complex abbreviations will be explained to help you fully understanding the content, and review exercises are provided at the end of the section.

Table 4.32. Common Medical Terms

ABBREVIATIONS	MEANING
Ab	antibody
abd	abdomen
BM	bowel movement, bone marrow
C1, C2, ...	cervical vertebra 1, cervical vertebra 2, ...
CCU	coronary care unit
CNS	central nervous system

Key Concepts

As can be seen in the table above, the abbreviation **BM (bowel movement or bone marrow)** can have two very different meanings. As such, it is always important to look at the context in which the abbreviation is used. This will help you determine which meaning is intended.

A **coronary care unit (CCU)** is a hospital unit that specializes in assessing heart rhythms and providing complex care to patients experiencing cardiac pathologies. Not all hospitals have a CCU, but there are a number of them in the Edmonton area, including at the Grey Nuns Community Hospital (Alberta Health Services, 2022).

Example of orders:

1. Pt to be discharged from the CCU this pm

Explanation of orders:

1. Patient to be discharged from the coronary care unit this evening.

Table 4.33. Common Medical Terms

ABBREVIATIONS	MEANING
DNA	deoxyribonucleic acid
DOB	date of birth
Dr.	doctor
Dx	diagnosis
EENT	eye, ear, nose, and throat
ENT	ears, nose, and throat
ER	emergency room
Fx	fracture



Fig. 4.19

Key Concept

Fractures (Fx) can occur in any bone in the body and, as can be seen in Fig. 4.19, there are different types of fractures depending on the mechanism of injury. Fractures are often, at least initially, treated in the **emergency room (ER)**, then the patient is sent to a surgical unit if they require surgery to repair the injury.

Example of orders:

1. Dx: GERD and COPD
2. Pt admitted to the ER with L leg Fx

Explanation of orders:

1. Diagnosis: gastroesophageal reflux disease and chronic obstructive pulmonary disease.
2. Patient admitted to the emergency room with a left leg fracture.

Table 4.34. Common Medical Terms

ABBREVIATIONS	MEANING
GI	gastrointestinal
GU	genitourinary
GYN	gynecology
HCA	healthcare aide
Ht	height
Hx	history
ICU	intensive care unit
JP	Jackson-Pratt drain
Kx	Kardex
L	left

Key Concept

A **Jackson-Pratt drain (JP)** has a soft plastic bulb with a flexible tube attached to it. It also has a stopper that can be used to drain the fluid from the bulb (Memorial Sloan Kettering Cancer Center, 2022). The tubing is placed inside the patient to allow for drainage to leave the patient's body and into the bulb, as can be seen in Fig. 4.20. When the bulb is squeezed, a gentle suction is created that draws excess fluid from the body. The bulb should be compressed at all times, except when draining the bulb (Memorial Sloan Kettering Cancer Center, 2022).

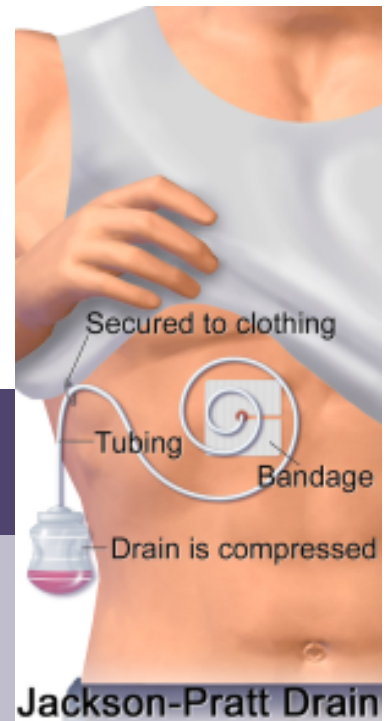


Fig. 4.20

Example of orders:

1. Pt has Hx of PID, referral to GYN

Explanation of orders:

1. Patient has a history of pelvic inflammatory disease, referral to gynecology.

Table 4.35. Common Medical Terms

ABBREVIATIONS	MEANING
L1, L2, ...	lumbar vertebra 1, lumbar vertebra 2, ...
lat	lateral
LLQ	left lower quadrant
LPN	licensed practical nurse
LUQ	left upper quadrant
MBA	motorbike accident
MD	medical doctor
meds	medications
met	metastasis
mmHg	millimetres of mercury

Key Concept



Fig. 4.21

The abbreviation **mmHg (millimetres of mercury)** is the standard unit of measurement for pressure and is often used in reference to blood pressure. Blood pressure numbers at or slightly below **120/80 mmHg** are considered to be within the normal range (American Heart Association, 2022). The first number (120) is the **systolic blood pressure** and shows how much pressure the blood is exerting against the artery walls when the heart beats. The second number (80) is the **diastolic blood pressure** and indicates how much pressure the blood is exerting against the artery walls while the heart is resting between beats (American Heart Association, 2022).

Example of orders:

1. Pt has pain to LUQ and LLQ following MBA

Explanation of orders:

1. Patient has pain to the left upper quadrant and left lower quadrant following a motorbike accident.

Table 4.36. Common Medical Terms

ABBREVIATIONS	MEANING
MVA	motor vehicle accident
NICU	neonatal intensive care unit
OPD	outpatient department
OR	operating room
Ortho	orthopedics
PA	posteroanterior
PAC	pre-admission clinic
PCA	patient controlled analgesic
post-op	after surgery
pre-op	before surgery

Key Concept

Patient-controlled analgesics (PCAs) are used on many different hospital units. PCAs, as the name indicates, allow the patient to control the administration of their analgesics. The patient presses a button, which then provides an analgesic through their IV to relieve their pain. The amount of analgesic that can be administered is limited and the amount used is monitored. PCAs are a great innovation for patient care because they enable patients to be self-reliant and also stay on top of their pain management.

Examples of orders:

1. Pt to have PCA post-op
2. Pt to arrive at PAC at 0700 tomorrow

Explanation of orders:

1. Patient to have patient-controlled analgesic after surgery.
2. Patient to arrive at patient admission clinic at 7 o'clock in the morning tomorrow.

Table 4.37. Common Medical Terms

ABBREVIATIONS	MEANING
prep	preparation
Pt	patient
qt	quart
req	requisitions
RLQ	right lower quadrant
RN	registered nurse
ROM	range of motion
RR	recovery room
RT	respiratory therapist
R	right

Key Concepts



Fig. 4.22

Respiratory therapists (RTs) are healthcare professionals who monitor, assess, and treat people who are having problems breathing. RTs are trained in many advanced airway interventions, including ventilation, airway management, cardiopulmonary resuscitation, and oxygen and aerosol therapy. They can assess ongoing patient needs and assist in various codes (medical emergencies) that may occur in the hospital. Fig. 4.22 shows a group of RTs practising their intubation skills.

Registered nurses (RNs) and **licensed practical nurses (LPNs)** work in hospitals and other medical settings (Ernstmeyer & Christman, 2021). RNs complete a bachelor's degree, whereas LPNs complete a two- to three-year program. Each profession has their own type of training and scope of practice.

Examples of orders:

1. Pt to RR post-op to be assessed by RT
2. Physio to assess ROM to R arm

Explanation of orders:

1. Patient to recovery room after surgery to be assessed by a respiratory therapist.
2. Physiotherapist to assess range of motion to the right arm.

Table 4.38. Common Medical Terms

ABBREVIATIONS	MEANING
RUQ	right upper quadrant
S1, S2, ...	sacral vertebra 1, sacral vertebra 2, ...
T1, T2, ...	thoracic vertebra 1, thoracic vertebra 2, ...
Tx	treatment
UV	ultraviolet
VAX	computerized medical system
W/C	wheelchair
wt	weight
yr	year

Key Concept

VAX is a type of computerized medical system used in Alberta. It provides a means of recording medication administration and other aspects of patient care. There are a few hospitals that currently use it; however, the provincial-wide implementation of ConnectCare, another form of electronic medical record keeping, will end the use of VAX in the future.

Example of orders:

1. Pt to mobilize with W/C
2. Record pt wt in VAX

Explanation of orders:

1. Patient to mobilize with wheelchair.
2. Record patient's weight in the computerized medical system.
- 3.

Exercise



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- Memorial Sloan Kettering Cancer Center. (2022). Caring for your Jackson-Pratt drain. <https://www.mskcc.org/cancer-care/patient-education/caring-your-jackson-pratt-drain>

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4.10 24-Hour Clock

When reading or recording time according to the 24-hour clock, the hours are counted from one to twenty-four, and the minutes from one to fifty-nine. The 24-hour clock is used in all areas of health care to avoid confusion and errors.

There are always four digits in the number when stating the time using a 24-hour clock. The first two digits indicate the hour, and the second two digits indicate the minutes. The use of a.m. and p.m. is unnecessary. A few examples and explanations are given below:

- 1. Morning hours are 0000 hours to 1200 hours. Note that 0000 hours (zero-hundred hours) is midnight, and 1200 hours (twelve-hundred hours) is noon.
- 2. Afternoon hours are 1200 hours to 2400 hours. Note that 1200 hours (twelve-hundred hours) is noon, and 2400 hours (twenty-four-hundred hours) is midnight.
- 3. 1000 (ten-hundred hours) means 10 o'clock in the morning.
- 4. 2230 hours (twenty-two-thirty hours) means 10:30 in the evening.

Fig. 4.23 is an image of a 24-hour clock. Midnight would be 2400, and five minutes after midnight would be written as 0005. All the standard times with the corresponding 24-hour clock times are listed in Tables 4.39 and 4.40.

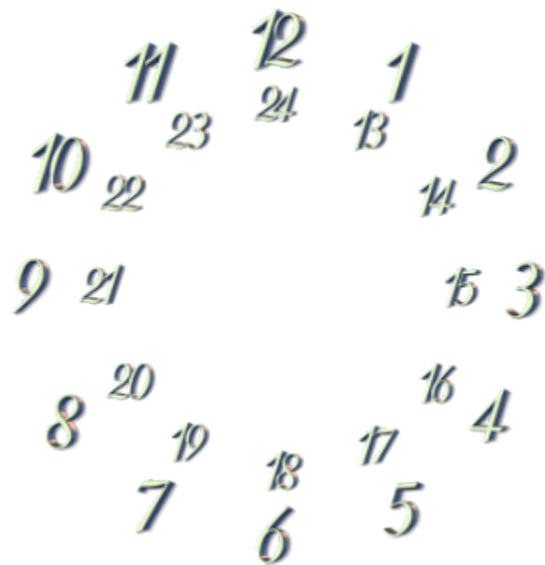


Fig. 4.23

Table 4.39. 24-Hour Clock (1 a.m. – Noon)

STANDARD TIME	24-HOUR CLOCK
1:00 a.m.	0100 hours
2:00 a.m.	0200 hours
3:00 a.m.	0300 hours
4:00 a.m.	0400 hours
5:00 a.m.	0500 hours
6:00 a.m.	0600 hours
7:00 a.m.	0700 hours
8:00 a.m.	0800 hours
9:00 a.m.	0900 hours
10:00 a.m.	1000 hours
11:00 a.m.	1100 hours
12:00 noon	1200 hours

Table 4.40. 24-Hour Clock (1 p.m. – Midnight)

STANDARD TIME	24-HOUR CLOCK
1:00 p.m.	1300 hours
2:00 p.m.	1400 hours
3:00 p.m.	1500 hours
4:00 p.m.	1600 hours
5:00 p.m.	1700 hours
6:00 p.m.	1800 hours
7:00 p.m.	1900 hours
8:00 p.m.	2000 hours
9:00 p.m.	2100 hours
10:00 p.m.	2200 hours
11:00 p.m.	2300 hours
12:00 midnight	2400 or 0000



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(Snow, 2016)

Roman Numerals

Lowercase Roman numerals are occasionally used in medical terminology. You will most frequently see Roman numerals used in medication orders documentation and possibly for some laboratory tests.

Lowercase Roman Numerals

Table 4.41 lists lowercase Roman numerals up to 10. You will most likely see the numerals **i** to **iii** used in medical orders.

Table 4.41. Roman Numerals

STANDARD NUMBER	LOWERCASE ROMAN NUMERAL
1	i
2	ii
3	iii
4	iv
5	v
6	vi
7	vii
8	viii
9	ix
10	x

Key Concepts

Examples of orders:

1. Polysporin eye gtts i-ii gtts in each eye bid at 0800 and 2000.
2. Ventolin nebs x ii tid (0600, 1400, and 2200).

Explanation of orders:

1. Polysporin eye drops, one to two drops in each eye twice a day at 8 o'clock in the morning and 8 o'clock in the evening.
2. Ventolin two nebulas three times a day at 6 o'clock in the morning, 2 o'clock in the afternoon, and 10 o'clock in the evening.

Exercise



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References

Snow, M. A. (2016, January 8). *Nursing assistant: 24 hour clock time* [Video]. YouTube. <https://www.youtube.com/watch?v=B3sPaYs24Oo>

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4.11 Review Exercises

The following final review exercises cover most of the abbreviations and additional content in this chapter. It is important to review the entire chapter in addition to completing these exercises to have a full understanding of all the concepts covered in Chapter 4.

Final Review



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CHAPTER V

ORGANIZATION OF THE BODY

5.1 Introduction to the Organization of the Body

Learning Objectives

By the end of this chapter, you should be able to

1. Describe the basic components and building blocks of the human body
2. Identify the 11 body systems and their function
3. Define the body cavities and the organs within
4. Identify the divisions of the spine
5. Describe the planes of the body
6. Identify the locations of the abdominal regions and quadrants

Chapter Overview

This chapter will provide you with an overview of the body's organization and related concepts. It will give you a chance to use and apply the skills and knowledge you have learned about medical terminology so far. Discussion will focus on the levels of organization within the body and a give basic overview of each of the body systems, which will give you the knowledge required to understand the next chapter of this text. We will also discuss body planes, cavities, abdominal quadrants, and divisions of the spine. The examples and exercises will help solidify your knowledge about the the organization of the human body.

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5.2 Levels of Organization and Body Systems

The first four chapters of this text have provided you with a solid foundation about medical terminology and its components. This chapter will allow you to apply that knowledge to basic concepts about anatomy, physiology, and other aspects of the human body. Anatomy focuses on structure, whereas physiology focuses on function. The video below will give you an overview of what anatomy and physiology encompass, then the remaining part of this section will discuss them in more detail.



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<https://openeducationalberta.ca/medicalterminology/?p=3125#oembed-1>

(CrashCourse, 2015)

The Levels of Organization

As shown in Fig. 5.1, it is best to consider the structures of the body in terms of levels of organization that increase in complexity: atoms, molecules, cells, tissues, organs, organ systems (body systems), and organisms.

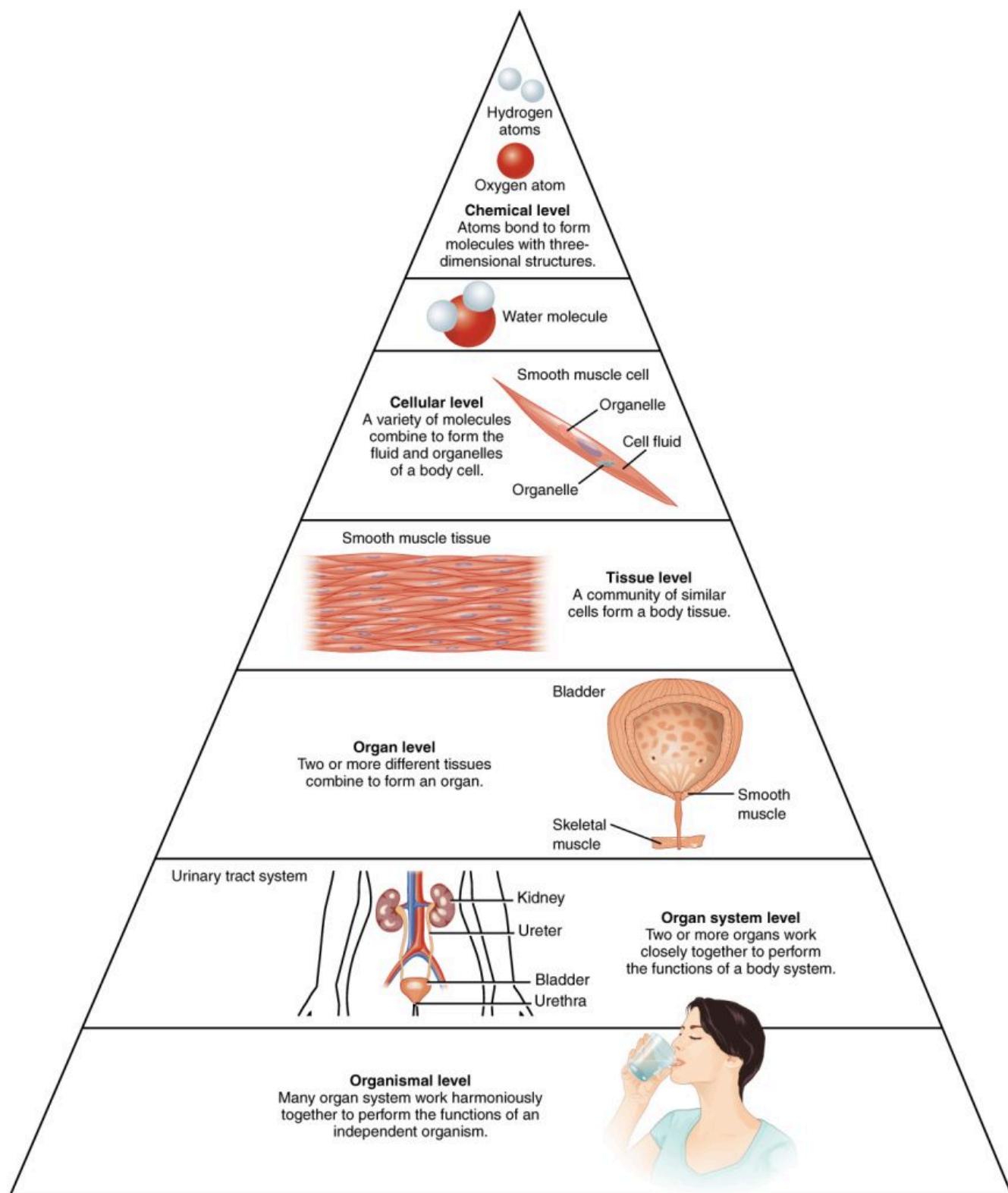


Fig. 5.1

All matter in the universe is composed of one or more unique pure substances called **elements**. Some examples of these are hydrogen, oxygen, carbon, nitrogen, calcium, and iron. The smallest unit of any of these elements is the **atom**, and

two or more atoms combine to form a **molecule**. Examples of molecules include water, proteins, and sugars that are found in all living things. Molecules are essentially the building blocks of all body structures.

A **cell** is the smallest independently functioning unit of a living organism. All aspects of human anatomy contain cells, and all the functions of human physiology are performed in cells or are initiated by cells.

A **tissue** is a group of many similar cells that work together to perform a specific function, and an **organ** is a distinct structure of the body composed of two or more tissue types. Each organ performs one or more specific physiological functions. There are many organs in the human body, and you learned about those organs in the first few chapters of this book in reference to the combining forms used in medical terminology. An **organ system (body system)** is a group of organs that work together to perform major functions and meet the physiological needs of the body.

There are 11 **body systems**. You will learn more about these body systems in Chapter 6, but a brief overview of them is given below. It is important to note that many organs actually work in more than one body system.

Key Concept

In the human body, the **organs** work collaboratively with multiple body systems. For example, the **heart (cardiovascular system)** and **lungs (respiratory system)** work together to deliver oxygen throughout the body and remove carbon dioxide from the body.

The **organism** level is the highest level of organization, and an organism can independently perform all the physiologic functions necessary for life. In a multicellular organism such as a human, all the cells, tissues, organs, and organ systems work together to maintain life.

Body Systems Overview

Cardiovascular System

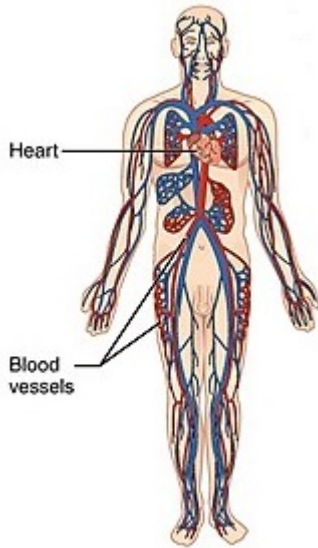


Fig. 5.2

- This system uses blood to deliver nutrients throughout the body and remove wastes from the body.
- The heart, which is the primary organ in this system, pumps blood around the body via a network of blood vessels.
- Blood, blood vessels, and the heart make up this complex system.

Respiratory System

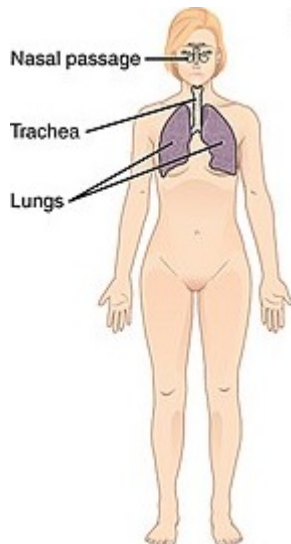


Fig. 5.3

- The primary functions of the respiratory system are to provide oxygen to the body's tissues for cellular respiration, remove the waste product carbon dioxide from the body, and help maintain the acid-base balance.
- The nose, trachea, lungs, bronchi, and bronchioles are the major parts in this system.

Endocrine System

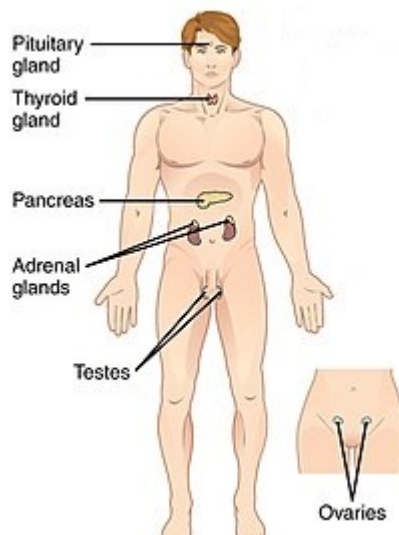


Fig. 5.4

- The purpose of the endocrine system is to regulate various organs by releasing hormones (chemical messengers).
- The pituitary, thyroid, parathyroid, and adrenal glands make up

this system, along with the pancreas, testes, and ovaries.

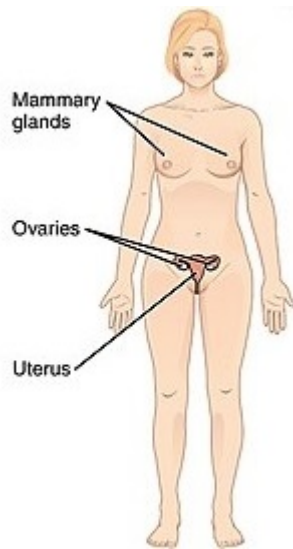


Fig. 5.5

Female Reproductive System

- This system functions to produce gametes and reproductive hormones.
- Its other function is to support a developing fetus and deliver it to the outside world.
- The ovaries, uterus, fallopian tubes, and mammary glands make up this system.

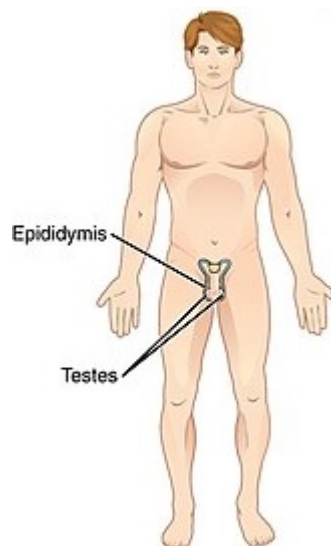


Fig. 5.6

Male Reproductive System

- The function of the male reproductive system is to produce sperm.
- The testes, scrotum, epididymis, vas deferens, prostate, seminal vesicles, and penis make up this system.

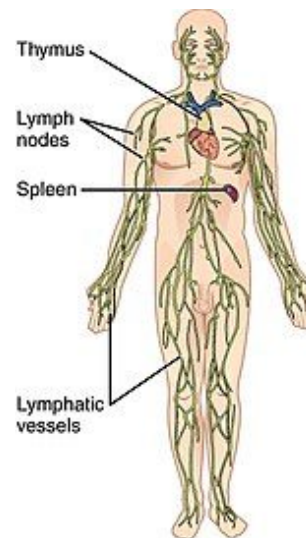


Fig. 5.7

Lymphatic System

- The major function of the lymphatic system is to drain extra body fluid (lymph) and return it to the bloodstream.
- It is also associated with the immune system and plays an important role in immunity.
- This system consists of a network of lymphatic vessels, as well as the spleen and lymph nodes and ducts.

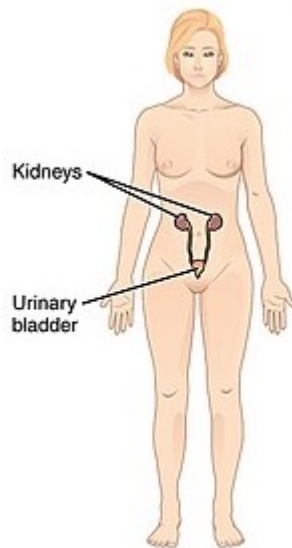


Fig. 5.8

Urinary System

- This system has various functions, but its main responsibility is cleansing the blood and removing wastes from the body.
- It also stores urine until a convenient time for disposal and provides the structures for transporting liquid waste from the body.
- This system consists of the kidneys, ureters, urethra, and bladder.

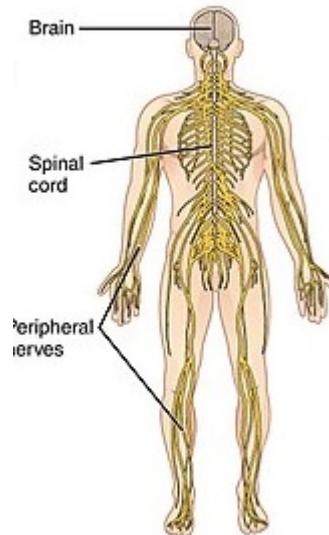


Fig. 5.9

Nervous System

- This system is very complex and is responsible for controlling much of the body, including both voluntary and involuntary functions.
- It is responsible for taking sensory input and integrating it with other sensations, memories, emotional states, and learning.
- The nervous system can be divided into two main components: the central nervous system and the peripheral nervous system.
- It consists of the brain, spinal cord, and nerves.

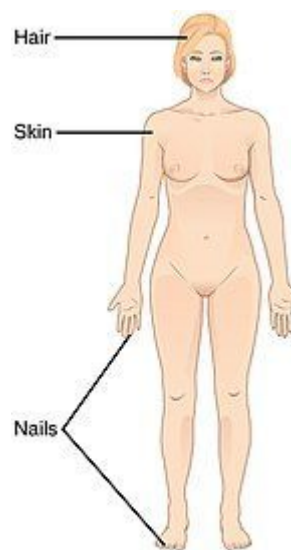


Fig. 5.10

Integumentary System

- This system is one of the largest body systems and makes up approximately 16% of total body weight.
- The main component of this system is the skin.
- The skin protects the inner organs, controls thermoregulation, functions as a sensory organ, and is necessary for vitamin

D synthesis.

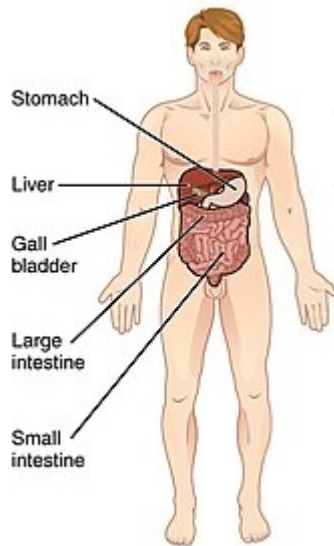


Fig. 5.11

Digestive System

- The function of the digestive system is to break down food, release its nutrients, absorb those nutrients into the body, and excrete waste.
- This system consists of the stomach, liver, gallbladder, and small and large intestines.

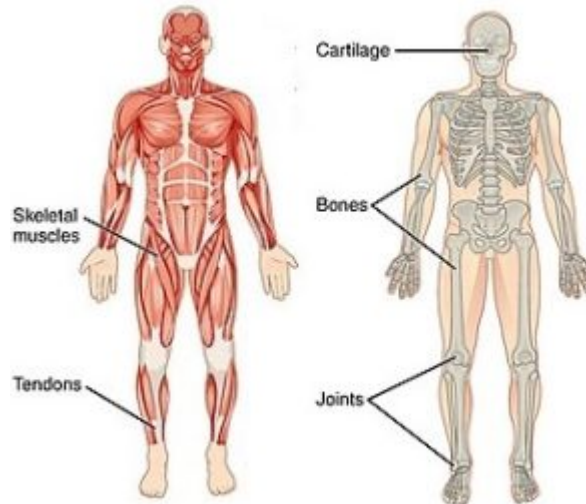


Fig. 5.12

Musculoskeletal System

- The function of this system is to support the body, facilitate movement, and protect the internal organs.
- Bones are also vital in the production of red blood cells.
- The musculoskeletal system consists of all the bones, muscles, joints, tendons, and cartilage in the body.

Review

Table. 5.1. Combining Form

COMBINING FORM	MEANING
bronch/o	bronchial tubes
cardi/o	heart
chondr/o	cartilage
col/o	colon
dermat/o	skin
encephal/o	brain
epitheli/o	skin
gastr/o	stomach
hepat/o	liver
lymph/o	lymph
nephro/o	kidney
neur/o	nerve
optic/o	eye
pulmon/o	lung
ur/o	urinary tract, urine, urea
vascul/o	blood vessels

Exercises



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5.3 Directional Terms and Body Planes

Directional terms are essential for describing the relative locations of different body structures; for example, wounds, tumours, or injuries. For instance, a surgeon might describe one band of tissue as “inferior to” another, or an oncologist might describe a tumour as “superficial to” a deeper body structure.

Directional Terms

- **Anterior** (or **ventral**) describes the front or the direction toward the front of the body; for example, the chest is anterior to the spine.
- **Posterior** (or **dorsal**) describes the back or the direction toward the back of the body; for example, the spine is posterior to the chest.
- **Superior** (or **cranial**) describes a position above or higher than another part of the body; for example, the heart is superior to the diaphragm.
- **Inferior** (or **caudal**) describes a position below or lower than another part of the body; for example, the pelvis is inferior to the abdomen.
- **Lateral** describes the side or the direction toward the side of the body; for example, the thumb is lateral to the fingers.
- **Medial** describes the middle or the direction toward the middle of the body; for example, the sternum is medial to both lungs.
- **Supine** describes a horizontal position with the body facing upward; for example, the patient lies supine during sleep.
- **Prone** describes a horizontal position with the body facing downward; for example, the spine is examined in the prone position.

Fig. 5.13 is an image of the directional positions described above. Fig. 5.14 shows both supine and prone positioning.

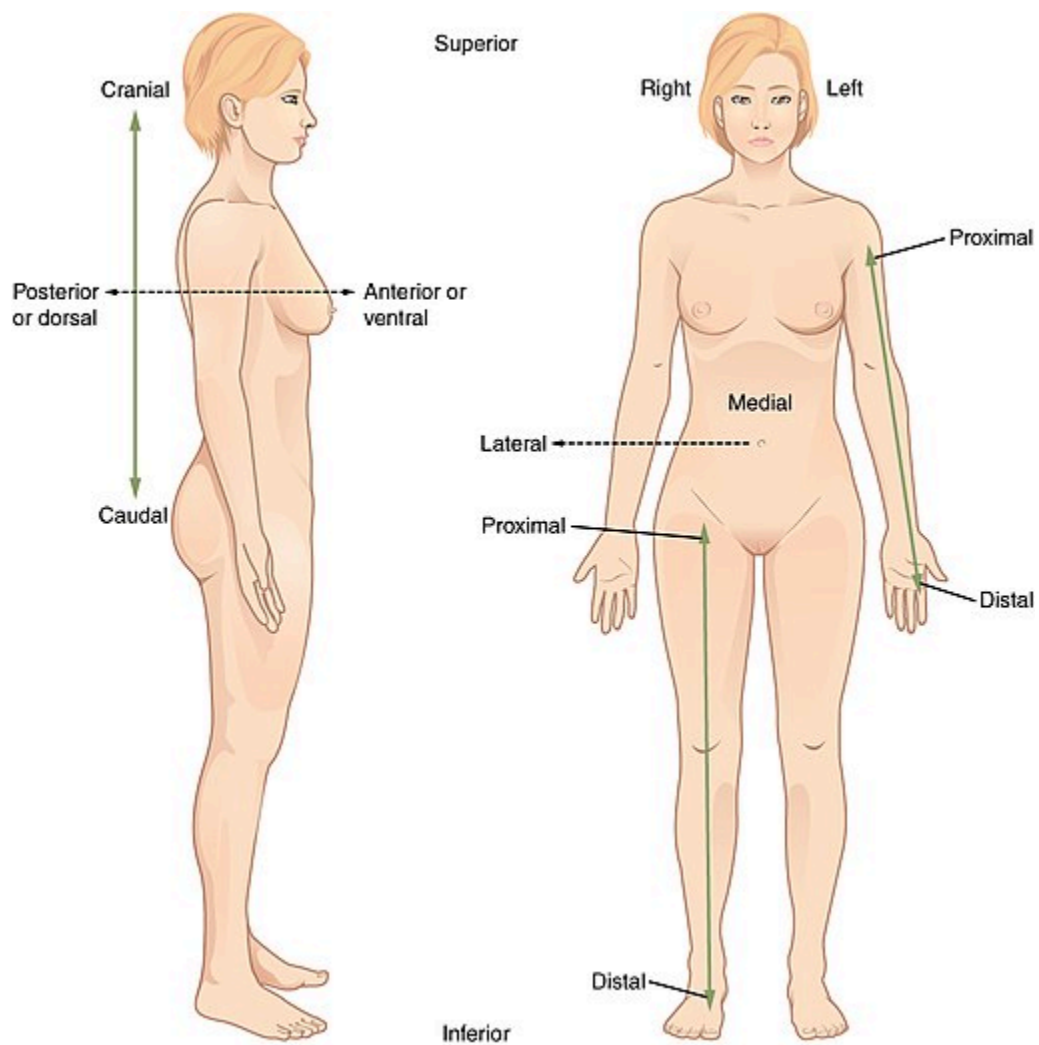


Fig. 5.13

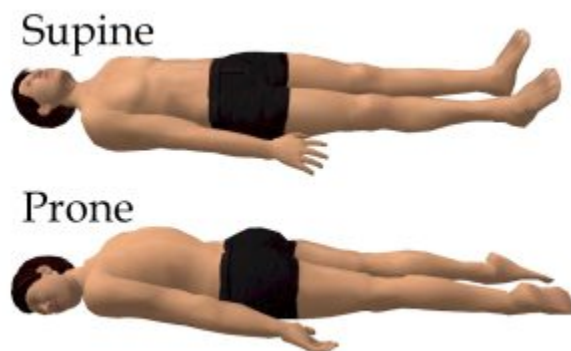


Fig. 5.14

Body Planes

A **section** is a two-dimensional surface that has been “cut” from a three-dimensional structure. Modern medical imaging devices enable clinicians to obtain “virtual sections” of living bodies; we call these **scans**. Body sections and scans can be correctly interpreted only if the viewer understands the plane along which the section was made.

A **plane** is an imaginary two-dimensional surface that passes through the body. There are three planes commonly referred to in anatomy and medicine:

1. The **sagittal plane** is the plane that divides the body or an organ vertically into right and left sides. It is also called the **lateral plane**. If this vertical plane runs directly down the middle of the body or an organ, it is called the **midsagittal plane**.
2. The **frontal plane** is the plane that divides the body or an organ into an anterior (front) portion and a posterior (rear) portion. The frontal plane is often referred to as the **coronal plane**.
3. The **transverse plane** is the plane that divides the body or organ horizontally into upper and lower portions.
4. The transverse plane is also called the **axial plane**. Transverse planes produce images referred to as **cross-sections**.

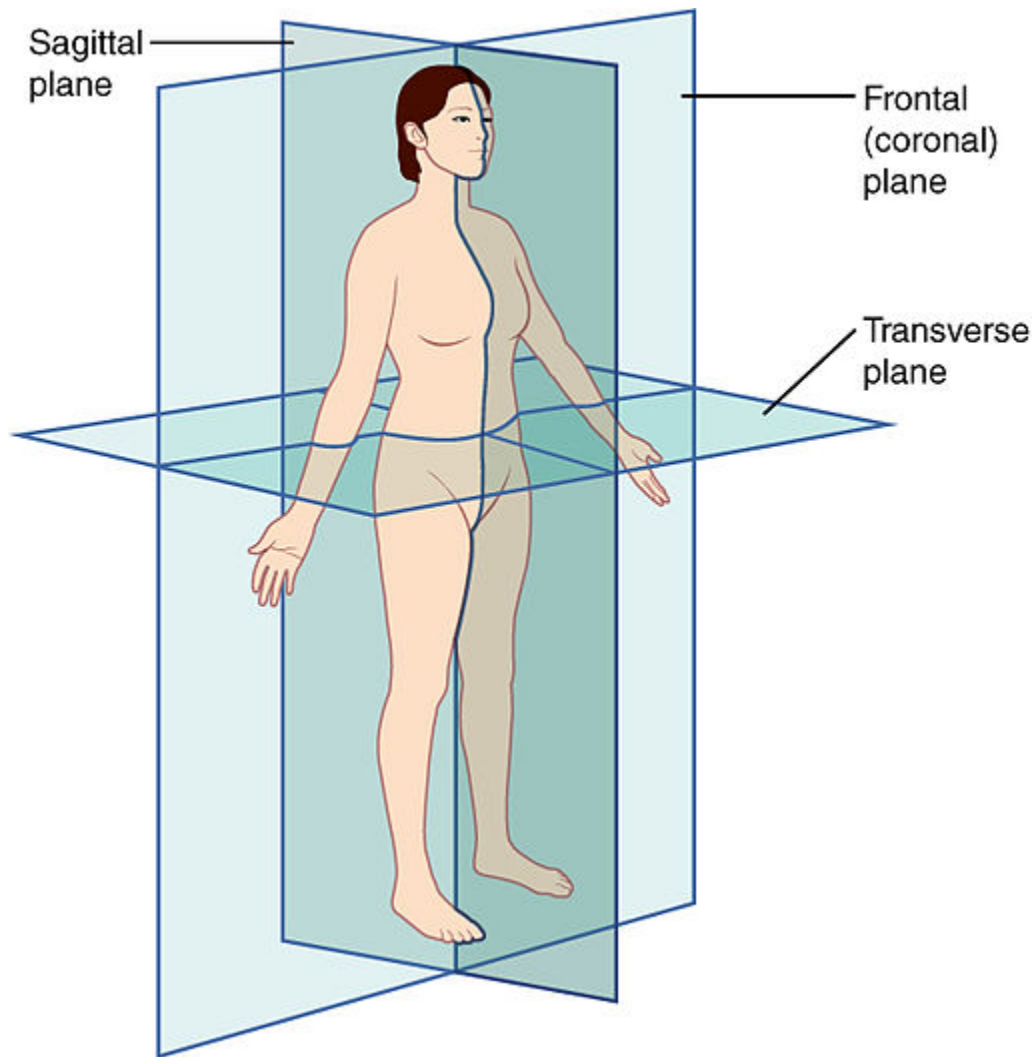


Fig. 5.15

Fig. 5.15 is an image of the three body planes using imaginary planes to help you visualize what each one would look like. The structure and condition that a physician is assessing will determine which plane will be ordered for a particular test.

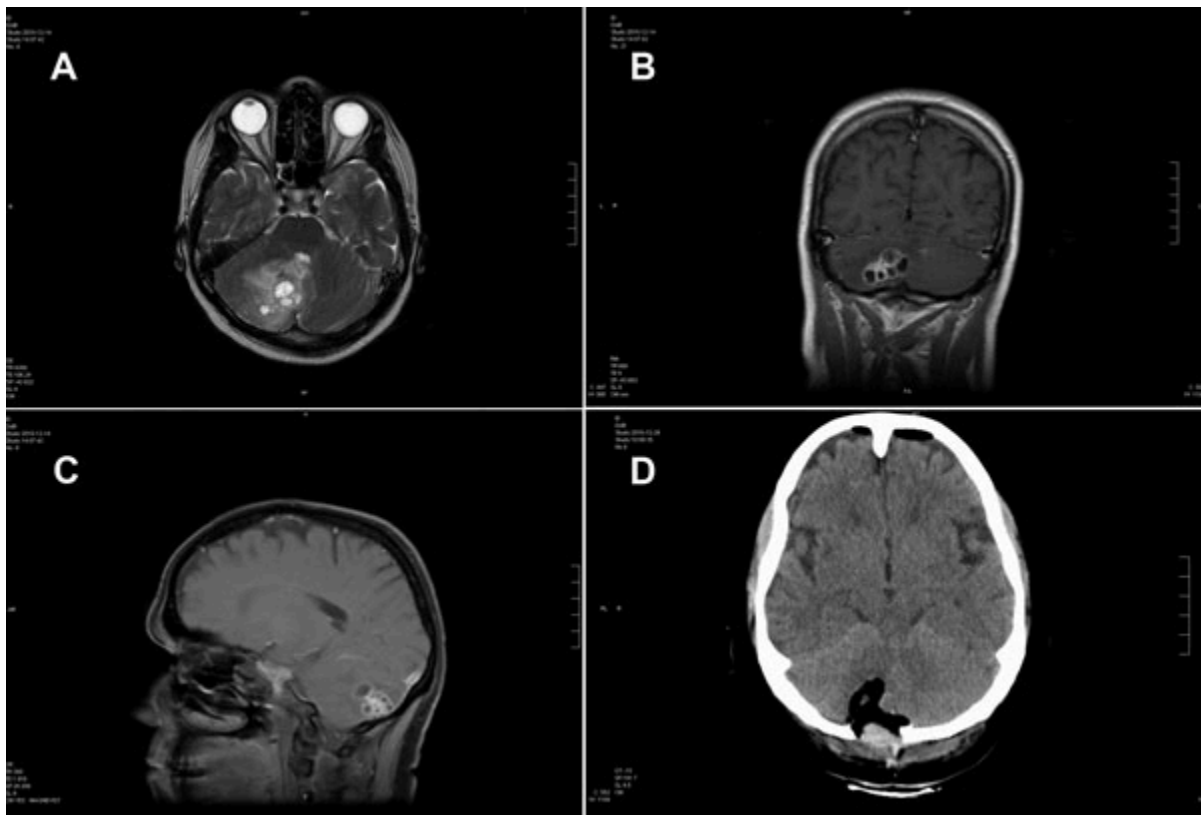


Fig. 5.16

Key Concept

Fig. 5.16 shows MRI and CT images of a brain using the different planes described above.

- **Image A** is an MRI image of a brain in the **transverse** or **axial** plane.
- **Image B** is an MRI image of the brain using the **frontal** or **coronal** view.
- **Image C** is an MRI image of the brain using the **sagittal** or **lateral** view.
- **Image D** is another **transverse** view of the brain using a CT scan.

Table 5.2. Combining Form Review

COMBINING FORMS	MEANING
anter/o	front
later/o	side
poster/o	back, behind
radi/o	X-ray

Exercises



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5.4 Body Cavities and the Abdominal Regions and Quadrants

There are several cavities within the body. Each cavity contains a number of organs and plays a specific role in the functioning of the body. We will first examine the body cavities and the organs contained within them. Next, we will look at the nine abdominal regions and four quadrants and relate this topic to patient care.

Body Cavities and Serous Membranes

The **dorsal (posterior) cavity** and the **ventral (anterior) cavity** are the largest body compartments. Fig 5.17 shows the body divided into the many body cavities. These cavities contain and protect delicate internal organs, and the ventral cavity 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.

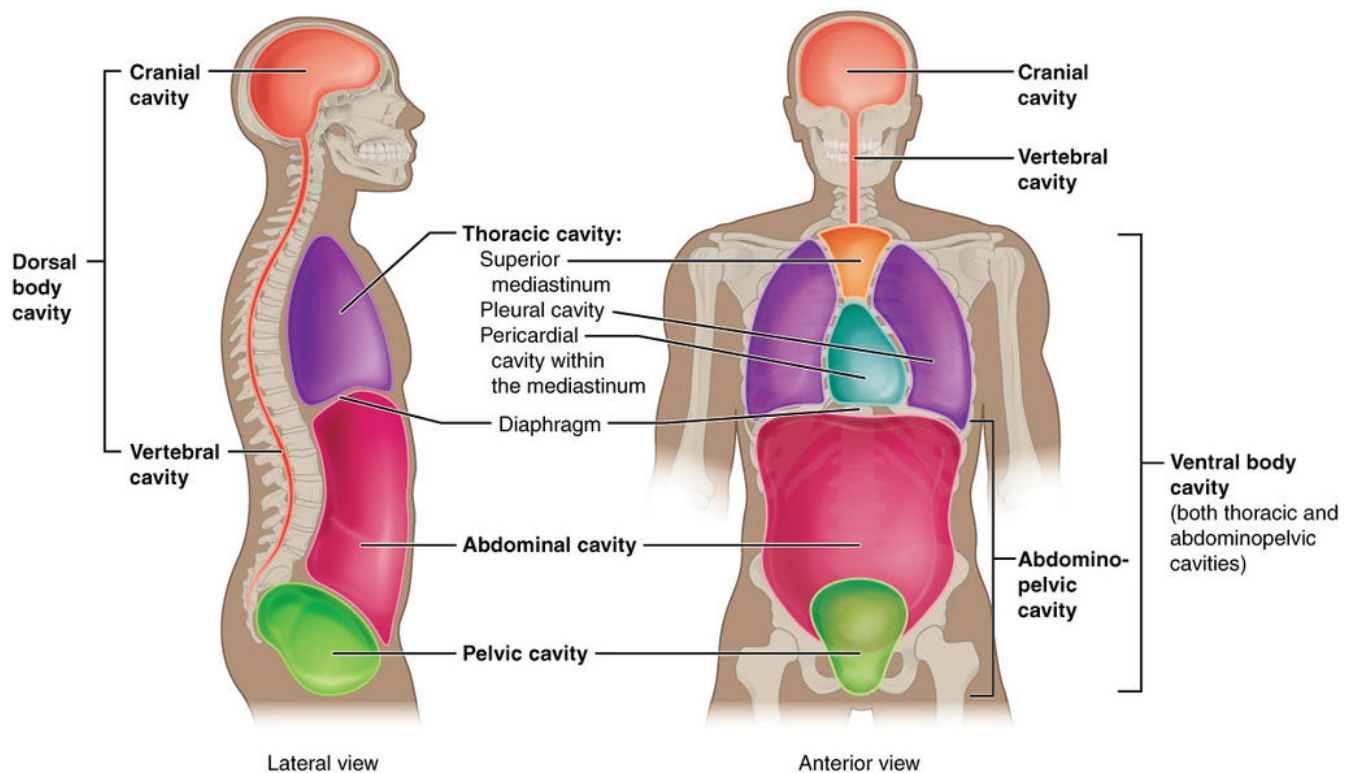


Fig. 5.17

The posterior (dorsal) and anterior (ventral) cavities are each subdivided into smaller cavities:

The **posterior (dorsal) cavity** has two main subdivisions:

- The **cranial cavity** houses the brain and pineal and pituitary glands.
 - It is protected by the bones of the skull and the cerebrospinal fluid.
- The **spinal (vertebral) cavity** encloses the spinal cord.
 - It is protected by the spinal column and the cerebrospinal fluid.

The **anterior (ventral) cavity** has two main subdivisions:

- The **thoracic cavity** is the more superior subdivision of the anterior cavity and is enclosed by the rib cage.
 - The **thoracic cavity** contains the heart, lungs, trachea, and bronchial tubes.
 - The **mediastinum** is located between the lungs and contains the heart, trachea, esophagus, and bronchial tubes.
 - The **pericardial cavity** is within the mediastinum and is formed from the pericardium, which is a double membrane that surrounds the heart.
 - The **pleural cavity** is a smaller cavity within the thoracic cavity. The lungs are protected by a double membrane called the **pleura**, and the space between the pleura is the pleura cavity.
 - The diaphragm is a muscle that forms the floor of the thoracic cavity and separates it from the more inferior **abdominopelvic cavity**.
- The **abdominopelvic cavity** is the largest cavity in the body.
 - No membrane physically divides the abdominopelvic cavity.
 - The abdominopelvic cavity houses both the **abdominal cavity** and the **pelvic cavity**.
 - The **abdominal cavity** houses the digestive organs (stomach, liver, gallbladder, and small and large intestines).
 - The organs in the abdominal cavity are surrounded by a double membrane called the **peritoneum**. The space between this double membrane is called the **peritoneal cavity**. This membrane adds protection and supports and reduces friction between the abdominal and pelvic organs. Fig. 5.18 shows the peritoneum (highlighted in green) and the peritoneal cavity in a transverse (axial) view.
 - The **pelvic cavity** is inferior to the abdominal cavity. It contains the male or female reproductive organs, urinary system organs (urinary bladder, ureters, urethra), rectum, and anus.

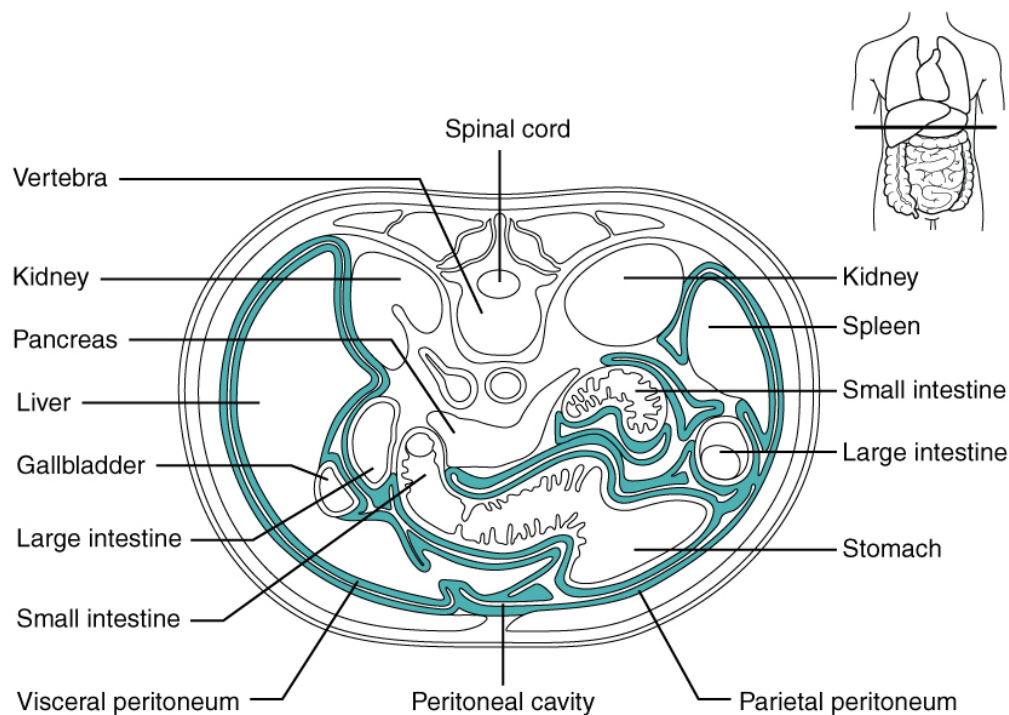


Fig. 5.18

Key Concepts

Sometimes fluid can build up in the different body cavities, causing strain on the body (Mayo Clinic, 2022a). Starting with the most superior body cavity, the cranial cavity, **hydrocephalus** is a condition in which there is an increase in fluid (cerebrospinal fluid) in the cranial cavity. This in turn puts increased pressure on the brain and can cause numerous issues, including headaches, visual disturbances, and balance problems, among others. This condition usually needs to be treated both medically and surgically (Mayo Clinic, 2022a).

The thoracic cavity has two main cavities where fluid can build up—the pleural cavity and the pericardial cavity (Cleveland Clinic, 2018). A collection of fluid in the pleural cavity is called **pleural effusion**. Fluid build-up in the pericardial cavity is called **pericardial effusion** (Mayo Clinic, 2022b). In both these conditions, when there is a build-up of fluid within their double membranes, patients may present with **angina** and **dyspnea** (Cleveland Clinic, 2018; Mayo Clinic, 2022b).

Fluid build-up in the peritoneal cavity is called **ascites** (Cleveland Clinic, 2021). Ascites can happen for a number of reasons, most commonly cirrhosis of the liver. Patients usually present with dyspnea and swelling in the abdomen and ankles (Cleveland Clinic, 2021).

Abdominal Regions and Quadrants

To promote clear communication, for instance, about the location of a patient's abdominal pain or a suspicious mass, healthcare providers typically divide up the abdominal cavity into either **nine regions** or **four quadrants**. Fig. 5.19 shows both (a) the nine abdominopelvic regions and (b) the four quadrants. It is important to be aware of the major organs in each region or quadrant. For example, the stomach is in the left upper quadrant (LUQ), and the appendix sits in the right lower quadrant (RLQ).

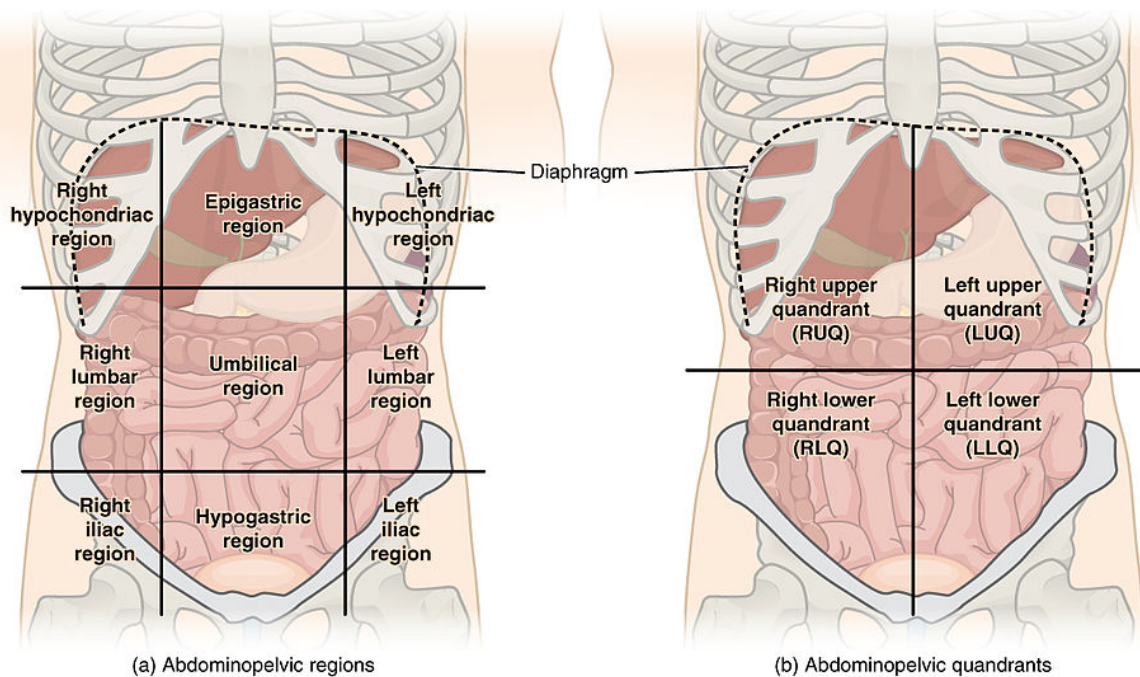


Fig. 5.19

Key Concept

The **nine abdominopelvic regions** and the **four quadrants** are often used when describing a mass or pain. It makes communication among healthcare providers more clear. For example, if a patient has a mass in the left lower quadrant it will be written as “patient has a mass in the LLQ.” This way, when another healthcare provider goes to reassess the patient, they know exactly what area of the abdomen they need to look at.

Table 5.3. Combining Form Review

COMBINING FORM	MEANING
abdomin/o	abdomen
anter/o	front
cephal/o	head
crani/o	skull
hydr/o	water
lapar/o	abdomen
mediastin/o	mediastinum
myel/o	spinal cord
pelv/o	pelvis
peritone/o	peritoneum
phren/o	diaphragm
pleur/o	pleura
poster/o	back, behind
spin/o	spine
spondyl/o	backbone, vertebra
thorac/o	chest

Exercise



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Exercises



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5.5 Divisions of the Spine

The **spine** is also known as the **spinal column** or **vertebral column**. It consists of **vertebrae** (singular = **vertebra**) separated by **intervertebral discs**. Together, the vertebrae and intervertebral discs form the spine, which is a flexible column that supports the head, neck, and body, and allows for movement. It also protects the spinal cord, which passes down the spine through openings in the vertebrae.

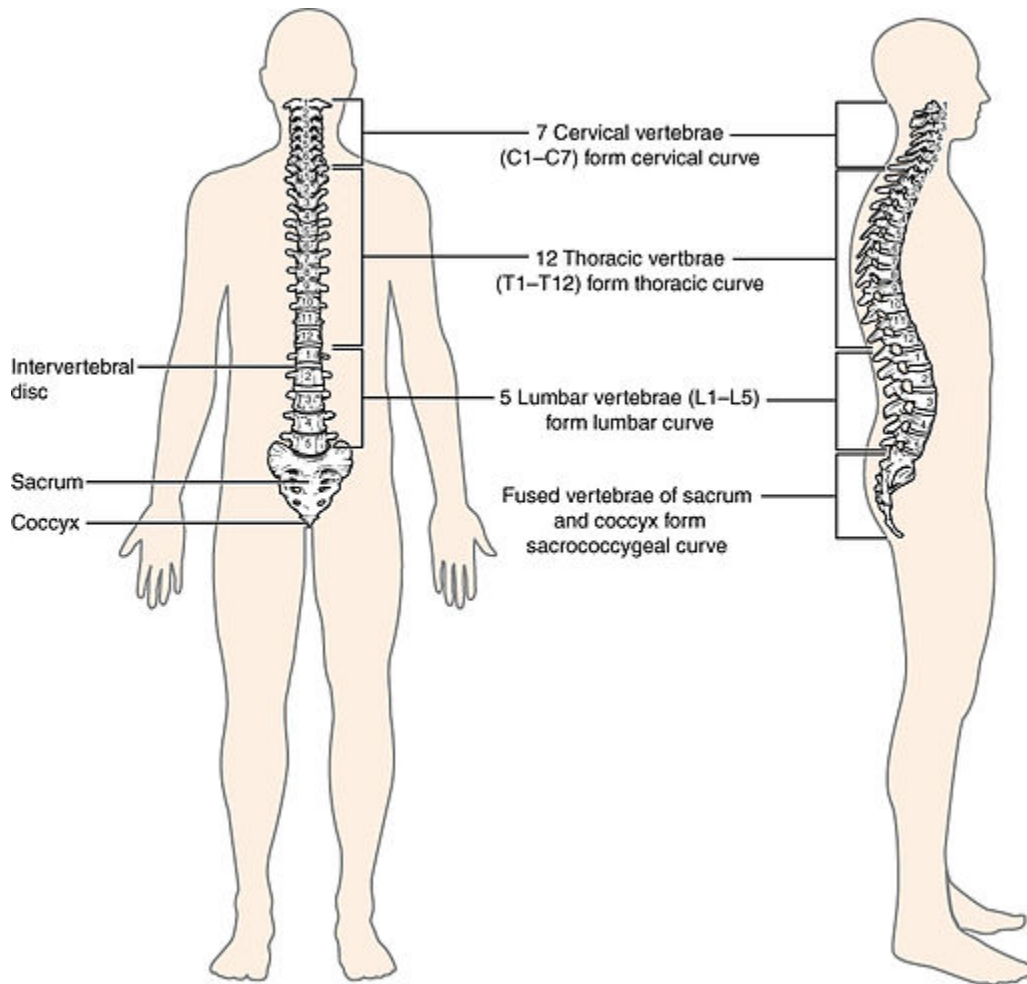


Fig. 5.20

The spine originally has a total of 33 vertebrae; however, this number decreases with age to 24 vertebrae, plus the sacrum and coccyx. It is divided into five regions, with the vertebrae in each area named for that region and numbered in increasing order from top to bottom. Fig. 5.20 and Table 5.4 provide a breakdown of the sections of the spine.

The neck has seven **cervical vertebrae**, each designated C1–C7. Below these are the 12 **thoracic vertebrae**, designated T1–T12. The lower back contains the **lumbar vertebrae**, numbered L1–L5. The **sacrum** is formed by the fusion of five **sacral vertebrae**. Similarly, the **coccyx**, or **tailbone**, results from the fusion of four small **coccygeal vertebrae**. The sacral

and coccygeal fusions, which result in the decrease in total number of vertebrae, do not begin until approximately age 20, and the fusions are not completed until a person is close to middle age.

Table. 5.4 Divisions of the Spine

DIVISION	BONES	ABBREVIATION
cervical	7 bones	C1-C7
thoracic	12 bones	T1-T12
lumbar	5 bones	L1-L5
sacral	5 fused bones	
coccygeal	4 fused bones	

Did you know?

Interestingly, almost all mammals have seven cervical vertebrae, regardless of their body size (Carter & Rutherford, 2020). This means that the size of the cervical vertebrae vary widely. They range from the tiny cervical vertebrae of a bird to the large vertebrae in the neck of a giraffe. In a full-grown giraffe, each cervical vertebra measures 28 centimetres (11 inches) tall (Carter & Rutherford, 2020).

The adult spine does not form a straight line, but instead has four curvatures along its length. The purpose of these curves is to increase the spine's strength, flexibility, and shock-absorbing ability. For example, when you are carrying a heavy backpack, the spine becomes more curved to accommodate the extra weight, then springs back when the weight is removed.

In the different regions of the spine, the vertebrae vary in size and shape, but they all follow a similar structural pattern. A typical vertebra consists of a **body**, a **vertebral arch**, and **seven processes**. The **body** is the front portion of each vertebra and supports the body's weight. The **vertebral arch** forms the back portion of each vertebra. The large opening between the vertebral arch and body contains the **spinal cord**. The seven **processes** are outgrowths that arise from the vertebral arch. They serve various functions, including attachments for muscles and ribs. The structure and components of the vertebrae can be seen in Fig. 5.21.

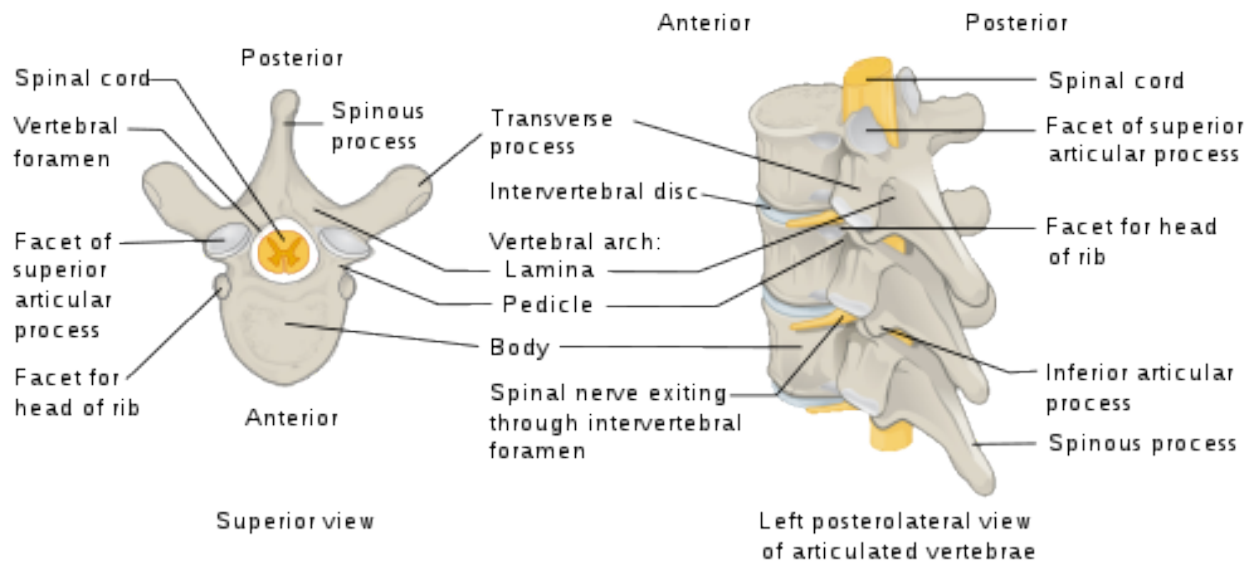


Fig. 5.21

A **lumbar puncture** is a common diagnostic test in which a needle is inserted into the lumbar region of the spinal column through the dura mater and arachnoid membrane into the subarachnoid space so that fluid can be withdrawn for testing. Because the spinal cord does not extend through the lower lumbar region of the spine, a needle can be inserted through the dura and arachnoid layers to withdraw cerebrospinal fluid and avoids the risk of damaging the

central tissue of the spinal cord. This procedure is also called a **spinal tap**, and the common abbreviation is **LP**. Fig. 5.22 shows a spinal tap being performed, and Fig. 5.23 demonstrates how a sample of fluid is taken for analysis.

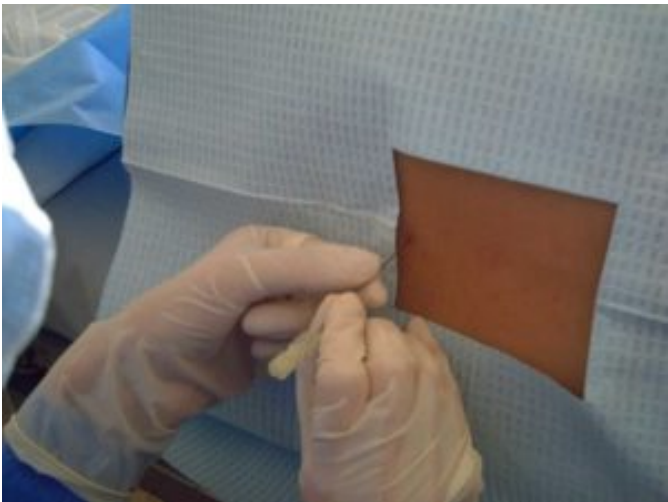


Fig. 5.22

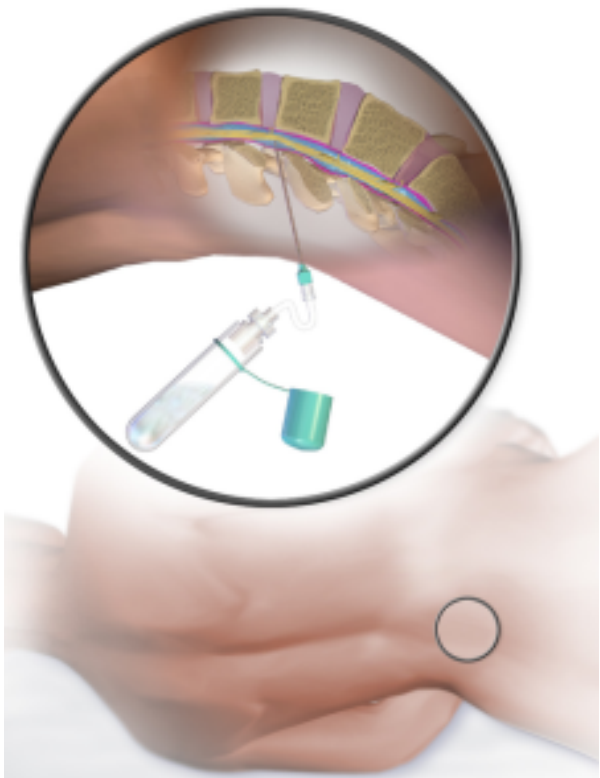


Fig. 5.23

Table. 5.5. Combining Form Review

COMBINING FORM	MEANING
cervic/o	neck
chondr/o	cartilage
coccyg/o	coccyx, tailbone
lamin/o	part of a vertebra/backbone
lumb/o	loin, waist
myel/o	spinal cord
pelv/o	pelvis
sacr/o	sacrum
spin/o	spine
vertebr/o	vertebra

Exercises



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5.6 Review Exercises

The following review exercises cover most of the content in this chapter. It is important that you review all the chapter content in addition to completing this review to have a full understanding of all the concepts covered in Chapter 5.

Final Review



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CHAPTER VI

BODY SYSTEMS

6.1 Introduction to Body Systems

Learning Objectives

By the end of this chapter, you will be able to

1. Differentiate the body systems
2. Define the common functions of each of the body systems
3. Describe the key components of each of the body systems
4. List the combining forms common to each body system
5. Describe the common pathologies that affect each of the body systems

Chapter Overview

An understanding of body systems is fundamental to any career in a health profession. Much of the content covered in this chapter is required knowledge about topics that are frequently discussed in any clinic or hospital. Familiarity with the human body can even help you make healthful choices for yourself and prompt you to take appropriate action when signs of illness arise. This chapter will discuss the functions, components, and common pathologies found in all body systems. There will be an ample number of practice questions and activities throughout the chapter, as well as a final review.

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6.2 Cardiovascular System

Overview and Functions

The cardiovascular system (Fig. 6.1) uses blood to deliver nutrients and remove wastes from the trillions of cells in the human body. The heart, which is the primary organ in this system, pumps blood throughout the body via a network of blood vessels. These three components—blood, blood vessels, and the heart—make up this complex system. Figure 6.1 illustrates the cardiovascular system, and the video provided explains the intricate function of the heart within this system.

A. = artery
V. = vein

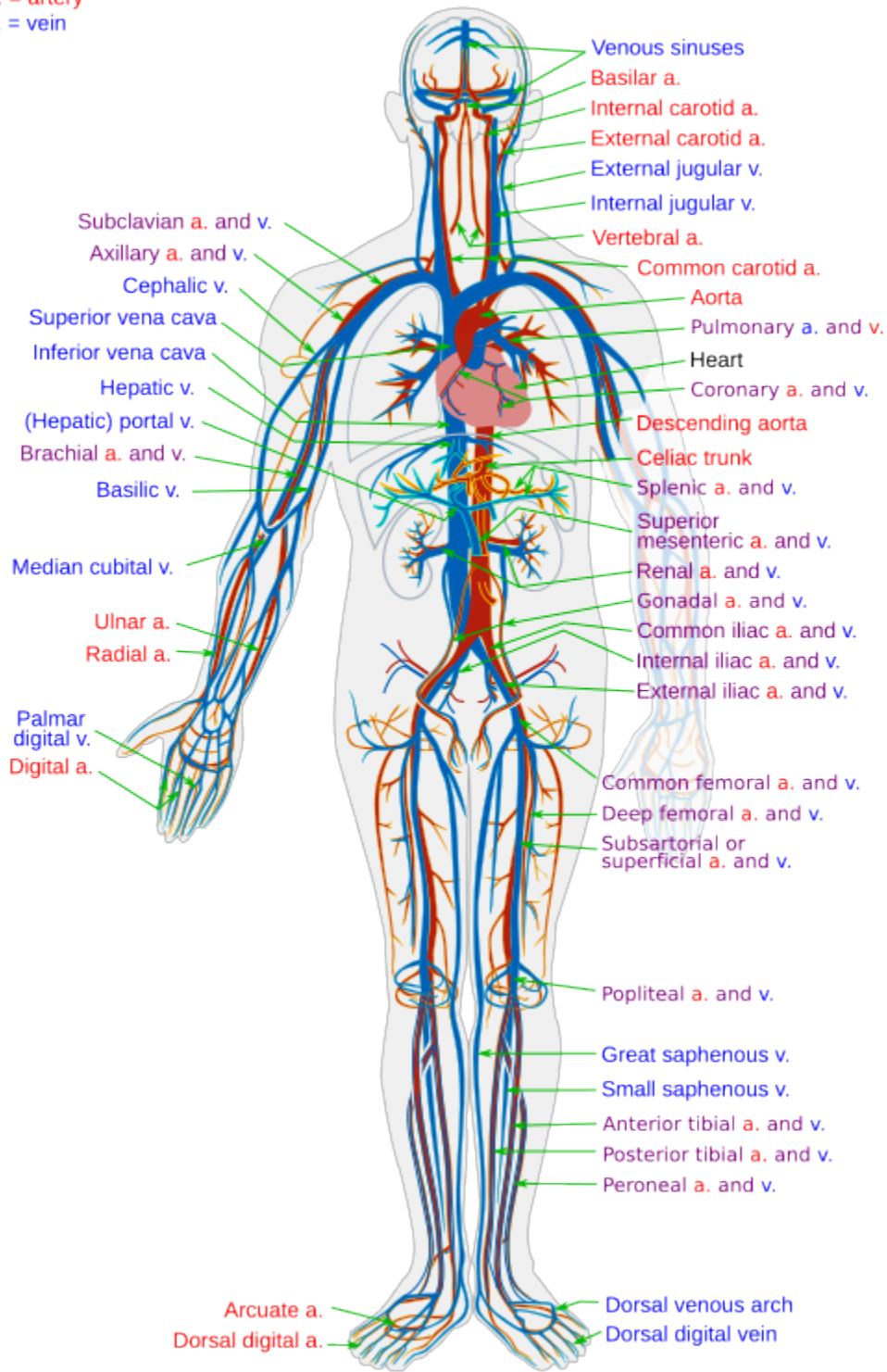


Fig. 6.1



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(CrashCourse, 2015)

Components of the Cardiovascular System

Heart: The human heart is located in the **thoracic cavity**, between the lungs in the space referred to as the **mediastinum**. The best way to describe the heart is a pump. Its contractions create pressure that sends blood into the major vessels, including the **aorta**. From there, the blood is distributed to the rest of the body.

Blood: Blood is composed of many different compounds and can be analyzed using lab tests to determine the various levels of these compounds present in the body. The main components of blood are the following:

- **Plasma:** Consists of water, proteins, nutrients, and hormones
- **Hematocrit:** Consists of red blood cells
- **Buffy coat:** Consists of white blood cells and platelets

The primary function of blood is to deliver oxygen and nutrients to the body's cells and to remove wastes from those same cells. Blood also has other functions, including defence, distribution of heat, and maintenance of homeostasis.

Blood vessels: Blood vessels transport blood throughout the body. They provide the physical site where gases, nutrients, and other substances are exchanged with body cells. An **artery** is a blood vessel that carries blood away from the heart. It branches into smaller vessels called **arterioles**, and they further branch into tiny **capillaries**, where nutrients and wastes are exchanged. The capillaries then combine to form **venules**, which are small blood vessels that carry blood to a **vein**, a larger blood vessel that returns blood to the heart.

Combining Forms

Table 6.1. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
angi/o	blood vessel	angioplasty
aort/o	aorta	aortic
arteri/o	artery	arteriosclerosis
arteriol/o	arteriole	arteriolitis
cardi/o	heart	cardiomegaly
coron/o	heart	coronary
hem/o	blood	hemoglobin
hemat/o	blood	hematoma
mediastin/o	mediastinum	mediastinotomy
phleb/o	vein	phlebotomy
vas/o	blood vessel	vasoconstriction
ven/o	vein	intravenous
venul/o	venule	venulectasia

Common Pathologies

Aneurysm: An aneurysm (Fig. 6.2) is the ballooning of a blood vessel caused by weakening of the wall of the vessel. It can occur in various vessels throughout the body, including the brain and abdomen. An aneurysm can be a life-threatening emergency, especially if the aneurysm bursts, which can lead to the person bleeding out internally.

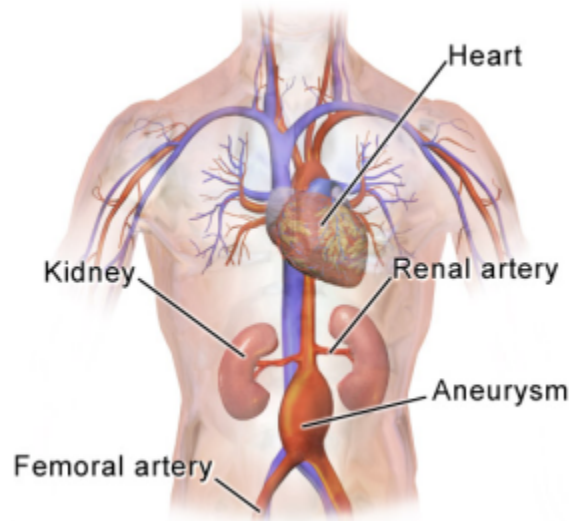


Fig. 6.2

Angina: Angina is characterized by chest pain and is caused by poor blood flow to the heart. Often it can be treated with nitroglycerin, a vasodilator medication that increases blood flow back to and through the heart, and rest.

Arteriosclerosis: This condition is defined as hardening of the arteries. Advanced age and lifestyle factors such as smoking, high blood sugar, infection, and high cholesterol are major risk factors for arteriosclerosis, which progresses over time. This pathology begins with some form of injury to the walls of the arteries, which results in inflammation to the area. The inflammation then spreads throughout the walls of the artery, causing weakness and scarring. Over time, the scarring results in the arteries becoming stiff or “hardened” (Ernstmeyer & Christman, 2020).

Atherosclerosis: This is a type of arteriosclerosis and is characterized by a build-up of plaque along the walls of the arteries (Fig. 6.3). The plaque is a fatty material made up of cholesterol, white blood cells, connective tissue, and smooth muscle cells. The plaque build-up obstructs blood flow and decreases the flexibility of the arteries.

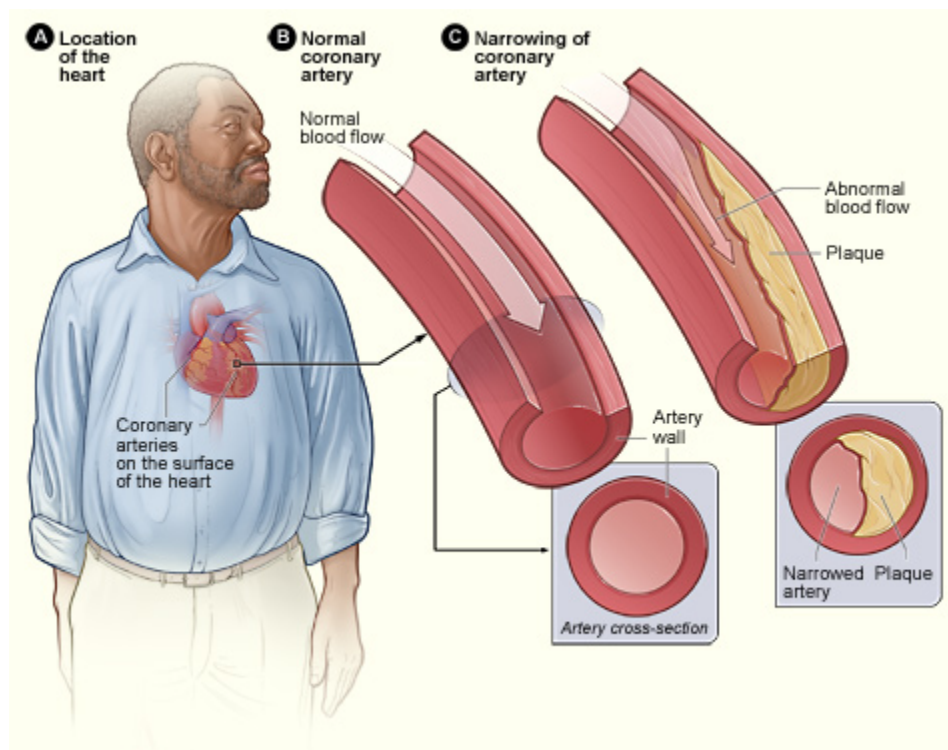


Fig. 6.3

Arrhythmia: Any deviation from the normal pattern of impulses and contractions within the heart is considered an arrhythmia. It can also be any form of fibrillation, which is uncoordinated beating of the heart. An electrocardiogram (Fig. 6.4) provides a record of the electrical activity of the heart and can help diagnose this condition.

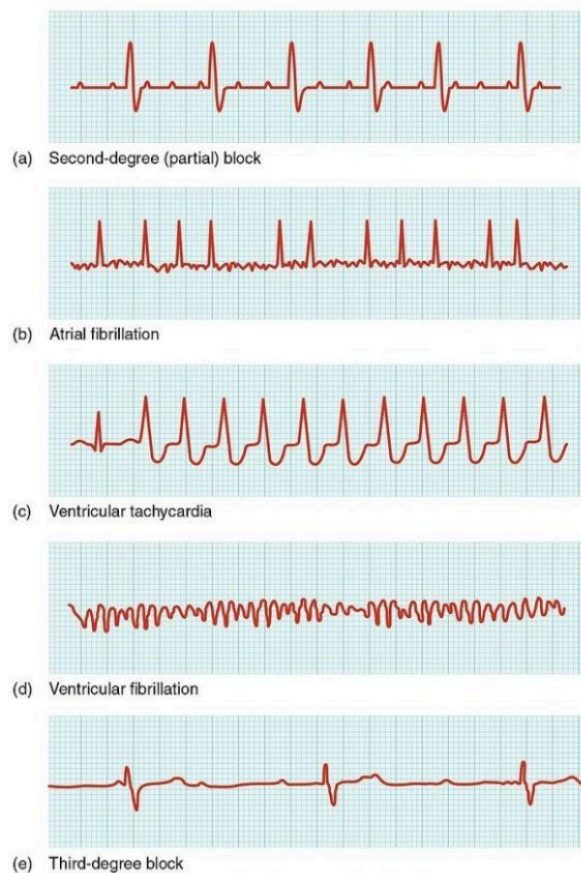


Fig. 6.4

Deep vein thrombosis (DVT): A deep vein thrombosis is a blood clot that forms in one of the larger blood vessels, often in the calf of the leg. It is more likely to occur after a long plane flight or period of immobility. The clot can result in a **pulmonary embolism**, which is a blood clot that travels to the lungs.

Heart failure: In this condition, the heart is unable to pump enough blood to supply the body. **Right-sided heart failure** occurs when the heart cannot pump enough blood to the lungs, where it picks up oxygen (Ernstmeyer & Christman, 2020). **Left-sided heart failure**, on the other hand, occurs when the heart cannot pump enough oxygen-filled blood to the rest of the body. There is no cure for this pathology; however, it can be treated with lifestyle changes and medications. Individuals with heart failure often exhibit **peripheral edema** (swelling of the hands and feet) and shortness of breath because of fluid overload in the lungs (Ernstmeyer & Christman, 2020).

Hyperlipidemia: High blood lipid levels or high circulating levels of lipids in the blood characterize this pathology. Cholesterol is a fat, also called a lipid, and it is necessary for our bodies to work correctly (Ernstmeyer & Christman, 2020). There are different types of cholesterol, and they include the following:

- **High-density lipoprotein (HDL) cholesterol:** This is considered a “good” cholesterol because it promotes the excretion of cholesterol (Ernstmeyer & Christman, 2020).
- **Low-density lipoprotein (LDL) cholesterol:** This is often called “bad” cholesterol because it stores cholesterol in the bloodstream, which contributes to atherosclerosis (Ernstmeyer & Christman, 2020). Too much LDL cholesterol can increase the risk for a stroke, peripheral vascular disease, and various forms of heart disease.
- **Total cholesterol:** This is all the cholesterol combined.

Hypertension (HTN): Hypertension is abnormally high blood pressure. The previous standard for this diagnosis was 140/90 mmHg, but recent guidelines have come out that state hypertension should begin to be treated at 130/80 mmHg (Ernstmeyer & Christman, 2020). This condition is treated with lifestyle changes and medications.

Myocardial infarction (MI): This is the medical term for what is commonly referred to as a **heart attack** (Fig. 6.5). It results from lack of blood flow and oxygen to a part of the heart. The lack of blood flow to that area (**ischemia**) then results in the death of the tissues (**necrosis**). Symptoms can vary but often present with chest pain that radiates to the back or shoulder, as well as paleness and diaphoresis (sweating).

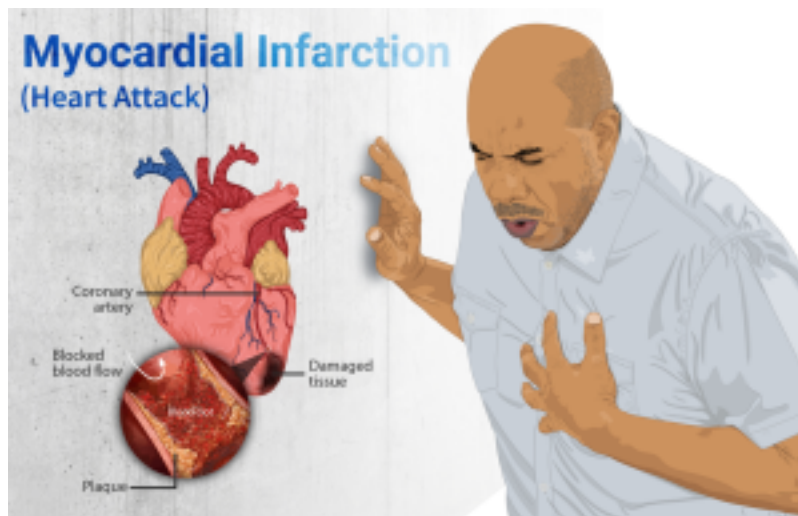


Fig. 6.5

Shock: There are many different types of shock; however, all of them are characterized by the inability of the body to get oxygen to the tissues and insufficient return of blood to the heart. Symptoms can vary and usually include paleness, rapid and weak pulse, and shortness of breath. Some types of shock include the following:

- **Cardiogenic shock:** Occurs when the heart cannot maintain cardiac output
- **Anaphylactic shock:** Results from a severe allergic reaction and massive vasodilation
- **Circulatory shock:** Occurs when the body cannot supply enough blood flow for adequate oxygenation of the tissues
- **Hypovolemic shock:** Excessive loss of blood volume caused by dehydration or hemorrhage
- **Septic shock:** Results from a severe infection and inflammation

Exercise





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6.3 Respiratory System

Overview and Functions

The primary functions of the respiratory system (Fig. 6.6) are to provide oxygen to the body's tissues for cellular respiration, remove the waste product carbon dioxide, and help maintain the acid-base balance. Although cells require oxygen, it is actually the accumulation of carbon dioxide that drives the respiratory system to breathe. This system includes the muscles used to move air in and out of the lungs, the structures involved in the movement of oxygen and carbon dioxide, and the microscopic gas exchange that occurs within the lungs. The majority of the chronic pathologies that affect this system are conditions that impair the gas exchange process and result in laboured breathing and other difficulties.

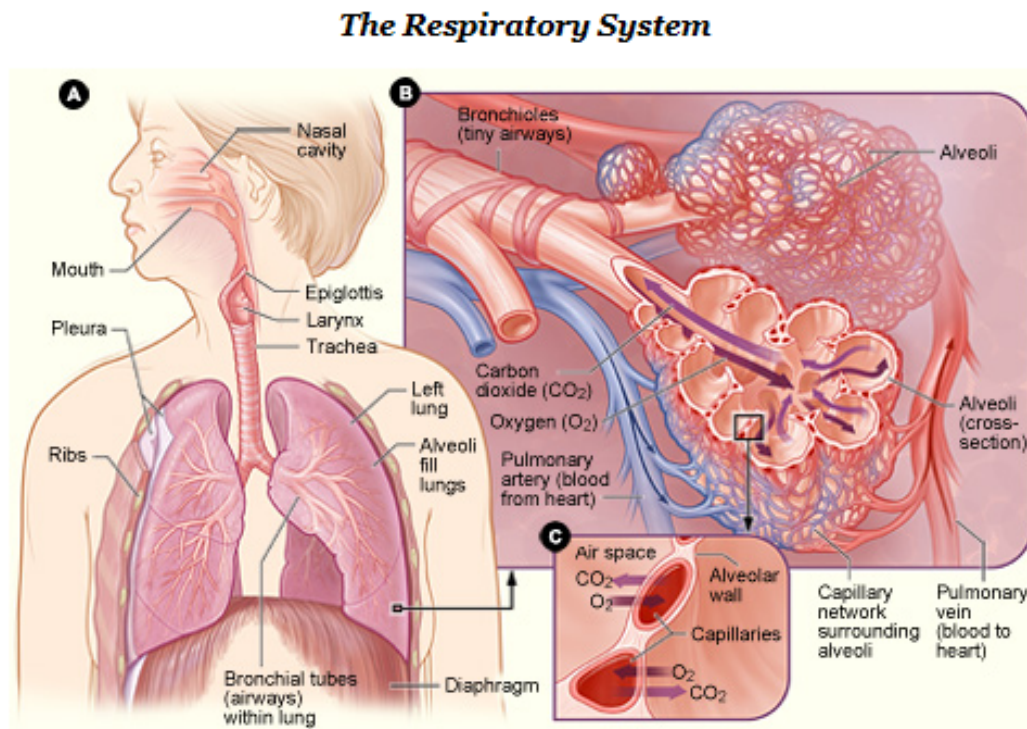


Fig. 6.6



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Components of the Respiratory System

Nose: The nose is the main entrance and exit for the respiratory system.

Pharynx: The pharynx is a tube made up of skeletal muscle and lined with mucous membrane that begins in the nasal cavity and ends at the larynx. The pharynx is divided into three major regions: **nasopharynx**, **oropharynx**, and **laryngopharynx**.

Larynx: This cartilaginous structure is found below the pharynx and connects at the lower end to the trachea. The larynx helps regulate the volume of air that enters and leaves the lungs. It is composed of three large cartilage pieces: **thyroid cartilage**, **epiglottis**, and **cricoid cartilage**.

Epiglottis: This very flexible, elastic piece of cartilage covers the opening of the trachea and is attached to the thyroid cartilage. It is an important structure in that it prevents food and liquids from entering the trachea.

Trachea: Also known as the **windpipe**, the trachea extends from the larynx to the lungs. It branches at the end into the **right** and **left bronchi**.

Bronchi: The bronchi lead to tree-like structures in both the right and left lungs that become the smaller **bronchioles** and finally end in the **alveolar sacs** and **alveoli**.

Alveoli: These are the small, almost grape-like structures at the end of the **alveolar ducts**. This is where gas exchange occurs.

Lungs: The lungs are the major organ in the respiratory system and contain the bronchi, bronchioles, and alveoli. The main function of the lungs is to exchange oxygen and carbon dioxide.

Pleura: This serous membrane lines the thoracic cavity and surrounds the lungs. Its purpose is to cushion and protect the lungs.

Diaphragm: The diaphragm is a dome-shaped muscle located at the base of the lungs. It divides the thoracic and abdominal cavities. Breathing is dependent on the contraction and relaxation of this muscle.

Key Concept

The lungs exchange respiratory gases across a very large surface area that is highly permeable to gases. This area amazingly totals approximately 70 square metres.

Combining Forms

Table 6.2. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
adenoid/o	adenoid	adenoiditis
alveol/o	alveoli (air sacs)	alveolar
bronch/o	bronchial tubes	bronchoscopy
bronchi/o	bronchial tubes	bronchiectasis
bronchiol/o	bronchioles	bronchiolitis
cyan/o	blue	cyanotic
epiglott/o	epiglottis	epiglottitis
laryng/o	larynx (voice box)	laryngitis
nas/o	nose	nasal
rhin/o	nose	rhinitis
pharyng/o	pharynx	pharyngectomy
phren/o	diaphragm	phrenic nerve
pleur/o	pleura	pleuritis
pneum/o	lung	pneumothorax
pneumon/o	lung	pneumonitis
pulmon/o	lung	pulmonary
tonsill/o	tonsils	tonsillectomy
trache/o	trachea (windpipe)	tracheostomy

Common Pathologies

Allergies: When the immune system reacts to a foreign substance that doesn't cause a reaction in most other people, they are experiencing an allergic reaction (Ernstmeyer & Christman, 2020). Substances that cause allergies vary greatly depending on the individual; however, they often include things such as pollen, grass, insect stings, pet dander, and food.

The immune system produces antibodies, which is normal, but when someone has an allergy, the immune system makes antibodies that identify a particular allergen as harmful, even though it is not (Ernstmeyer & Christman, 2020). The reaction that the individual experiences varies depending on the body system involved and the severity of the allergy. Some people only have a minor irritation, whereas others experience a potentially life-threatening emergency.

Anaphylaxis: This is a severe reaction to an allergen; for example, to a food or insect sting (Ernstmeyer & Christman, 2020). When someone experiences anaphylaxis they could go into shock.

Signs and symptoms of anaphylaxis include the following:

- Loss of consciousness
- Hypotension
- Airway constriction
- Shortness of breath
- Skin rash/hives
- Lightheadedness
- Rapid, weak pulse
- Nausea and vomiting

Asphyxia: By definition, asphyxia is a decrease in oxygen levels and an increase in carbon dioxide in the body. The individual is not breathing, and this can be caused by an injury or obstruction of the breathing passageways. Common causes of asphyxia are strangulation, drowning, or choking on food (Doyle & McCutcheon, 2020).

Asthma: This is a chronic disease characterized by inflammation of the airways and constriction of the bronchioles, which can inhibit air from entering the lungs (Fig. 6.7). There is also excessive mucus secretion in the respiratory tract, which contributes to airway occlusion.

Symptoms of asthma include the following:

- Coughing
- Shortness of breath
- Wheezing
- Chest tightness

During a severe asthma attack, the individual may also experience symptoms such as difficulty breathing, cyanosis, confusion, rapid pulse, sweating, and severe anxiety.

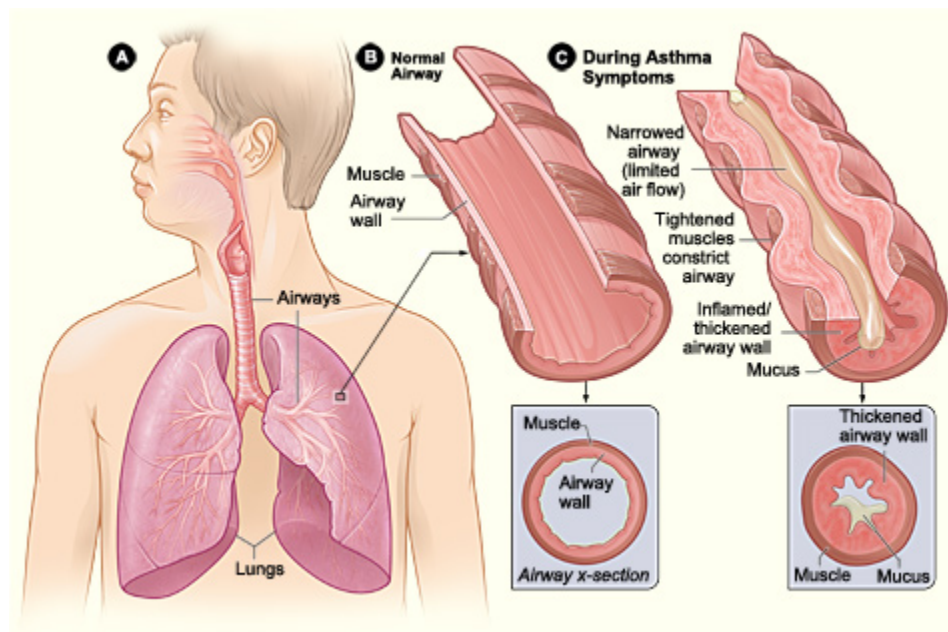


Fig. 6.7

Key Concept

Asthma is a very common condition that affects both adults and children. Approximately 8.2% of adults and 9.4% of children in the United States have asthma. It is also the most frequent cause of hospitalization in children.

Atelectasis: This is the collapse of all or part of a lung. It can be caused by pressure on the lung or a blockage of the bronchi or bronchioles (Doyle & McCutcheon, 2020).

Bronchitis: This disease is characterized by inflammation of the lining of the bronchial tubes (Ernstmeyer & Christman, 2020). It often develops from a cold and is a very common pathology. **Acute bronchitis**, sometimes called a chest cold, usually improves within a week to 10 days without lasting effects, though the cough may linger for weeks. **Chronic bronchitis** is considered to be a type of **chronic obstructive pulmonary disease (COPD)** (Ernstmeyer & Christman, 2020).

Chronic obstructive pulmonary disease (COPD): This condition is a chronic inflammatory lung disease that causes obstructed airflow out of the lungs (Ernstmeyer & Christman, 2020). It is most often caused by smoking cigarettes, but can also result from long-term exposure to irritating gases or dust. There are two types of COPD: emphysema and chronic bronchitis. **Emphysema** is a condition in which the alveoli are destroyed and the lungs are hyperinflated (Ernstmeyer & Christman, 2020). **Chronic bronchitis**, on the other hand, is inflammation of the lining of the bronchial tubes. COPD is treatable but not curable because symptoms often don't appear until significant lung damage has occurred.

Signs and symptoms of COPD may include the following:

- Shortness of breath, especially during physical activity
- Wheezing
- Chest tightness
- Chronic cough that may produce mucus (sputum) that can be clear, white, yellow, or greenish
- Cyanosis
- Frequent respiratory infections
- Lack of energy
- Unintended weight loss

(Ernstmeyer & Christman, 2020)

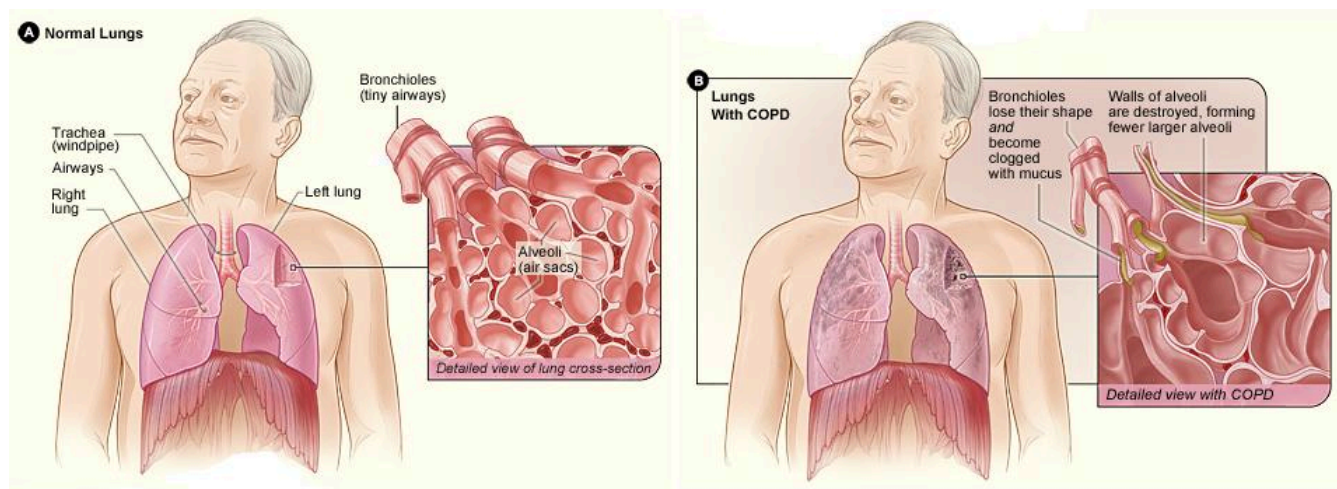


Fig. 6.8

Hemoptysis: This condition is characterized by spitting up blood (Chabner, 2018) and can be caused by various respiratory illnesses or trauma.

Hemothorax: This is a collection of blood in the pleural cavity, which is the space between the chest wall and the

lung. The most common cause is chest trauma, but hemothorax can also result from abnormal blood clotting or thoracic surgery (Doyle & McCutcheon, 2020).

Tuberculosis (TB): The bacteria *Mycobacterium tuberculosis* causes tuberculosis (TB), a disease that primarily impacts the lungs but can also infect other parts of the body (Ernstmeyer & Christman, 2020). Treatment for TB is challenging and requires patients to take a combination of multiple drugs for an extended time. Some TB strains are multidrug resistant, which makes treatment even more difficult (Ernstmeyer & Christman, 2020).

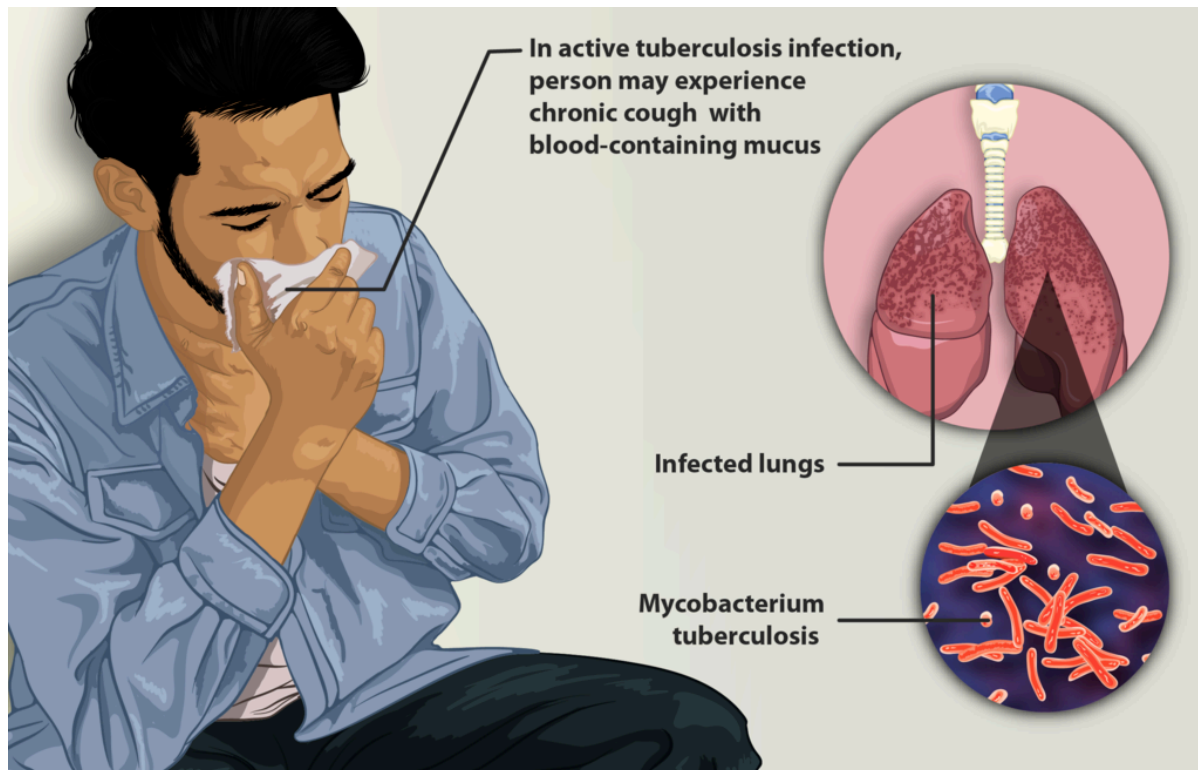


Fig. 6.9

Exercise



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6.4 Endocrine System

Overview and Functions

The purpose of the endocrine system (Fig. 6.10) is to regulate various organs by releasing hormones. It is a key player in maintaining homeostasis within the body, which it does by sending chemical signals to one or more glands in order to control and coordinate hormones. Sometimes these chemical signals have immediate effect, whereas others take time for changes to occur. For example, target cells may take up to 48 hours to respond to reproductive hormones, but adrenal hormones, such as epinephrine and norepinephrine, are released within seconds when you are confronted with a dangerous or frightening situation.

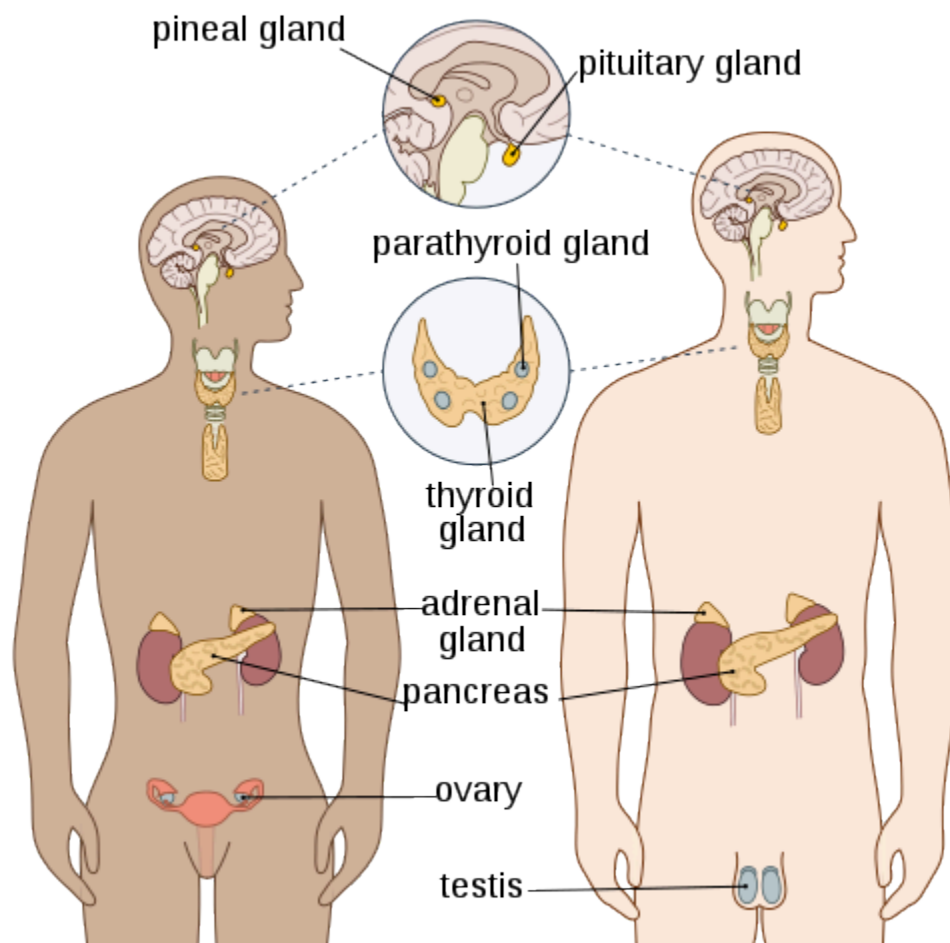


Fig. 6.10



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(CrashCourse, 2015)

Components of the Endocrine System

Hypothalamus: The hypothalamus is a structure in the brain. It is located in front of and below the thalamus and both produces and secretes many hormones.

Pineal gland: This gland is positioned below and slightly behind the thalamus. It is a very small gland whose functions are not entirely understood. Some of the specialized cells in the pineal gland are known to produce and secrete the hormone melatonin.

Pituitary gland: This small, bean-sized organ is divided into two parts. The first part is the **posterior pituitary**, which does not produce hormones but stores and secretes hormones produced by the hypothalamus. The other part is the **anterior pituitary**, which does produce hormones.

Thyroid gland: This butterfly-shaped organ is located in front of the trachea, just below the larynx. It produces hormones that regulate the body's metabolic rate and control digestive, muscle, and heart functions, as well as brain development and bone maintenance.

Parathyroid glands: These glands are tiny, round structures found on the rear surface of the thyroid gland. They produce and secrete parathyroid hormone, the major hormone involved in the regulation of blood calcium levels.

Adrenal glands: The triangular-shaped adrenal glands are found on the top of the kidneys. They have a rich blood supply and actually possess one of the highest rates of blood flow in the whole body. They produce hormones that help regulate metabolism, the immune system, blood pressure, the body's response to stress, and other essential functions.

Pancreas: This long, slender organ is located posterior to the bottom half of the stomach. It is primarily an exocrine gland, secreting a variety of digestive enzymes, but it also has an endocrine function. Its pancreatic islets secrete the hormones glucagon, insulin, somatostatin, and pancreatic polypeptide.

Ovaries: The ovaries are female reproductive organs. The primary hormones produced by the ovaries are estrogens, which include estradiol, estriol, and estrone. Estrogens play an important role in many physiological processes, including the development of the female reproductive system, regulation of the menstrual cycle, the development of female secondary sexual characteristics, the development of breast tissue, and the maintenance of pregnancy. Another important ovarian hormone is progesterone, which contributes to regulation of the menstrual cycle and is necessary to prepare the body for pregnancy and maintain pregnancy.

Testes: The testes are male reproductive organs. The primary hormone produced by the testes is testosterone, which is a steroid hormone important in the development of the male reproductive system, the maturation of sperm cells, and the development of male secondary sex characteristics, which include a deepened voice, body hair, and increased muscle mass.

Combining Forms

Table 6.3. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
adenoid/o	gland	adenoidectomy
adren/o	adrenal gland	adrenopathy
adrenal/o	adrenal gland	adrenalectomy
hypophys/o	pituitary gland	hypophysectomy
oophor/o	ovary	oophorectomy
ovari/o	ovary	ovarian
orch/o	testis	orchitis
orchi/o	testis	orchioplasty
orchid/o	testis	orchidotomy
pancreat/o	pancreas	pancreatitis
parathyroid/o	parathyroid gland	parathyroidectomy
pituitary/o	pituitary gland	hyperpituitarism
thyroaden/o	thyroid gland	thyroadenitis
thyroid/o	thyroid gland	thyroidotomy

Common Pathologies

Acromegaly: This disorder affects adults and is caused by abnormally high levels of growth hormone that results in increased growth of the bones in the face, hands, and feet. Fig. 6.11 shows a typical presentation of the hand of a person with this pathology (right) compared to the hand of someone who does not have the condition (left).

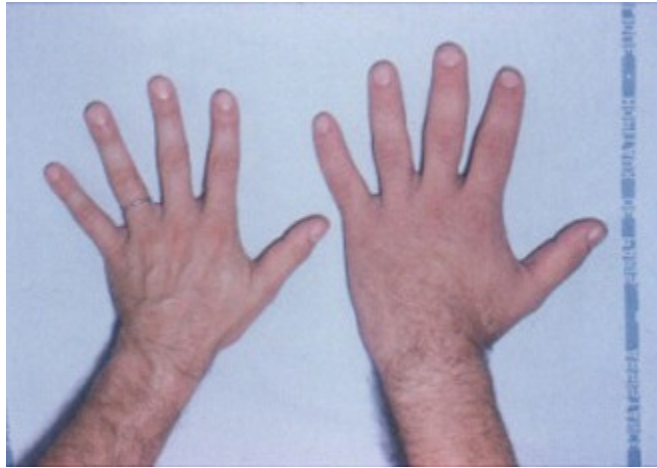


Fig. 6.11

Addison's disease: This condition is caused by the hyposecretion of corticosteroids, which also results in low blood glucose levels and low blood sodium levels. An **Addisonian crisis** is a life-threatening condition that presents with severely low blood pressure as a result of low corticosteroid levels (Ernstmeyer & Christman, 2020).

Cushing's syndrome: Excessive production of the hormone cortisol results in this pathology. The signs and symptoms are rapid weight gain, depression, anxiety, high blood sugar, moon-shaped face, and fatigue (Fig. 6.12). Individuals also experience weak muscles and bone pain.

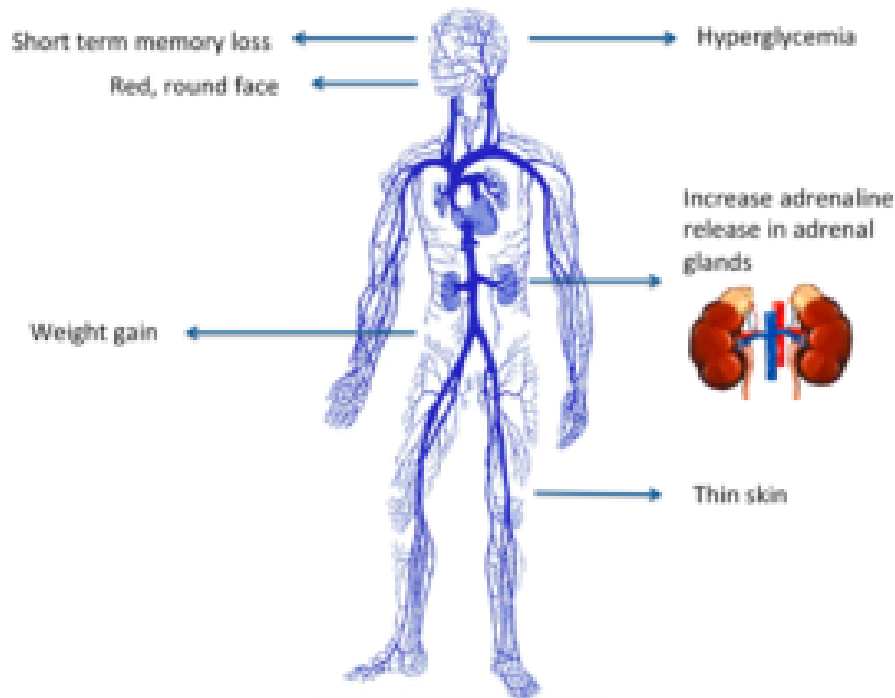


Fig. 6.12

Diabetes mellitus: This condition results from dysfunction in the production and secretion of insulin or target cell responsiveness to insulin. There are two types of diabetes:

- **Type 1:** No insulin is produced, and individuals must take insulin injections to maintain blood sugar levels.
- **Type 2:** Usually develops later in life and generally develops because of lifestyle factors such as diet and exercise. This type of diabetes can usually be controlled through diet, exercise, and oral medications. Some individuals do end up needing insulin injections, though that is rare.



Fig. 6.13

Gigantism: A disorder in children, gigantism is caused by the secretion of abnormally high levels of growth hormone, resulting in excessive growth.

Goiter: This condition is an increase in the size of the thyroid gland and appears as a lump in the neck. It can result from hypothyroidism.

Graves' disease: This is a type of hyperthyroidism. The causative factor is an autoimmune reaction in which antibodies overstimulate the thyroid gland.

Hyperthyroidism: This is an elevated blood level of thyroid hormones that is often caused by a pituitary or thyroid tumour. Individuals can present with an increased metabolic rate, diarrhea, weight loss, increased heart rate, sweating, and tremors. They may also present with bulging eyes, which is known as **exophthalmic goiter** (Fig. 6.14), and a goiter in the region of the thyroid.



Fig. 6.14

Hypothyroidism: This condition is characterized by low levels of thyroid hormone in the blood. Inflammation of the thyroid gland can cause hypothyroidism, but it can also result from dietary deficiency of iodine (usually found in

iodized salt). Individuals experience cold extremities, reduced libido, weight gain, reduced mental activity, and possibly menstrual irregularities.

Exercise



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6.5 Female Reproductive System

Overview and Functions

The female reproductive system functions to produce gametes and reproductive hormones, making it similar to the male reproductive system. However, it has another function—to support a developing fetus and deliver it to the outside world. Unlike the male reproductive system, the female reproductive system is located primarily inside the pelvic cavity. Figs. 6.15 and 6.16 provide an overview of the main components of the female reproductive system.

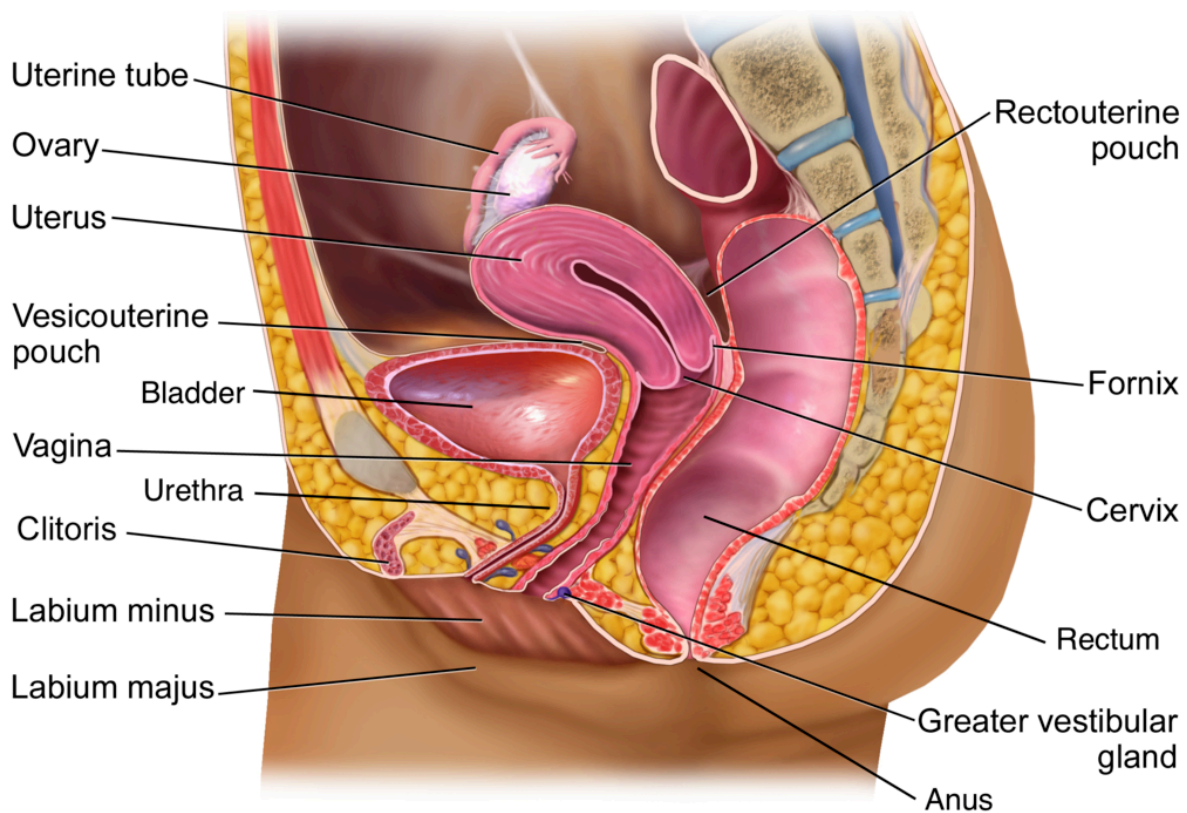


Fig. 6.15

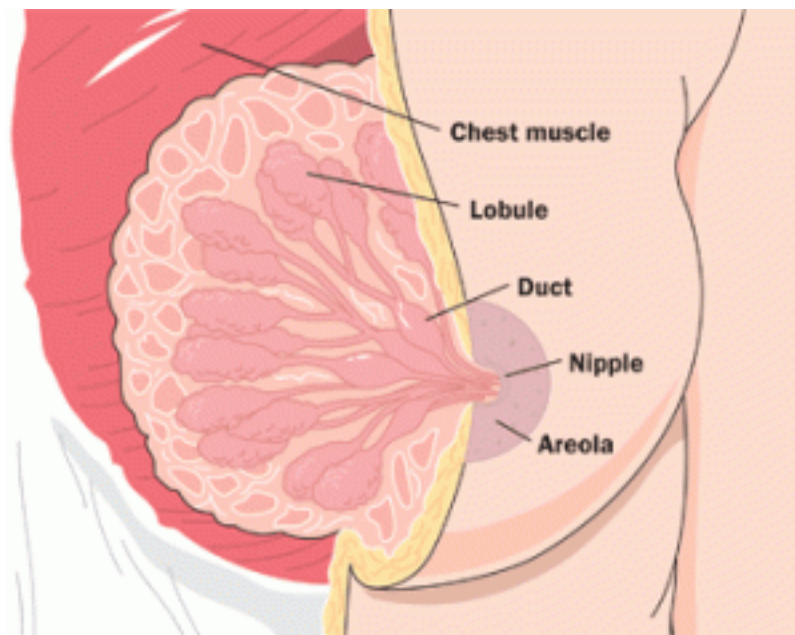


Fig. 6.16



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(CrashCourse, 2015)

Components of the Female Reproductive System

Vagina: Approximately 10 cm long, the vagina is the muscular entrance to the reproductive tract. It is the exit from the uterus during menses and childbirth. The vagina leads to the cervix, which is the opening to the uterus.

Cervix: This structure connects the lower end of the uterus to the vagina.

Uterus: This muscular organ nourishes and supports the growing embryo. On average, it is approximately 5 cm wide and 7 cm long.

Ovaries: These are the two female gonads. They are located at the entrance to the fallopian tubes.

Fallopian tubes: The fallopian tubes are the pathway that the **oocyte** travels from the ovary to the uterus. The two fallopian tubes are located close to the ovaries but are not directly connected to them.

Breast: The breasts are located far from the other female reproductive organs and, as such, are considered accessory organs of the female reproductive system. The function of the breasts is lactation, which is supplying milk to an infant. The external features of the breast include the nipple, which is surrounded by the areola.

Combining Forms

Table 6.4. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
cervic/o	cervix	cervical
colp/o	vagina	colpotomy
hyster/o	uterus	hysterectomy
mamm/o	breast	mammography
mast/o	breast	mastectomy
men/o	menstruation	amenorrhea
metri/o	uterus	endometrial
uter/o	uterus	uterotomy
o/o	egg	oocyte
oophor/o	ovary	oophorectomy
ovari/o	ovary	ovarian
salping/o	fallopian tube	salpingitis
vagin/o	vagina	vaginitis

Common Pathologies

Amenorrhea: The absence of periods (Carter & Rutherford, 2020).

Cervical cancer: Typically slow-growing cancer, cervical cancer is highly curable when found and treated early. When the condition becomes advanced, signs and symptoms may include abnormal bleeding or discharge from the vagina. It is diagnosed with a Pap smear (Carter & Rutherford, 2020).

Dysmenorrhea: Painful periods (Carter & Rutherford, 2020).

Ectopic pregnancy: This is an abnormal pregnancy that occurs when an embryo implants outside the uterus (Fig. 6.17). This type of pregnancy is not viable and can be a serious health risk for the mother. As the embryo grows in size, it can cause stretching and eventually a rupture in the area in which it implants. The embryo may implant in the fallopian tubes, ovaries, or possibly the abdomen.

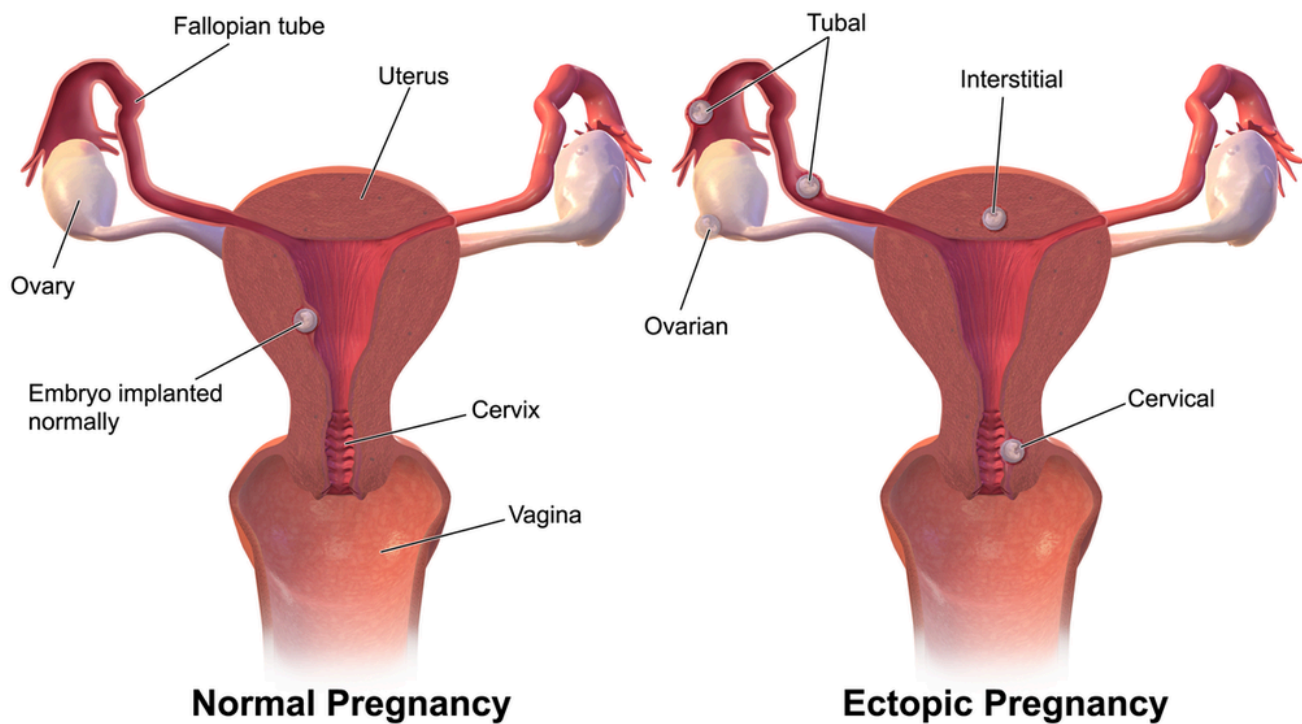


Fig. 6.17

Endometriosis: This condition is characterized by endometrial tissue growing outside the uterus; for example, in the fallopian tubes, ovaries, or pelvic cavity. Endometriosis can contribute to an increased risk of infertility. Signs and symptoms include dysmenorrhea and menstrual irregularity (Carter & Rutherford, 2020).

Fibroid: This is a benign mass of cells in the uterus and can cause irregular bleeding. Another name for this type of mass is **leiomyoma** (Chabner, 2018).

Menorrhagia: Heavy bleeding during menstrual periods (Chabner, 2018).

Oligomenorrhea: Infrequent or irregular periods (Carter & Rutherford, 2020).

Pelvic inflammatory disease (PID): This condition presents as an infection of the fallopian tubes and other reproductive organs and often results from a **sexually transmitted infection (STI)**. Even if the condition is treated, it can leave scarring and result in fertility issues.

Polycystic ovary syndrome (PCOS): PCOS has no known cause but results in eggs developing into cysts that do not release during ovulation, but rather build up and enlarge. The most common symptoms are oligomenorrhea, amenorrhea, dysmenorrhea, enlarged ovaries, weight gain, anxiety, depression, hyperglycemia, and infertility (Carter & Rutherford, 2020).

Sexually transmitted infections (STIs): This is a general term for infections that are spread through sexual contact between individuals. There are various types of STIs, but a couple of the more common ones are chlamydia and gonorrhea (Carter & Rutherford, 2020).

Exercise



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6.6 Male Reproductive System

Overview and Functions

The function of the male reproductive system is to produce the sperm, which can then be transferred to the female reproductive tract. The testes are a critical component of the system because they produce both the sperm and the hormones that support all the male reproductive physiology. There are other accessory organs that assist with the production of sperm and seminal components that are also needed in the process. They include the epididymis, vas deferens, prostate, seminal vesicles, and the penis.

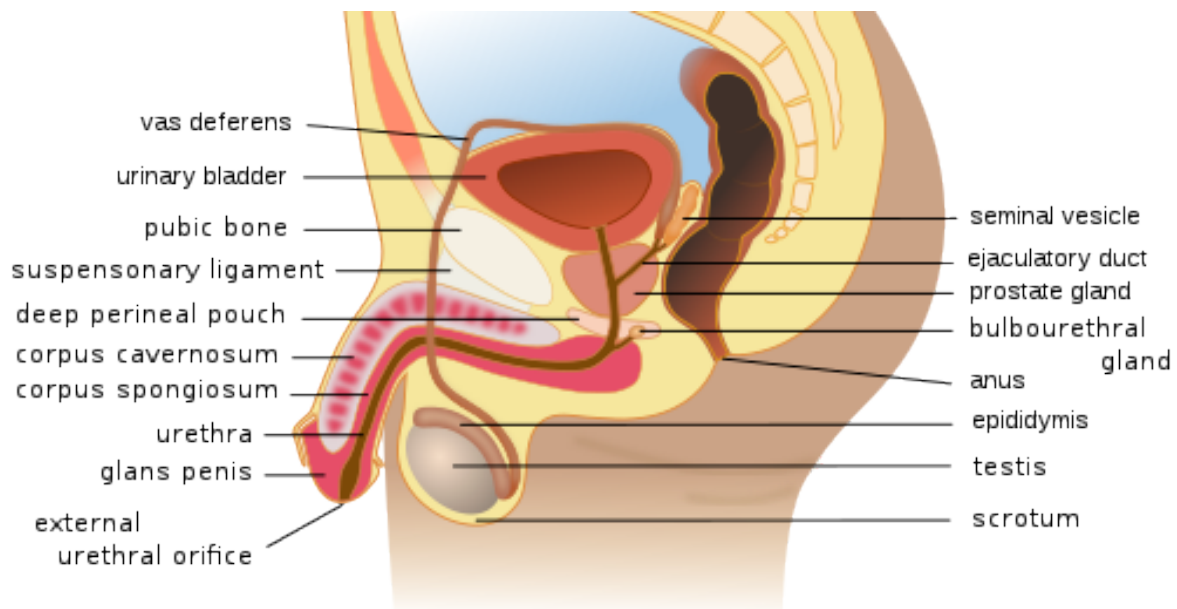


Fig. 6.18



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Components of the Male Reproductive System

Scrotum: The scrotum is a skin-covered, highly pigmented, muscular sac that encloses the testes. The location of the scrotum behind the base of the penis is important in sperm production, which occurs in the testes. Sperm production cannot occur at body temperature, and the location of the scrotum outside the body keeps the testes 2 to 4°C below core body temperature.

Testes: These are the male gonads or, in other words, the male reproductive organs. The testes produce sperm and androgens such as testosterone. The singular form of testes is **testis**.

Epididymis: This is a coiled tube attached to each testis. Newly formed sperm travel down the epididymis as they continue to mature, a journey that on average takes 12 days, and the mature sperm are stored in the tail end of the epididymis.

Vas deferens: This thick, muscular tube is bundled together inside the scrotum with connective tissue, blood vessels, and nerves. It is also known as the **ductus deferens** and transports sperm from the epididymis to the urethra.

Seminal vesicles: As sperm pass through the vas deferens, they mix with fructose fluid from the seminal vesicles. The fluid accounts for approximately 60% of the semen's volume.

Prostate gland: This gland sits in front of the rectum and at the base of the bladder, surrounding part of the urethra. The prostate is about the size of a walnut and excretes an alkaline, milky fluid into the semen, which assists with transportation to the female reproductive tract.

Bulbourethral glands: These glands release a thick, salty fluid that lubricates the end of the urethra and helps clean urine residue from the male urethra (Carter & Rutherford, 2020).

Penis: This is the male organ of copulation and deposits semen into the female reproductive tract.

Combining Forms

Table 6.5. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
balan/o	penis	balanitis
orch/o	testis	orchitis
orchi/o	testis	orchioplasty
orchid/o	testis	orchidotomy
prostat/o	prostate gland	prostatectomy
scrot/o	scrotum	scrotitis
urethr/o	urethra	urethrotomy
vas/o	vas deferens	vasectomy

Common Pathologies

Benign prostatic hyperplasia/hypertrophy (BPH): This condition is characterized by an increase in the size of the

prostate. Individuals typically present with difficulty urinating. It can be treated with medication or a procedure such as a transurethral resection of the prostate (TURP).

Cryptorchidism: This occurs when one or both of the testes do not descend into the scrotum prior to birth. The testes usually move into the scrotal cavity during the seventh month of development of a male fetus.

Hydrocele: This is an accumulation of fluid within the scrotum and can be treated surgically. In some cases, this pathology corrects itself without treatment.

Prostate cancer: Malignant cancer present within the prostate gland (Carter & Rutherford, 2020).

Sexually transmitted infections (STIs): This is a general term for infections that are spread through sexual contact between individuals. There are various types of STIs, but a couple of the more common ones are chlamydia and gonorrhea (Carter & Rutherford, 2020).

Varicocele: An enlarged or swollen vein in the scrotum.

Exercise



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6.7 Lymphatic System

Overview and Functions

The lymphatic system (Fig. 6.19) is one of the lesser-known systems of the human body, but it plays an extremely important function. It consists of a network of lymphatic vessels, lymph nodes, and ducts. One of the major functions of the lymphatic system is to drain body fluids and return them to the bloodstream. Blood pressure can cause leakage of fluid from the capillaries, resulting in the accumulation of fluid in the spaces between individual cells in the tissues. Each day, about 20 L of plasma flow through the body's arteries, arterioles, and capillaries, but only about 17 L are returned to circulation by way of veins. The rest is released into the interstitial spaces of the tissues because of capillary filtration. The lymphatic system collects this excess fluid, now called **lymph**, from tissues in the body and returns it to the bloodstream.

The lymphatic system is also associated with the immune system to the point that the systems are virtually indistinguishable. The immune system is the complex collection of cells and organs that destroy and/or neutralize pathogens that could cause disease or death. Cells in the immune system use lymphatic vessels to make their way from the interstitial spaces back into the circulatory system, and they also use **lymph nodes** as staging areas for the development of immune responses. For example, lymph nodes swell during an infection, and **lymphocytes** are transported via the lymphatic vessels.

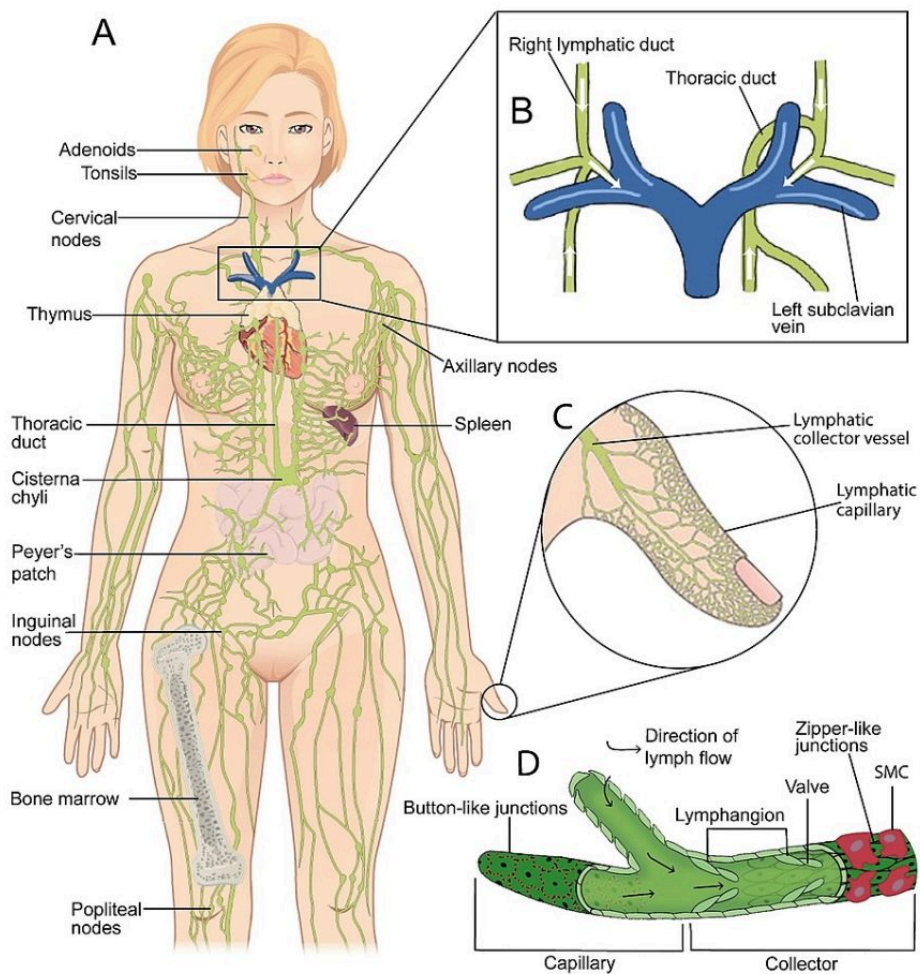


Fig. 6.19



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(CrashCourse, 2015)

Components of the Lymphatic System

Lymph: Lymph is the fluid contained within the lymphatic system.

Lymph nodes: These bean-shaped organs can be found throughout the body; some of those locations are shown in Fig. 6.19. Humans have 500 to 600 lymph nodes. Their function is to remove debris and pathogens from the lymph. Bacteria that infect interstitial fluid are taken up by the lymphatic capillaries and transported to a regional lymph node.

Lymphatic vessels: These vessels begin as capillaries, which feed into larger and larger lymphatic vessels, and eventually empty, through a series of ducts, into the bloodstream.

Lymphatic capillaries: These are the smallest of the lymphatic vessels and the start of the lymph flow. Interstitial fluid enters the lymphatic system via the capillaries to become lymph fluid. Lymphatic capillaries are located in almost every tissue in the body and are interwoven among the arterioles and venules of the circulatory system.

Lymphatic trunks: These are large lymphatic vessels that collect lymph from the smaller lymphatic vessels, such as the capillaries, and empty it into the blood via **lymphatic ducts**.

Lymphoid nodules: These nodules are non-encapsulated patches of lymphoid tissue and are found throughout the body. They are simpler than the lymph nodes and spleen in that they consist simply of a dense cluster of lymphocytes without a surrounding fibrous capsule. These nodules are located in the respiratory and digestive tracts, which are areas routinely exposed to environmental pathogens.

Lymphocytes: These are the primary cells of adaptive immune responses. The two basic types of lymphocytes are **B cells** and **T cells**, which are distinguished from one another by their surface protein markers, as well as by the molecules they secrete. Both types of cells initially develop in the bone marrow, but then the T cells move to the thymus to mature and the B cells remain in the bone marrow.

Bone marrow: Bone marrow is a primary lymphoid organ and is where B cells undergo nearly all of their development. It is also where immature T cells develop until they move to the thymus gland.

Spleen: The spleen is considered to be a major secondary lymphoid organ. It is about 12 cm (5 in) long and is a fragile organ without a strong capsule. The spleen is sometimes called the “filter of the blood” because of its extensive vascularization and the fact that it removes microbes and other materials from the blood.

Thymus: This primary lymphoid organ is found in the space between the sternum and the aorta of the heart. It is involved in the development and maturing of T cells and is most active during infancy and childhood.

Tonsils: These lymphoid nodules are located on the inner surface of the pharynx. They are important in fighting oral pathogens and developing immunity.

Combining Forms

Table 6.6. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
lymph/o	lymph fluid	lymphocyte
lymphaden/o	lymph node	lymphadenectomy
lymphangi/o	lymph vessel	lymphangitis
myel/o	bone marrow	myeloma
splen/o	spleen	splenectomy
thym/o	thymus gland	thymocyte
tonsill/o	tonsils	tonsillectomy

Common Pathologies

Acquired immune deficiency syndrome (AIDS): This condition is caused by the **human immunodeficiency virus (HIV)** and was nearly 100% fatal when it first appeared. However, the development of antiviral medications has transformed HIV infection into a chronic, manageable disease. Signs and symptoms include malignancies, infections, lethargy, and gastrointestinal issues.

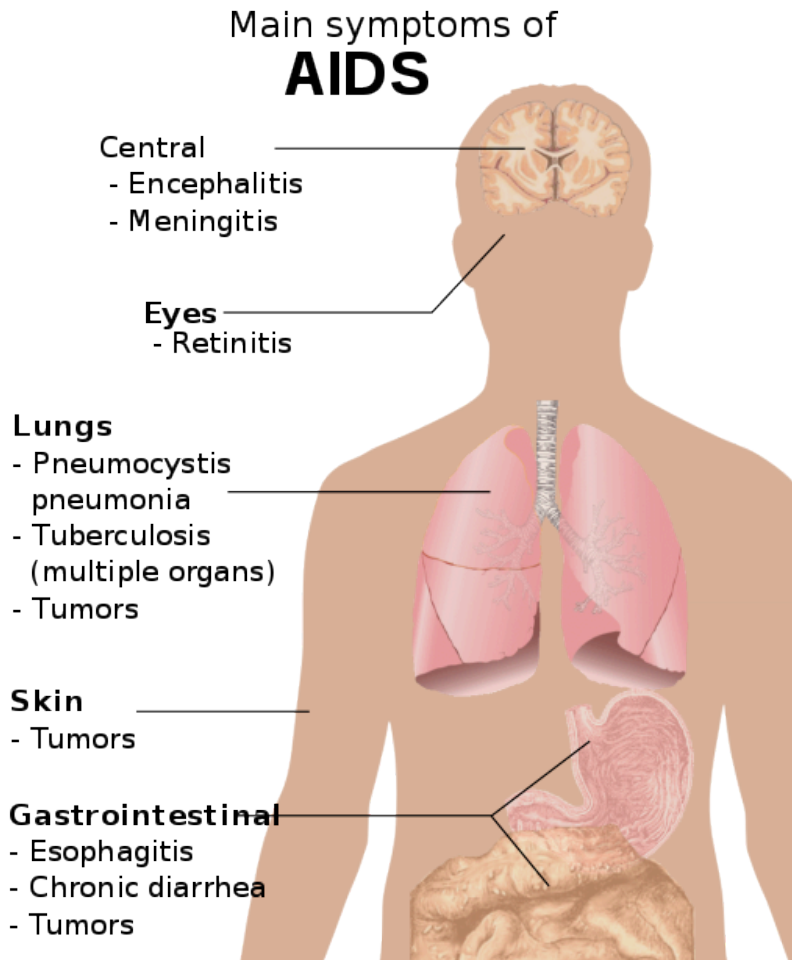


Fig 6.20

Autoimmune responses/diseases: When the immune system overreacts, individuals may experience autoimmune diseases. Often the cause is unknown, and treatment involves anti-inflammatory and immunosuppressive medications. Autoimmune diseases can be localized, like rheumatoid arthritis, or systemic, such as lupus (Carter & Rutherford, 2020).

Hodgkin's lymphoma: This type of cancer affects the immune system and can cause antibodies to attack the nervous system. Masses of T and B lymphocytes collect in the spleen, liver, lymph nodes, and other tissues in the body. These lymphocytes do not work as they should, which makes it very likely the individual will develop infections.

Mononucleosis: This condition is an acute disease in which the lymph nodes become enlarged and the number of lymphocytes increases (Chabner, 2018). It is very contagious and was referred to in the past as the “kissing disease” because that is how many individuals were thought to have become infected with this illness.

Severe combined immunodeficiency disease (SCID): This is one of the most serious forms of inherited

immunodeficiency diseases. It results in impaired B and T cells, which puts children at increased risk of infection. As a result, those that have this disease often die within the first year of life (Carter & Rutherford, 2020).

Exercise



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6.8 Urinary System

Overview and Functions

The urinary system (Fig. 6.21) is responsible for cleansing the blood and removing wastes from the body. However, it has other equally important functions, including regulating pH, blood pressure, and the concentration of solutes in the blood; producing erythropoietin (EPO) to stimulate red blood cell production; the final synthesis step of vitamin D production; and producing the active form of vitamin D. The urinary system, controlled by the nervous system, also stores urine until a convenient time for disposal, then provides the structures for transporting liquid waste from the body.

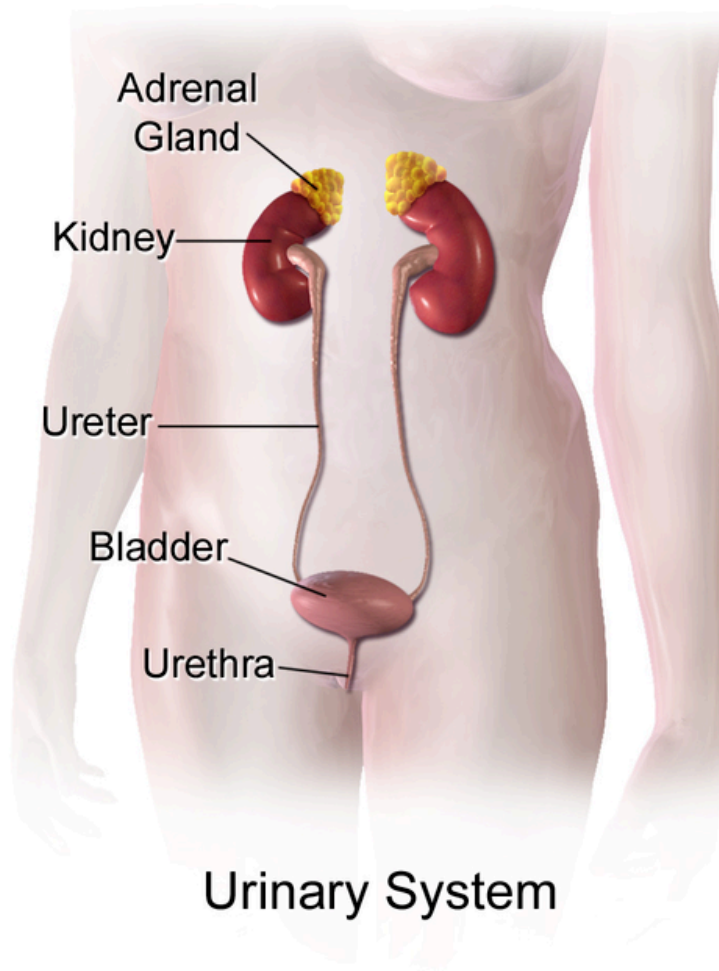


Fig. 6.21



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(CrashCourse, 2015)

Components of the Urinary System

Kidneys: The two kidneys are complex organs that perform very complicated and necessary functions that are required for survival. If the kidneys fail, there are devastating effects on the body's homeostasis. Individuals will experience weakness, lethargy, shortness of breath, anemia, widespread edema, metabolic acidosis, rising potassium levels, heart arrhythmias, and many more symptoms. **Nephrons** are the functional units of the kidney because they cleanse the blood and balance the components within it (Carter & Rutherford, 2020). They take a simple filtrate of the blood and modify it into urine. Approximately 1 to 2 L of urine are produced and excreted from the body every day.

Ureters: In each kidney, the **renal pelvis** narrows to become the ureter. As urine passes through the ureter, it does not passively drain into the urinary bladder, but rather is propelled by waves of muscle movement. Each ureter is approximately 30 cm long.

Urinary bladder: The bladder collects urine from both ureters and holds it until it is released from the body via the urethra.

Urethra: This structure transports urine from the bladder to outside the body. The urethra is the only urologic organ that is different between males and females. In women, the urethra is shorter, usually about 4 cm long, whereas in males, it is closer to 20 cm in length. Because of the shorter length of the female urethra, there is less of a barrier to fecal bacteria, so women experience more urinary tract infections (UTIs).

Combining Forms

Table 6.7. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
cyst/o	urinary bladder	cystitis
nephr/o	kidney	nephrectomy
pyel/o	renal pelvis	pyeloplasty
ren/o	kidney	renal
ur/o	urine, urinary tract	urologist
ureter/o	ureter	ureteroscopy
urethr/o	urethra	urethrotomy
vesic/o	urinary bladder	vesicostomy

Common Pathologies

Albuminuria: The presence of protein, or albumin, in the urine (Carter & Rutherford, 2020).

Anuria: No urine production.

Cystitis: This inflammation of the urinary bladder is often caused by an infection (Carter & Rutherford, 2020).

Dysuria: Painful urination (Carter & Rutherford, 2020).

Glomerulonephritis: This condition is acute or chronic nephritis that involves inflammation of the kidney's filters (glomeruli) (Carter & Rutherford, 2020). The result is that the kidneys lose their ability to remove wastes from the blood to make urine. It has various causes, and if left untreated, it can lead to kidney failure.

Glycosuria: The presence of glucose in the urine.

Hematuria: The presence of blood in the urine (Chabner, 2018).

Hydronephrosis: This is a condition in which the kidneys begin to swell because of urine retention. It is often caused by kidney stones and blood clots (Carter & Rutherford, 2020).

Incontinence: The loss of the ability to control micturition (releasing urine from the bladder).

Kidney failure: This occurs when the kidneys lose all, or some, of the ability to produce urine and filter the blood. Symptoms include weakness, lethargy, shortness of breath, edema, anemia, metabolic acidosis, heart arrhythmias, uremia, loss of appetite, and/or an increase or decrease in urination. The treatment for kidney failure is dialysis (Carter & Rutherford, 2020). Hemodialysis is an ongoing treatment in which the individual goes into the hospital regularly to have their blood processed through a dialysis machine (Fig. 6.22), which removes the waste products and returns the blood to the person's body (Carter & Rutherford, 2020).



Fig. 6.22

Kidney stones: These hard deposits, typically made up of minerals and salts, form inside the kidney and can cause abdominal pain and discomfort (Fig. 6.23). This condition is also referred to as **nephrolithiasis** (Carter & Rutherford, 2020).

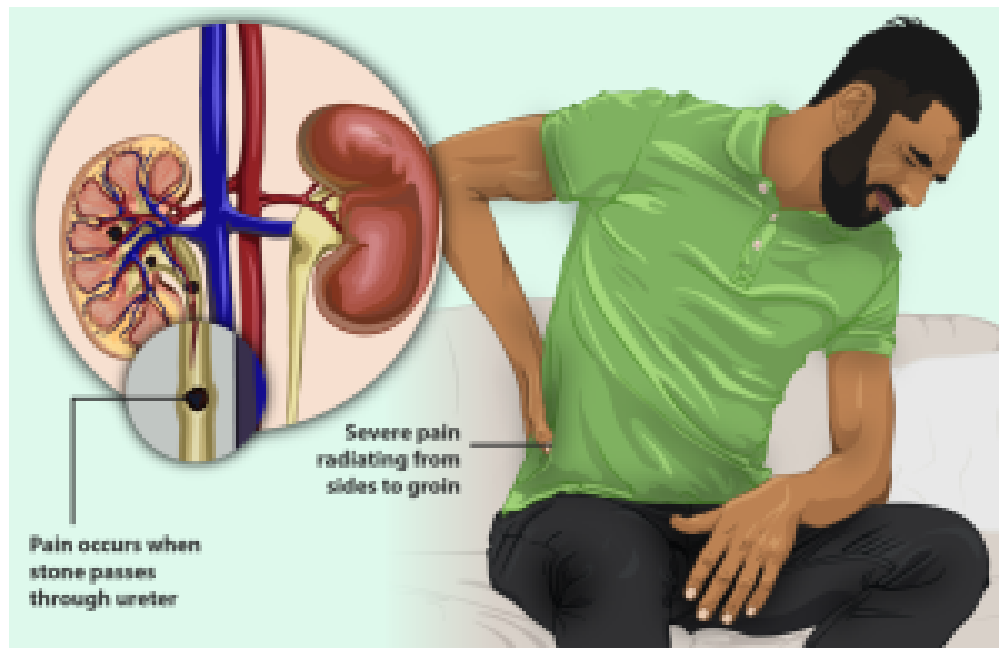


Fig. 6.23

Oliguria: This condition is characterized by below-normal output of urine of approximately 300 to 500 mL per day. It can be caused by dehydration, blood loss, diarrhea, cardiogenic shock, kidney disease, or an enlarged prostate.

Polycystic kidney disease (PKD): This is a genetic disease in which cysts grow inside the kidneys. The kidneys then enlarge and damage occurs to the filtering structures of the kidneys (Carter & Rutherford, 2020).

Polyuria: This condition is characterized by excessive urine production of more than 2.5 L a day. It can be caused by diabetes mellitus, excessive intake of caffeine or alcohol, kidney disease, drugs similar to diuretics, sickle cell anemia, and excessive water intake.

Renal cell carcinoma: This is a cancer that occurs in the kidney tubes where urine is produced or collected. It is one of the most common cancers that occurs within the kidneys (Carter & Rutherford, 2020).

Uremia: The retention of urea and uric acid in the blood.

Urinary tract infection (UTI): This infection is caused by bacteria or sometimes fungi. The exact type of bacterial growth is determined by collecting urine for culture and sensitivity (C&S) testing (Carter & Rutherford, 2020). Results from the C&S test will determine the best treatment options for the individual.

Exercise





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6.9 Nervous System

Overview and Functions

The nervous system (Fig. 6.24) is a very complex system and is responsible for controlling much of the body, including both voluntary and involuntary functions. It receives information about the environment around us, and then creates responses to that information. This system is also responsible for taking sensory input and integrating it with other sensations, memories, emotional states, and learning. The nervous system can be divided into two main components: the central nervous system and the peripheral nervous system. From there, it is further subdivided by functions and components.

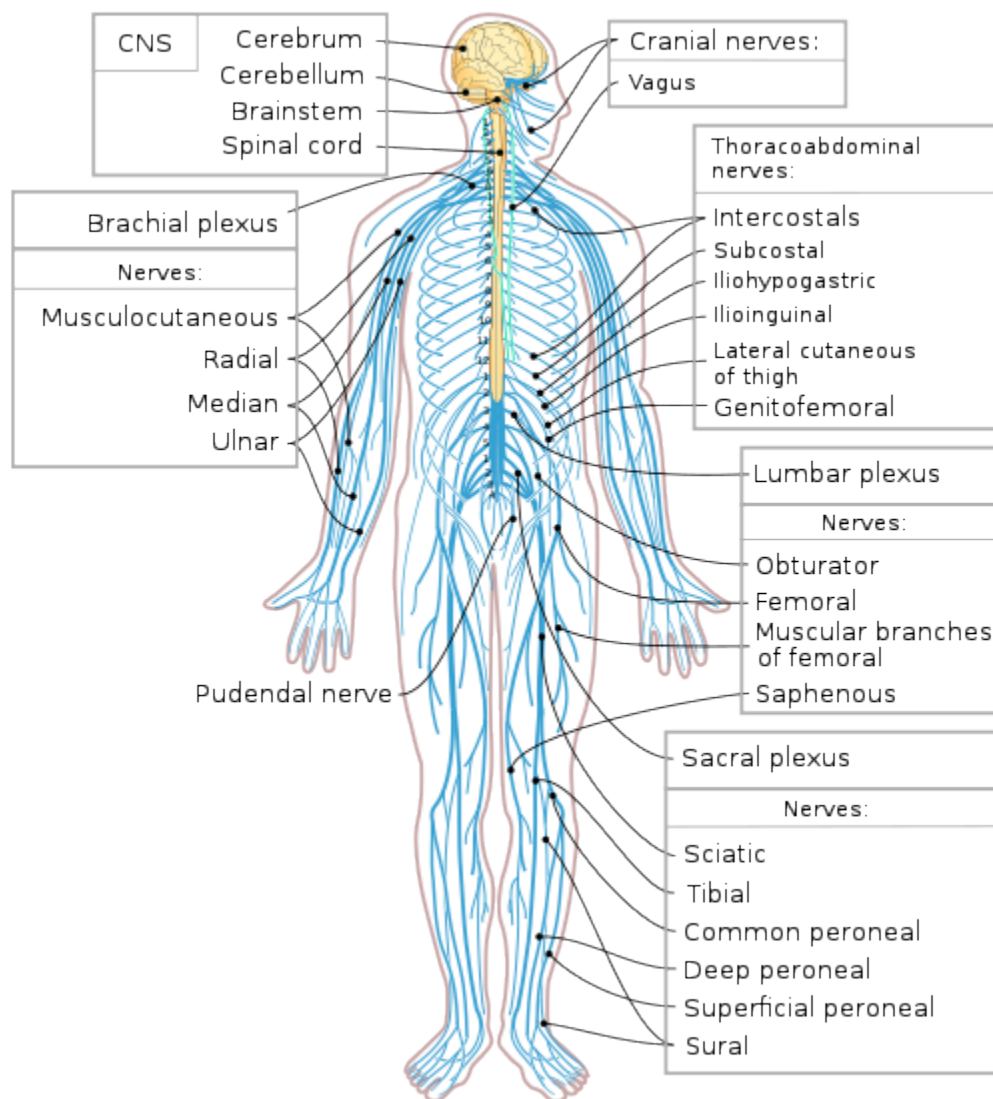


Fig. 6.24



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(CrashCourse, 2015)

Components of the Nervous System

The two main components of the nervous system are the central nervous system (CNS) and the peripheral nervous system (PNS).

Central nervous system (CNS): The brain and the spinal cord make up the central nervous system. The brain is described in terms of its major regions, which include the cerebrum, diencephalon, brain stem, and cerebellum. The regulation of homeostasis and conscious experiences are controlled in the brain. Reflexes and the integration of sensory and motor pathways are handled in the spinal cord.

Peripheral nervous system (PNS): This part of the nervous system connects the central nervous system with the rest of the body. The nerves, axons, and ganglia that make up the PNS are found throughout the body. Many are found in other organs and even in other systems, such as the digestive system, as well as the eyes, ears, nose, and various other locations. Messages travel back and forth from the CNS to the muscles, organs, and senses in the peripheral areas of the body. When **sensory neurons** carry messages and various forms of sensory information towards the CNS, they are considered **afferent fibres**. When the CNS uses **motor neurons** to carry instructions from the CNS to the muscles, they are called **efferent fibres**. Messages continually go back and forth along neurons between the CNS and the periphery. The PNS has two subdivisions as well—the **somatic nervous system** and the **autonomic nervous system**. Fig. 6.25 provides an overall picture of the nervous system and its components.

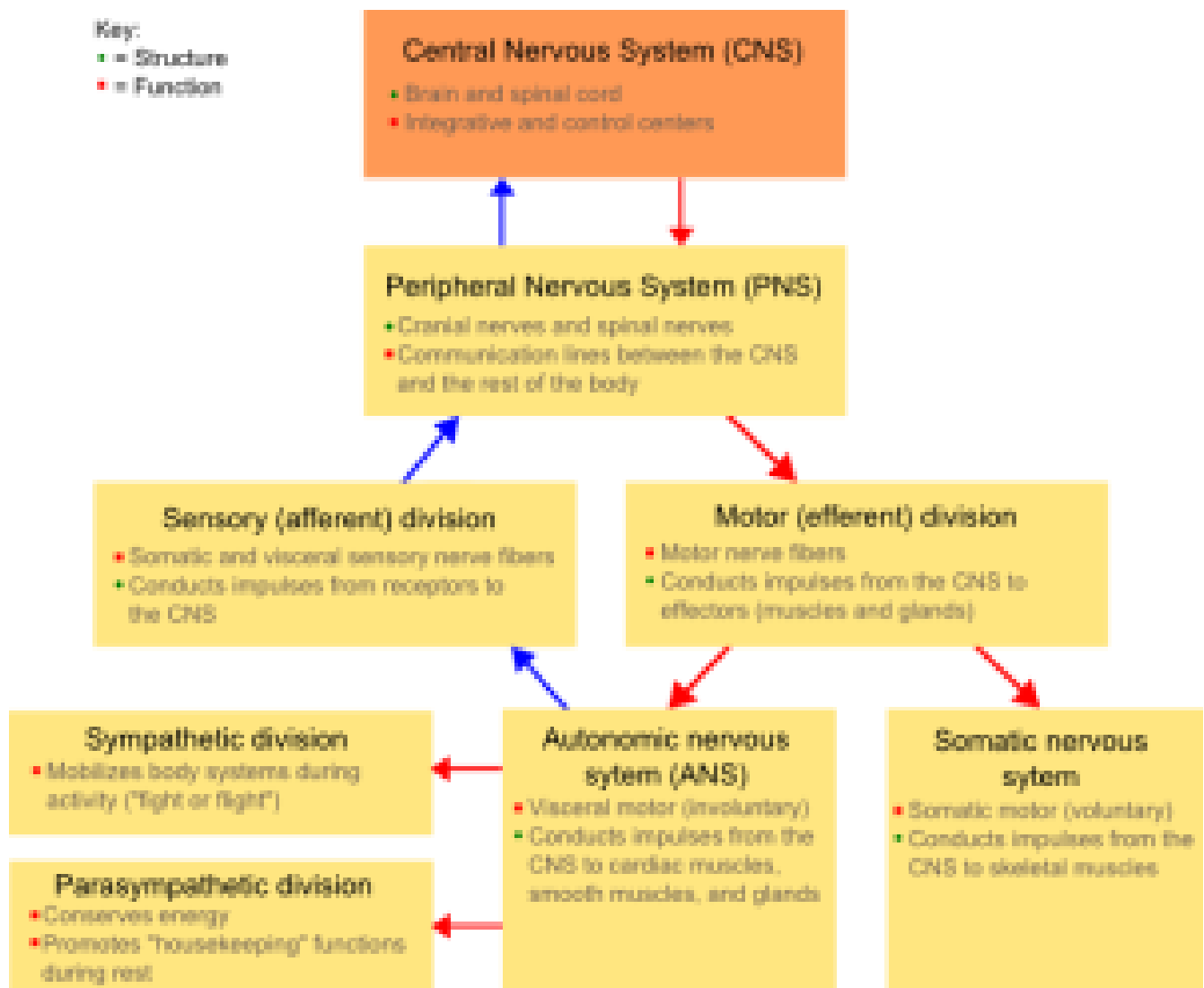


Fig. 6.25

Somatic nervous system: This part of the PNS is responsible for conscious perception of the environment and for voluntary responses to that perception through use of skeletal muscles.

Autonomic nervous system: This part of the PNS handles involuntary responses that the brain controls without the need for conscious thought. It consists of the **sympathetic** and **parasympathetic nervous systems** and uses a balance of the two to regulate the body's involuntary functions, including heart rate, respiratory rate, digestion, and sweating:

- **Sympathetic nervous system:** Associated with the fight-or-flight response
- **Parasympathetic nervous systems:** Focuses on what could be called "rest and digest"

Fig. 6.26 shows how the sympathetic and parasympathetic nervous systems work within the body. Both affect the same areas of the body but in a different manner.

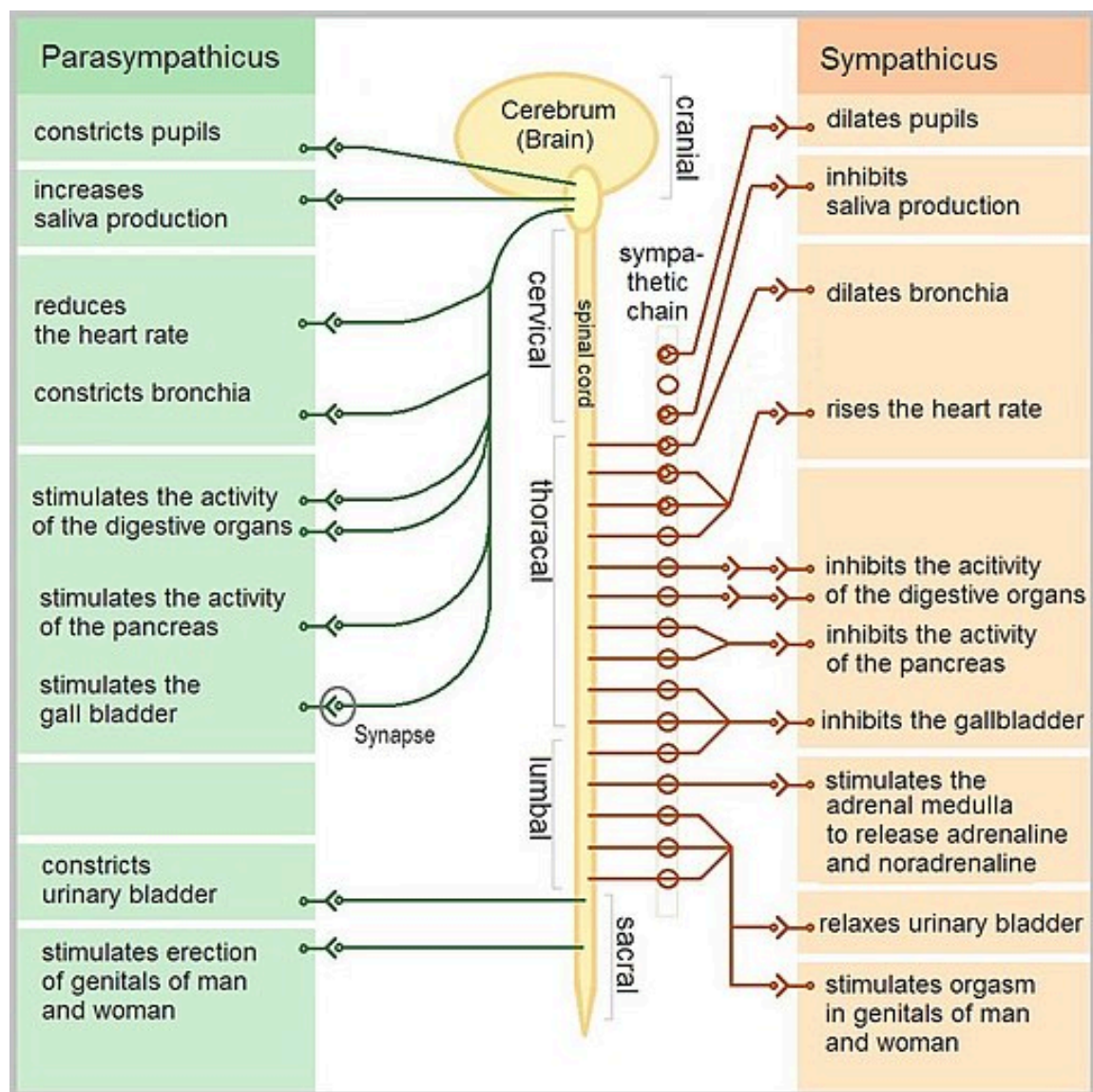


Fig. 6.26

Combining Forms

Table 6.8. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
aur/o	ear	aural hematoma
cerebell/o	cerebellum	cerebellitis
cerebr/o	cerebrum	cerebral
dur/o	dura mater	durotomy
encephal/o	brain	encephalopathy
medull/o	medulla oblongata	medullary
mening/o	meninges	meningitis
myel/o	spinal cord	myelitis
myring/o	eardrum	myringoplasty
neur/o	nerve	neurologist
ocul/o	eye	ocular
ophthalm/o	eye	ophthalmologist
optic/o	eye	optical
ot/o	ear	otalgia
phak/o	lens of the eye	aphakia
retin/o	retina	retinopathy
tympan/o	eardrum	tympanostomy

Common Pathologies

Alzheimer's disease: This form of dementia is characterized by the accumulation of beta-amyloid plaque, a type of dense protein found in the cerebral cortex. It is a degenerative disease in which individuals experience memory loss and confusion. As shown in Fig. 6.27, the brain atrophies (shrinks) as the condition progresses.

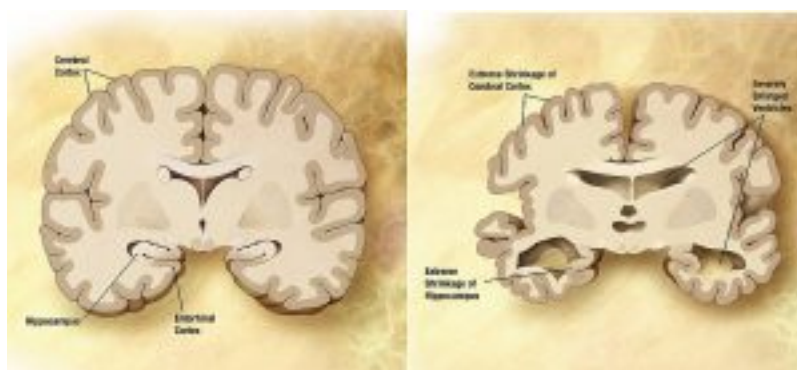


Fig. 6.27

Cerebrovascular accident (CVA): Commonly known as a **stroke**, this condition is characterized by loss of blood flow to a part of the brain (Fig. 6.28). There are two types of strokes: ischemic and hemorrhagic. An **ischemic stroke** is caused

by a blocked or narrowed vessel in the brain that obstructs blood flow. The cause is often a blood clot or fatty deposit. In a **hemorrhagic stroke**, bleeding to the brain occurs because of a damaged blood vessel.

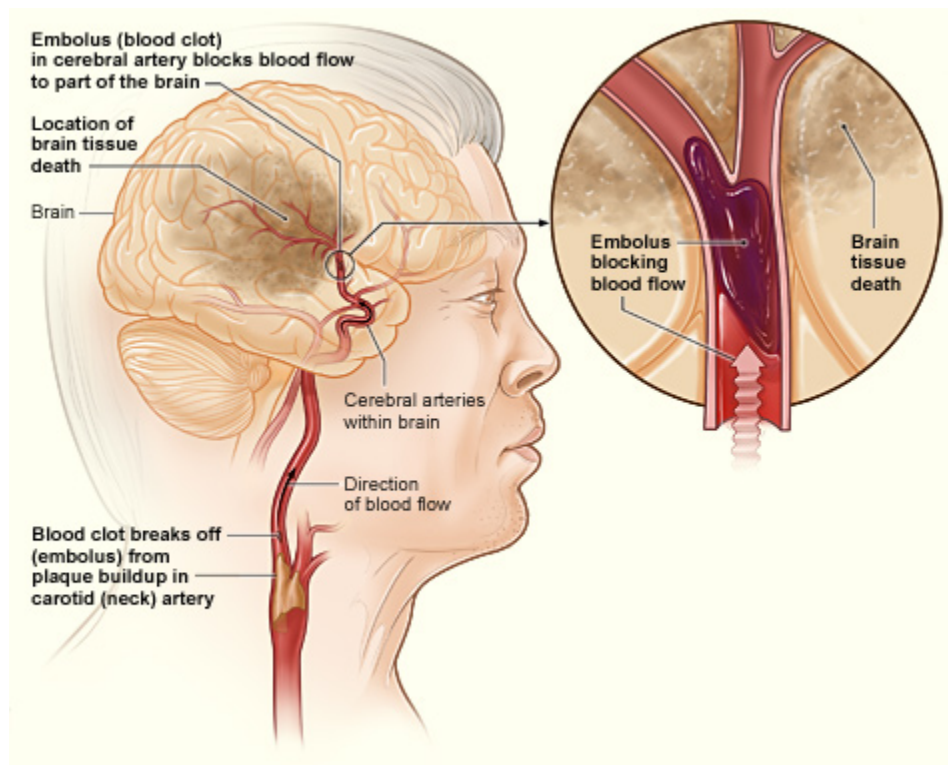


Fig. 6.28

Key Concept

The mnemonic **FAST** helps people remember what to look for when a cerebrovascular accident (stroke) is suspected:

- Look at the person's face. Do they have problems moving **F**ace muscles and making regular facial expressions?
- Ask the person to raise their **A**rms above their head. Can the person lift one arm but not the other?
- Has the person's **S**peech changed? Are they slurring words or having trouble saying things?
- If any of these things have happened, then it is **T**ime to call for help.

Cataract: This condition clouds the normally clear lens of the eye. A possible cause is a decrease in the flexibility of the eye lens because of the aging process; also, some infants are born with congenital cataracts (Carter & Rutherford, 2020).

Concussion: A concussion is a traumatic injury to the brain from an impact (Fig. 6.29). Symptoms include memory loss, headaches, and difficulty concentrating. There may or may not be a loss of consciousness (Ernstmeyer & Christman, 2020).

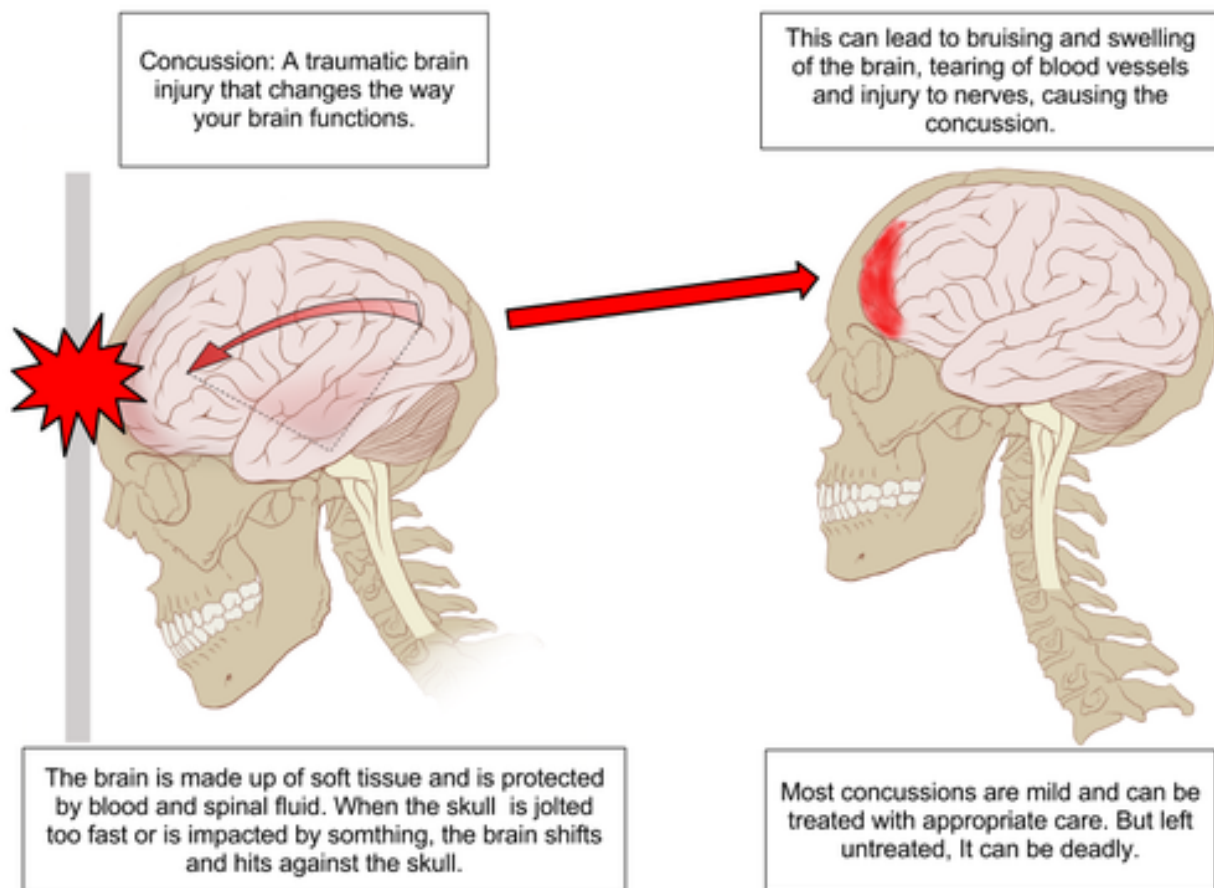


Fig. 6.29

Epilepsy: This is a chronic condition of reoccurring seizures. Symptoms of a seizure include muscle rigidity, jerking, muscle twitching, and muscle weakness. Epilepsy is often diagnosed with the use of an electroencephalogram, and then treated with a combination of a few different medications (Ernstmeyer & Christman, 2020).

Glaucoma: This condition is an increase in intraocular pressure owing to an increase in fluid build-up in the anterior compartment of the eye.

Hemiplegia: This is paralysis of one side of the body and is often the result of a stroke.

Meningitis: This disease is inflammation of the meninges, which are the membranes around the CNS. It can be caused by a virus or bacteria. Symptoms include fever, chills, nausea, vomiting, neck soreness, confusion, and severe headaches.

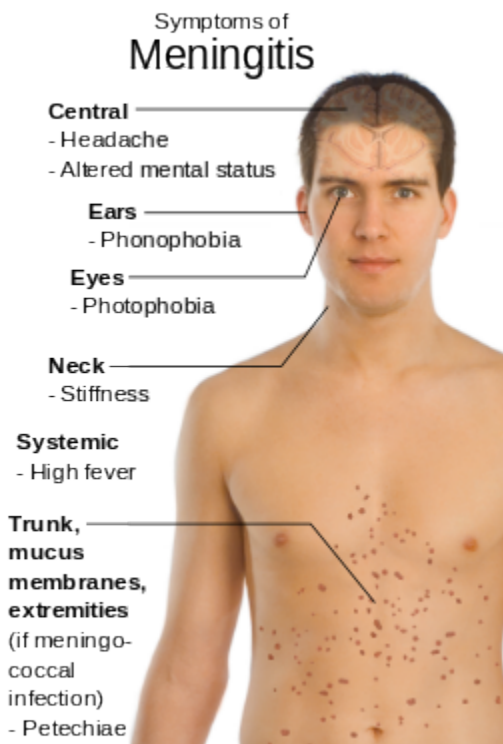


Fig. 6.30

Multiple sclerosis (MS): This is an autoimmune disease in which antibodies produced by the lymphocytes attack the myelin (the insulating sheath around the nerves) in the nervous system. As a result, the myelin becomes inflamed, destroyed, or scarred. Myelin is needed to maintain nerve condition, and damage to it results in nerve conduction in the CNS to be slowed. Symptoms of MS include vision issues, numbness and tingling in the extremities, pain, muscle spasms, issues with balance, and muscle weakness.

Paraplegia: This is paralysis of the lower half of the body and is often the result of trauma.

Parkinson's disease: This progressive disease of the nervous system affects the ability to move. Onset usually occurs in middle adulthood, and symptoms worsen over time. There is no cure, and the cause is unknown. Symptoms include tremors, muscle rigidity, unstable posture, issues with gait, and slow body movements (Ernstmeier & Christman, 2020).

Syncope: Another term for this condition is **fainting**. It is characterized by sudden, temporary loss of consciousness.

Tinnitus: This condition is characterized by ringing in the ears. It is often caused by inflammation of the middle ear or exposure to loud noise (Ernstmeier & Christman, 2020).

Transient ischemic attack (TIA): A TIA is similar to a stroke but does not last as long. If the classic symptoms of a stroke resolve without treatment, a TIA is possibly the cause.

Exercise



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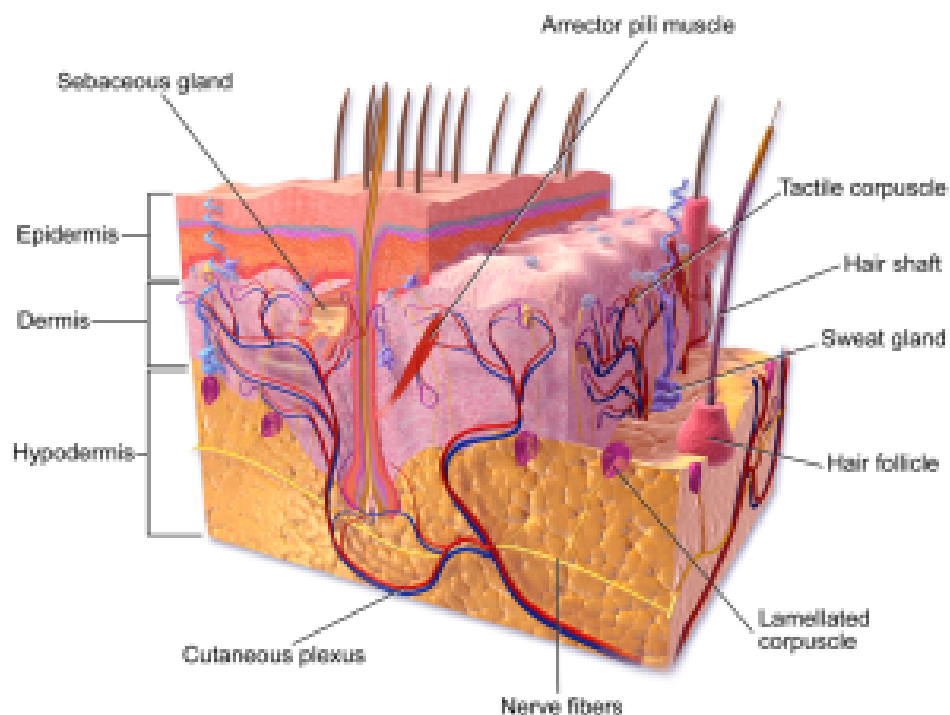
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6.10 Integumentary System

Overview and Functions

The integumentary system (Fig. 6.31) is one of the largest body systems and makes up approximately 16% of total body weight. The main component of this system is the skin, which is responsible for much more than simply contributing to your outward appearance. The skin protects the inner organs, controls thermoregulation, functions as a sensory organ, and is necessary for vitamin D synthesis. It is made up of multiple layers of cells and tissues that are held to underlying structures by connective tissues. The deepest layer of skin has many blood vessels and also has sensory, autonomic, and sympathetic nerve fibres that ensure communication to and from the CNS. Accessory organs within this system include hair, nails, and various glands.



The Components of the Integumentary System

Fig. 6.31



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(CrashCourse, 2015)

Components of the Integumentary System

Epidermis: This is the outermost skin layer and is composed of keratinized, stratified squamous epithelium.

Dermis: This inner skin layer is the main component of the integumentary system and contains blood and lymph vessels, nerves, and other structures, such as hair follicles and sweat glands.

Hypodermis: This layer is also known as the **subcutaneous layer** and lies below the dermis. It connects the skin to the fibrous tissues of the bones and muscles.

Hair: This is a keratinous filament that grows out of the epidermis. It is primarily made of dead, keratinized cells.

Nail bed: This epidermal structure is found at the tips of our fingers and toes. The **nail body** is formed on the nail bed and protects the tips of our fingers and toes and assists with picking up small objects.

Sudoriferous glands: Also known as **sweat glands**, these glands produce sweat to cool the body when it becomes warm. There are two types of sweat glands, and each secretes slightly different products.

Sebaceous glands: These glands are a type of oil gland and are found all over the body. They help to lubricate and waterproof the skin and hair. Many of these glands are found near hair follicles. The sebaceous glands generate and excrete **sebum**, which is a mixture of lipids, onto the skin surface, lubricating the dry and dead layer of keratinized cells. The secretion of sebum is stimulated by hormones, many of which do not become active until puberty.

Combining Forms

Table 6.9. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
cutane/o	skin	cutaneous
derm/o	skin	epidermal
dermat/o	skin	dermatologist
epitheli/o	skin (surface tissue)	epithelial
onych/o	nail	onycholysis
pil/o	hair	pilosebaceous
trich/o	hair	trichotillomania
ungu/o	nail	ungiectomy

Common Pathologies

Acne: This condition commonly occurs in areas of the skin that have more sebaceous glands, such as the face and back. It is associated with hormones and commonly occurs with the onset of puberty.

Albinism: This genetic disorder affects the colouration of hair, eyes, and skin. Individuals with albinism appear white or very pale because of a lack of melanin.

Alopecia: This condition is characterized by hair loss or lack of hair where it would usually be (Fig. 6.32).



Fig. 6.32

Basal cell carcinoma: This is a form of skin cancer that affects the epidermis. It is the most common form of skin cancer in certain parts of the world. It is often found on the neck, head, arms, and back because those areas are more likely to be exposed to the sun.

Eczema: This condition presents as an allergic reaction characterized by dry, itchy patches on the skin (Fig. 6.33). It often looks like a rash and can appear anywhere on the body. Eczema can progress, and the skin can become itchy, dry, swollen, and bleeding.

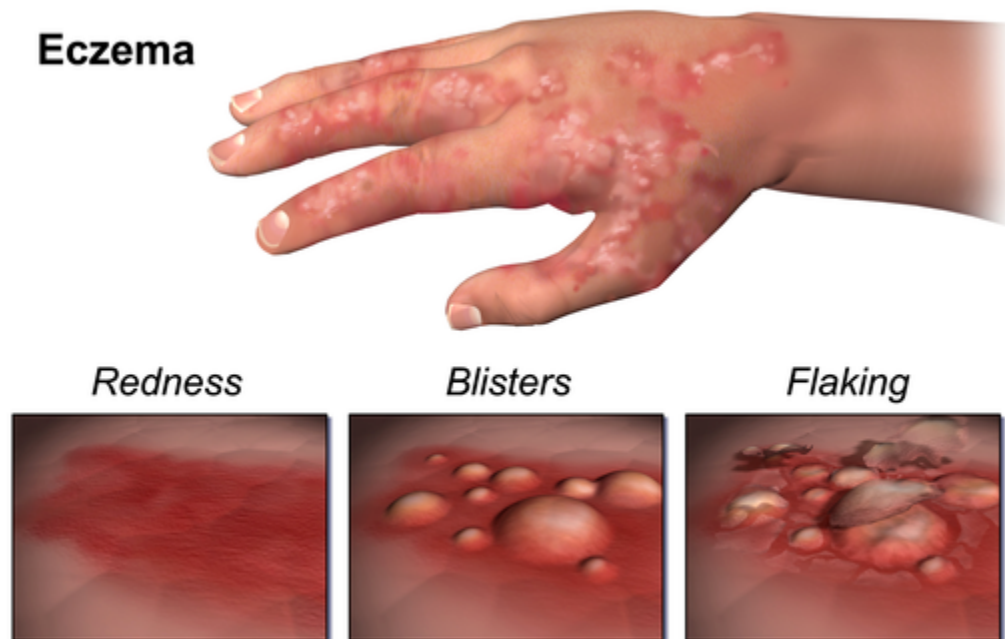


Fig. 6.33

Melanoma: This type of cancer typically develops from a mole and then grows uncontrollably. It is highly malignant and is one of the most fatal types of cancer.

Key Concept

The **ABCDE mnemonic** is used to assess moles and can help with the diagnosis of early stage melanoma:

- **Asymmetry** – the two sides are not symmetrical
- **Borders** – the edges are irregular in shape
- **Colour** – the colour is varied shades of brown or black
- **Diameter** – it is larger than 6 mm (0.24 in)
- **Evolving** – its shape has changed

Mole: Also known as a **nevus**, a mole appears as a pigmented lesion on the skin. Many are benign in nature.

Psoriasis: This chronic autoimmune disorder is characterized by patches of thick, red skin with the appearance of silvery scales. Psoriasis can be found on the elbows, knees, scalp, low back, face, feet, fingernails, toenails, and even the mouth (Carter & Rutherford, 2020).

Squamous cell carcinoma: This form of skin cancer is more aggressive than basal cell carcinoma and is the second most common type of skin cancer. It is often found on the scalp, ears, and hands, and affects the keratinocytes in the dermis and epidermis.



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6.11 Digestive System

Overview and Functions

The function of the digestive system (Fig. 6.34) is to break down food, release its nutrients, and absorb those nutrients into the body. The small intestine is the pillar of the system. It is where the majority of digestion occurs and where most of the released nutrients are absorbed into the blood. However, each of the digestive system organs makes a vital, and necessary, contribution to this process.

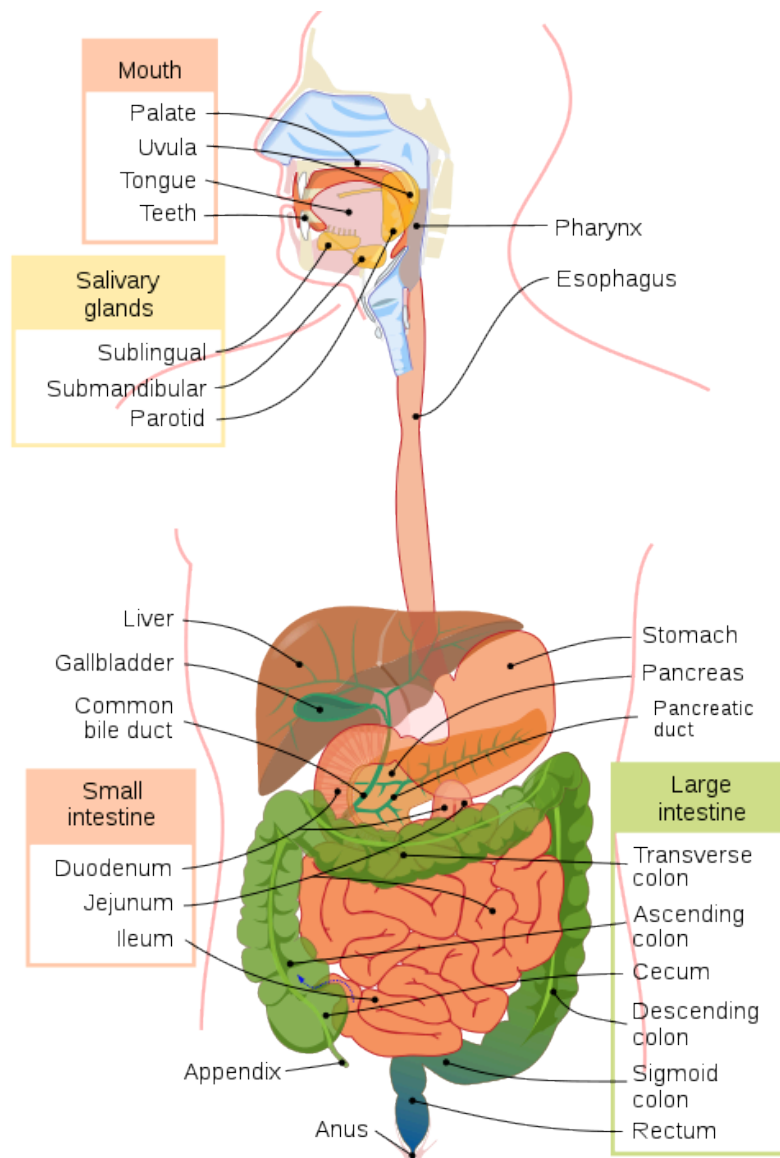


Fig. 6.34



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(CrashCourse, 2015)

Components of the Digestive System

Mouth: The mouth begins the digestive process by ingesting food and chewing it, starting the chemical breakdown of carbohydrates, then moving the food into the pharynx.

Salivary glands: These small exocrine glands are located within the mouth and tongue. They constantly produce saliva, and on average, secrete about 1 to 1.5 L of saliva each day.

Teeth: Similar to bones, the teeth are used to tear, grind, and otherwise mechanically break down food.

Pharynx: This organ is also known as the **throat** and is involved in both digestion and respiration. When food enters the pharynx, involuntary muscle contractions close off the airways to prevent food from entering. When a person is not eating, the airways are open for air to enter from the mouth and nasal cavities.

Esophagus: This muscular tube connects the pharynx to the stomach. It is approximately 25 cm (10 in) long and is collapsed when not engaged in swallowing.

Stomach: The stomach participates in almost all the digestive activities except for ingestion and defecation. There are four main regions to the stomach: cardia, fundus, body, and pylorus.

Small intestine: Almost all digestion occurs in the small intestine, and practically all absorption takes place there as well. The small intestine has three parts: duodenum, jejunum, and ileum.

Key Concept

The small intestine is about 3 m (10 ft) long in a living person, but about twice as long in a cadaver as a result of the loss of muscle tone. This also makes it about five times longer than the large intestine.

Large intestine: The primary function of the large intestine is to complete the absorption of nutrients and water, synthesize vitamins, form feces, and eliminate feces from the body. The large intestine has four main regions: cecum, colon, rectum, and anus.

Liver: The largest gland in the body, the liver weighs approximately 1.4 kg (3 lb) in an adult. It is also one of the most important organs because of its role as an accessory digestive organ and in metabolism and regulation.

Pancreas: The functions of the pancreas involve a mix of exocrine functions, such as secreting digestive enzymes, and endocrine functions, such as releasing hormones into the blood.

Gallbladder: This organ is approximately 8 to 10 cm (3 to 4 in) long. It stores, concentrates, and then sends bile into the duodenum (part of the small intestine).

Combining Forms

Table 6.10. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
abdomin/o	abdomen	abdominal
an/o	anus	anal
append/o	appendix	appendectomy
appendic/o	appendix	appendicitis
cholecyst/o	gallbladder	cholecystostomy
col/o	colon	colectomy
colon/o	colon	colonography
duoden/o	duodenum	duodenoscope
enter/o	intestine	gastroenteritis
esophag/o	esophagus	esophagogastrectomy
gastr/o	stomach	hemigastrectomy
hepat/o	liver	hepatitis
ile/o	ileum	ileostomy
jejun/o	jejunum	jejunoileitis
lapar/o	abdomen	laparotomy
or/o	mouth	oral
pancreat/o	pancreas	pancreatic
pharyng/o	pharynx	pharyngitis
proct/o	anus and rectum	proctologist
rect/o	rectum	rectal
sigmoid/o	sigmoid colon	sigmoidoscopy
stomat/o	mouth	stomatologist

Common Pathologies

Celiac disease: This is an immune sensitivity reaction that occurs in the small intestine when gluten is consumed. Damage to the small intestine will occur if gluten consumption continues (Carter & Rutherford, 2020).

Cholecystitis: This condition is usually caused by gallstones that develop and block the bile duct. As a result, the gallbladder becomes inflamed.

Cholelithiasis: This condition is also known as **gallstones** (Fig. 6.25); the stones are pieces of solid material that form in the gallbladder (WebMD, 2022a). Gallstones can range in size from a grain of rice to a golf ball, and as they get larger,

the chance that they will block the bile duct increases. When a blockage occurs, the result is pain and discomfort in the gallbladder region.

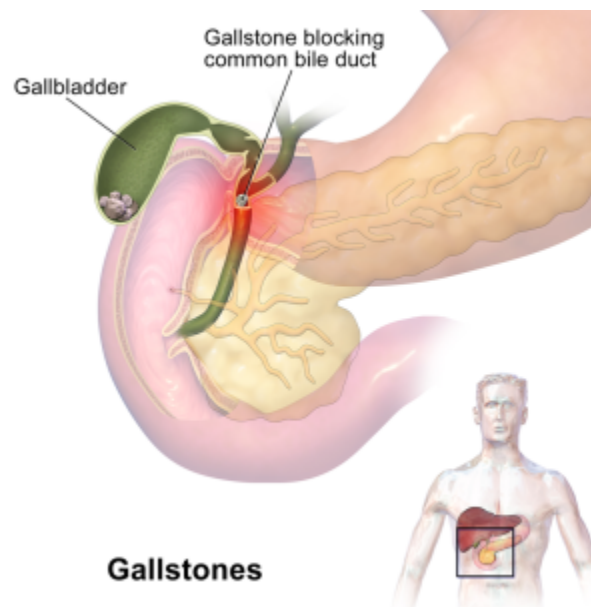


Fig. 6.35

Cirrhosis: This condition is characterized by liver scarring. Cirrhosis is a chronic condition that cannot be cured, and as it progresses, it can become life threatening. Chronic alcoholism and some liver diseases can cause cirrhosis (Mayo Clinic, 2022).

Colon cancer: One of the most malignant types of cancer, smoking, excessive alcohol intake, a diet high in animal fats, and a family history of colon cancer increase a person's chances of being diagnosed. Common symptoms include constipation, diarrhea, cramping, abdominal pain, and bleeding from the rectum.

Colonic polyposis: Also known as **polyps**, this condition is characterized by small growths that protrude outward from the intestinal wall. Most are benign, but some can become cancerous. Usually this condition is only present in those over the age of 50 (Carter & Rutherford, 2020).

Diverticulitis: This condition is caused by inflammation of the diverticula (see **Diverticulosis**, below) (WebMD, 2022b). Symptoms include severe abdominal pain and fever.

Diverticulosis: This condition is characterized by small bulging pockets, known as **diverticula**, that form within the walls of the digestive tract (WebMD, 2022b). Often there are no signs or symptoms unless they become inflamed. The pockets can grow in size and food can become stuck, resulting in **diverticulitis** (WebMD, 2022b).

Gastroesophageal reflux disease (GERD): This condition occurs when the lower esophageal sphincter does not fully close, and the contents of the stomach travel back up into the esophagus (Fig. 6.36). The backwash of stomach acid, known as acid reflux, irritates the lining of the esophagus, causing heartburn, chest pain, and difficulty swallowing.

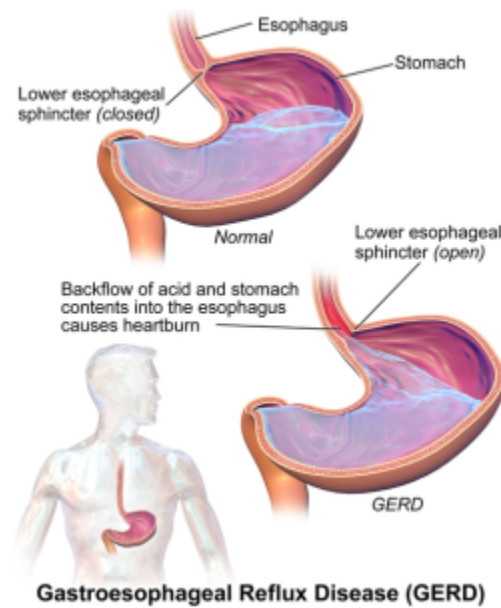


Fig. 6.36

Hepatitis A, B, and C: Hepatitis is inflammation of the liver and can be caused by various factors. Viruses, alcohol consumption, toxins, medications, and even autoimmune responses can result in hepatitis (Carter & Rutherford, 2020).

Hernia: This condition occurs when fatty tissue or an organ pushes through a weak area of the surrounding muscle or connective tissues. The most common hernias occur in the abdomen or groin areas.

Inflammatory bowel disease (IBD): This disease occurs when a part of the digestive tract becomes inflamed. The two most common types of IBD are **Crohn's disease**, which occurs in the upper GI tract, and **ulcerative colitis**, which occurs in the colon. These are chronic conditions that can be treated but not cured (Carter & Rutherford, 2020).

Irritable bowel syndrome (IBS): The cause of IBS is unknown. Symptoms include bloating, gas, and abdominal pain (Carter & Rutherford, 2020). Usually those that suffer from IBS are advised to make dietary and lifestyle changes to deal with the symptoms they experience.

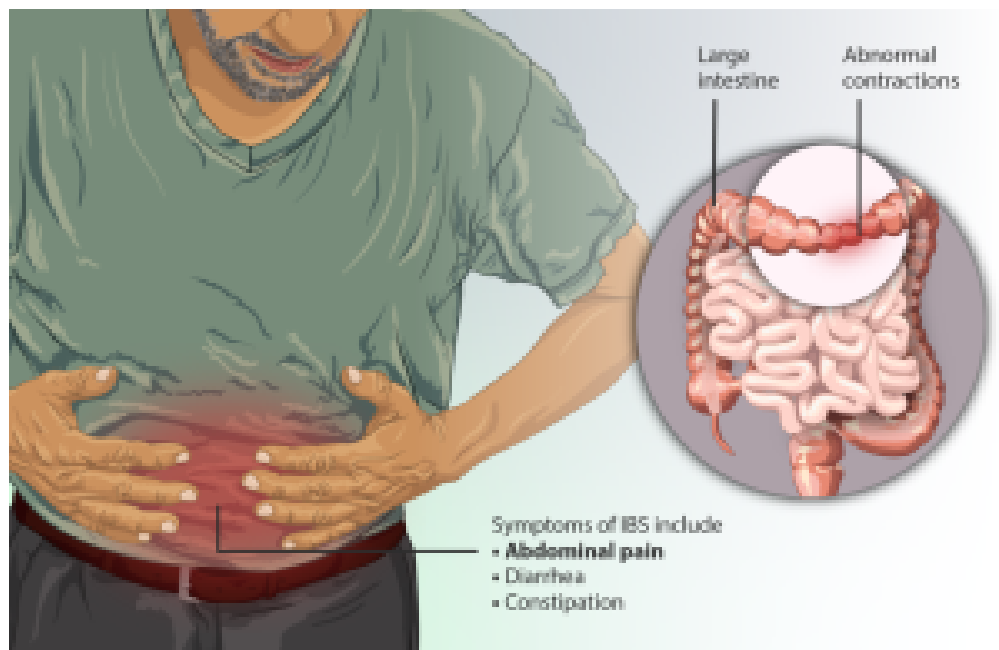


Fig. 6.37

Jaundice: This condition is caused when bilirubin, a yellowish pigment produced during the normal breakdown of red blood cells, increases because it cannot be removed effectively from circulation. Often a failing liver causes this condition, giving a yellowish tinge to the skin, eyes, and mucosa. Fig. 6.38 below shows a person exhibiting the common symptoms of jaundice.



Fig. 6.38

Ulcers: These sores in the lining of the stomach are caused by gastric juices breaking down the stomach mucosa. This causes erosions of the stomach lining, which can heal on their own, but deeper and larger ones become ulcers. Certain medications, such as non-steroidal anti-inflammatory drugs (NSAIDs), and infections, like *Helicobacter pylori*, can contribute to ulcer formation.

Exercise



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6.12 Musculoskeletal System

Overview and Functions

The musculoskeletal system consists of all the bones, muscles, joints, tendons, and cartilage found in the human body (Figs. 6.39 and 6.40). The purpose of this system is to support the body, facilitate movement, and protect the internal organs. Bones are also vital in the production of red blood cells. Some resources show the muscular and skeletal systems as separate; however, for the purposes of this book, they are combined in order to provide a basic overview of their components, functions, and pathologies.

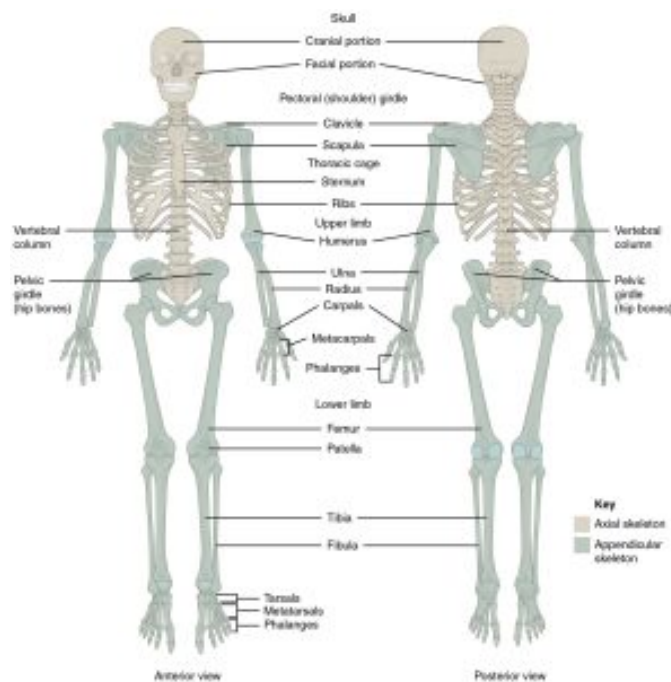


Fig. 6.39

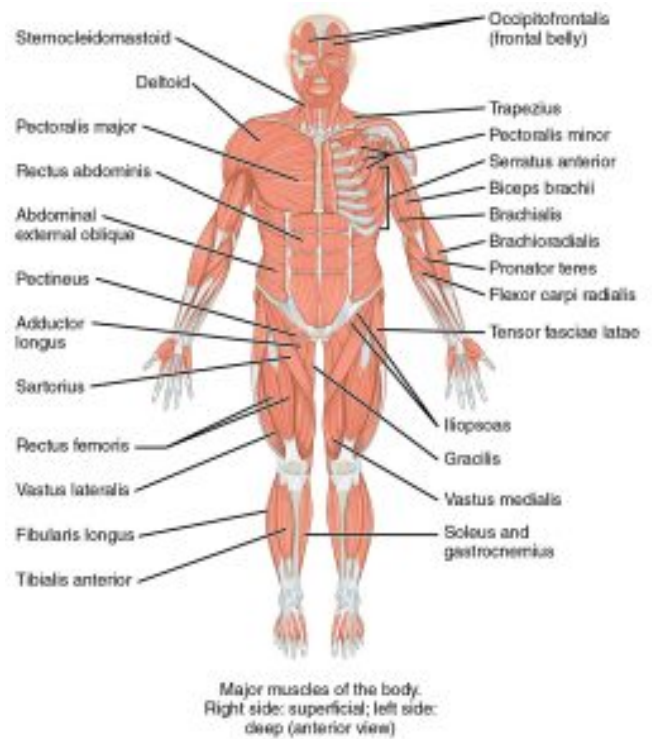


Fig. 6.40



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(CrashCourse, 2015a)



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(CrashCourse, 2015b)

Components of the Musculoskeletal System

The skeleton is subdivided into two major components:

- **Axial skeleton:** The axial skeleton forms the vertical, central axis of the body and includes all the bones of the head, neck, chest, and back. It protects the brain, spinal cord, heart, and lungs. It also serves as the attachment site for muscles that move the head, neck, and back, and for muscles that act across the shoulder and hip joints to move their corresponding limbs. There are 80 bones in the axial skeleton.
- **Appendicular skeleton:** The appendicular skeleton includes all the bones of the upper and lower limbs, plus the bones that attach each limb to the axial skeleton. There are 126 bones in the appendicular skeleton.

Bones: There are 206 bones that compose the adult skeleton. Bones are also known as **osseous tissue** and are hard, dense connective tissue. The purpose of bones is to assist with movement, protect the organs, and produce red blood cells.

Muscle: This is one of the four primary tissue types of the body. The body contains three kinds of muscle tissue: **skeletal muscle**, **cardiac muscle**, and **smooth muscle**.

Joints: These are also known as **articulation** and are any place where adjacent bones or bone and cartilage come together to form a connection.

Tendons: These dense, fibrous connective tissues anchor muscle to bone.

Cartilage: This elastic connective tissue is found at the ends of bones as well as in other locations such as the tip of the nose.

Ligaments: These tough, elastic connective tissues connect bone to bone.

Combining Forms

Table 6.11. Combining Forms

COMBINING FORM	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
arthr/o	joint	arthritis
cervic/o	neck	cervical
chondr/o	cartilage	chondrocytes
coccyg/o	coccyx, tailbone	coccygeal
cost/o	rib	costectomy
crani/o	skull	craniotomy
ligament/o	ligament	ligamentitis
lumb/o	loin, waist	lumbar
muscul/o	muscle	muscular
my/o	muscle	myectomy
myos/o	muscle	myositis
myel/o	bone marrow	myeloma
odont/o	tooth	orthodontist
oste/o	bone	osteomyelitis
pelv/o	pelvis, hip bone	pelvic
sacr/o	sacrum	sacroiliitis
spin/o	spine, backbone	spinal stenosis
spondyl/o	vertebra	spondylosis
ten/o	tendon	tenotomy
tendin/o	tendon	tendinopathy
vertebr/o	vertebra	vertebral

Common Pathologies

Ankylosing scoliosis: This is a lateral curvature and twist of the spine. It is most common among girls and typically gets worse during adolescent growth spurts. Many people who have this pathology do not require treatment, but some must wear a back brace or, in rare instances, may require surgery.

Arthritis: By definition, arthritis means “inflammation (-itis) of the joint (arthr/o).” Individuals with arthritis often present with joint pain, redness, and swelling. There is no cure for arthritis, and it is treated through exercise, medications, and, in some cases, joint replacement.

Carpal tunnel syndrome: This pathology is common among those with occupations requiring repetitive movements of the hand, such as office workers and cashiers. It is characterized by pain or numbness accompanied by muscle weakness in the area of the wrist and hand where the median nerve becomes compressed (Fig. 6.41).

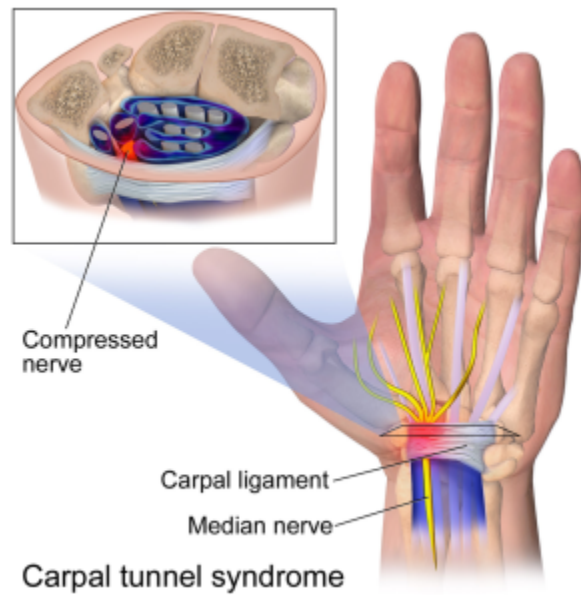


Fig. 6.41

Gout: This condition occurs when uric acid builds up in a joint. Symptoms of gout include swelling, pain, and redness in the affected joint. Gout can flare up, then dissipate and reoccur at a later date. It can affect any joint, but most often occurs in the toes.

Kyphosis: This is a forward curvature of the spine in the thoracic (upper back) region.

Lordosis: This is an excessive inward (anterior) curvature of the spine in the lumbar region and is often associated with obesity or the late stages of pregnancy. It is sometimes called swayback.

Muscular dystrophy: This condition is a progressive weakening of the skeletal muscles. It is an inherited disorder and mostly affects males. Symptoms usually start with balance issues and then progress to inability to walk. Eventually, muscular dystrophy causes respiratory failure and death.

Osteoarthritis: This is the most common form of arthritis and involves the breakdown of cartilage and bone over time (Fig. 6.42). The most common symptoms are pain and stiffness that progressively worsen.

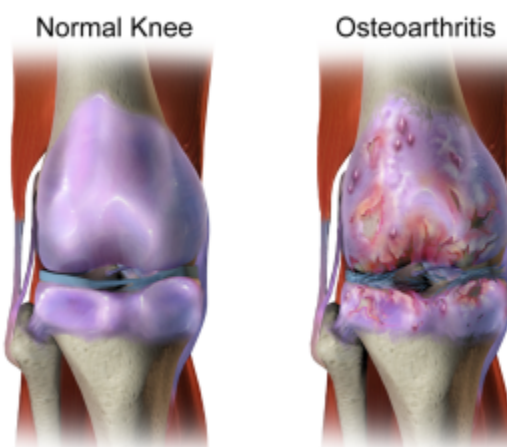


Fig. 6.42

Osteomyelitis: This is an infection within the bone that is caused by staphylococcus bacteria. The bacteria can travel through the bloodstream to the bone or gain access via a wound or surgery (Carter & Rutherford, 2020).

Osteoporosis: This pathology is characterized by progressive bone loss that causes bones to become weak and thin over time (Fig. 6.43). There can be an increased chance of fractures because the bones are weakened. The likelihood of developing osteoporosis increases with age, and the condition is more common in females.



Fig. 6.43

Rheumatoid arthritis (RA): This autoimmune disease presents with inflammation to the joint tissues of the hands, wrists, and knees. Symptoms include debilitating pain and swelling in the affected area (Fig. 6.44).

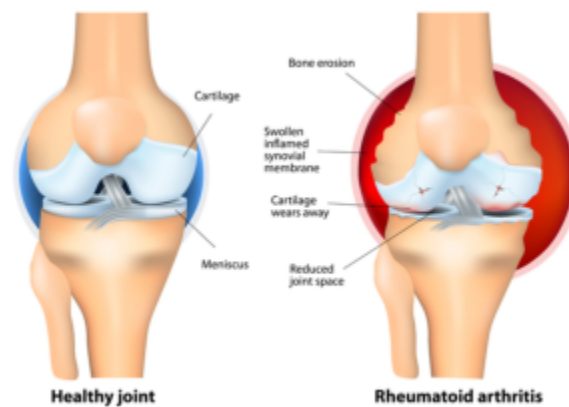


Fig. 6.44



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- Carter, K., & Rutherford, M. (2020). *Building a medical terminology foundation*. eCampusOntario. <https://ecampusontario.pressbooks.pub/medicalterminology/> licensed under [CC BY 4.0](#)
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6.13 Review Exercises

The following exercises review the content in this chapter. Some of the content might not be covered in these exercises, so it is important that you review all of the chapter on your own in addition to doing the exercises.

Combining Form Review



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Pathology Review



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Review



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CHAPTER VII

MEDICATIONS

7.1 Introduction to Medications

Learning Objectives

By the end of this chapter, you will be able to

1. Define the terms **prescription**, **narcotic**, and **over-the-counter medication**
2. Identify routes of medication administration
3. Define the terms **brand** and **generic** as they pertain to drug names
4. Describe the difference between **inactive** and **active ingredients** in medications
5. Identify **alternative medicines** and possible interactions these may have with prescription medications
6. Define a **drug monograph** and its components
7. Identify common forms and uses for intravenous fluids
8. List the rights and responsibilities of medication administration
9. Describe the different **medication classifications** and provide reasons that a patient would be taking medications within these classifications

Chapter Overview

Medications are taken everyday by many patients in hospitals and many people in the course of their daily lives. They can be taken to relieve acute symptoms such as a headache or nausea, or for chronic conditions such as cardiac, endocrine, or respiratory pathologies. The fact that they are so commonplace in our world today emphasizes the importance of certain considerations that need to be addressed before any medication is given to a patient or a member of the general population.

Certain factors, which could include a patient's age, overall health, sex, or chronic conditions, will greatly impact the way a medication affects a person's body. For example, medications taken by a 40-year-old man would have a substantially different effect than if the same medications were taken by a 95-year-old or even a five-year-old. As such, it is very important to understand these factors and their effects when a certain medication is prescribed to a patient.

Many of the earliest known medications, such as digitalis, were extracted from plants, and others, such as aspirin, were chemically related to the willow tree (Turley, 2016). Using plant extracts had some disadvantages because there were variable levels of potency and the extracts could also contain other substances that had unwanted actions in the human body. As a result, the production of medications is now performed under strict guidelines to ensure that there is consistency among medications prescribed or taken over the counter.

This chapter will introduce you to some basic considerations that you should be aware of when it comes to medications, and then an overview of common medication classifications will be discussed.

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Turley, S. M. (2016). *Understanding pharmacology for health professionals* (5th ed.). Pearson Education.

7.2 Basics of Medications

Types of Medications

Prescription Medications

Prescription medications are any medications that must be prescribed by a physician. Physicians today have unlimited information available to them about medications, and pharmacists are also very knowledgeable about various factors concerning medications and can inform the consumer or patient. At the time a patient receives their prescribed medication, they are also given a **drug monograph** about the medication. The drug monograph provides all the information about the medication, including why it is to be taken, possible side effects, adverse effects, drug interactions, and common dosages.

Controlled Drugs



Fig. 7.1

Controlled drugs are any medications that have a high potential for abuse or addiction. Hospital and retail pharmacies dispense controlled drugs and therefore must be registered with the Alberta College of Pharmacists.

On a nursing unit, controlled drugs are kept in a locked cupboard or locked in a computerized cart, and a nurse carries the key. This helps eliminate the potential for theft and also complies with our drug laws. Every time a medication is required from the locked cupboard or cart, the nurse administering that drug must record the relevant information on the sheet or computer provided. In most cases, the controlled drug must also be double-checked and the order signed by another nurse on the unit to ensure accuracy and decrease errors.

At the University of Alberta Hospital, for example, they have computerized carts called **Pyxis carts**. You can see an example of a computerized medication cart that is similar to a Pyxis cart in Figure 7.1. These carts are stocked in the pharmacy according to physicians' orders and taken to the respective units. When a medication for a patient is needed, the cart is unlocked by the nurse with a password. The nurse must enter the patient's name, the doctor's name, and the drug and dose. Only the drawer with the specific medication is released. The cart keeps track of the medications for each patient, the number of times it is given, and the nurse who gave it. Using a computerized drug-dispensing system decreases the potential for errors and allows for greater accuracy in accounting for drugs and for billing.

Over-the-Counter Medications

Any medication that a patient can purchase without a prescription is considered an **over-the-counter (OTC) medication**. Note that these medications can still have side effects and possibly adverse effects if too much is taken. A prescription is not required, and these medications can either be purchased at a pharmacy or at any location that sells such medications. An example of this type of medication would be Tylenol, which is commonly used to treat headaches, or Gravol, which is taken when someone is experiencing nausea.

Herbal Medications

Alternative medicine has become increasingly popular in recent years. Many members of the general population purchase herbal medicines over the counter, and it is important that they are aware that some of these herbs can interact with any prescribed medications they are taking (Drugs.com, 2021). Unfortunately, many people are under the false assumption that if a medication is “herbal,” it can’t harm you.

Many herbal medications can interact with prescribed or over-the-counter medications (Drugs.com, 2021). The table below provides some examples of just a few herbal medications that can have negative, and in some cases potentially deadly, interactions with prescribed medications.

Table 7.1. Herbal Medications

Herbal Medicine	Effect
Coenzyme 10 (CoQ10)	Used to help with heart damage, but when used with warfarin, may decrease blood thinning
Cranberry	Used to treat UTIs, but may increase the effect of blood thinners like warfarin
Echinacea	Used to boost the immune system, but use caution with immunosuppressant drugs
Evening primrose oil	Provides healthy fatty acids, but may also lower the seizure threshold
Garlic	Lowers cholesterol and blood sugar, but also affects blood clotting, so use caution if taking an anticoagulant
Ginseng	Used to decrease stress and increase energy, but also decreases the effects of anticoagulants

(Drugs.com, 2021)

Active and Inactive Ingredients

Most medications contain both inactive and active ingredients. **Inactive ingredients** are generally fillers, dyes, coatings, or solvents. They do not interfere with the action of the medication but are used to colour, keep together, or contain the active ingredients. The **active ingredients** in medications are the parts that create the desired therapeutic effect that could be, for example, relief of pain or infection.

Brand and Generic Names

All medications have **generic names**, and these are the same worldwide. They also have **brand names**, which can vary between parts of the world and are created by the companies that sell the medications. A generic medication could be sold under multiple brand names. Usually the brand names are easier to pronounce and remember, which makes them easier to sell.

The Canadian drug reference is the **Compendium of Pharmaceuticals and Specialties (CPS)**. It is the resource that all pharmacists and physicians use to reference medications. Nowadays, it is available through various online subscriptions as well as an app that can be downloaded and regularly updated. Previously, it was only available in paper format and as such would only be updated annually. In the CPS, brand names are boldface or underlined and generic names are italicized.

Table 7.2. Examples of Brand and Generic Names

Brand Name	Generic Name
Benadryl	<i>diphenhydramine</i>
Gravol	<i>dimenhydrinate</i>
Motrin	<i>ibuprofen</i>
Tylenol	<i>acetaminophen</i>

Although these are just a few examples, typically the brand name is the more recognized name within the general population compared to the generic name, which is generally more complex in nature.

Adverse Effects and Side Effects

When taking any medication, whether over the counter, herbal, or prescribed, there are possible side effects and adverse effects. The two terms are often used interchangeably, and although these effects can be similar in nature, they are actually very different. **Side effects** occur when a medication is taken and produces an effect other than the intended one. Although this may not be the desired affect, it is generally something that is anticipated by the physician as a result of taking that particular medication. For example, often when someone takes a narcotic medication, they experience constipation as a side effect. An **adverse effect**, on the other hand, is unintended, but it is also a dangerous effect that occurs when a medication is taken. In many cases, it is severe, unpredictable, and results in the medication having to be discontinued. Anaphylaxis, a severe allergic reaction, would be an example of this.

Key Concept

Note on allergies: We are not always born with allergies and may even develop them later in life. You may, for example, have taken a certain medication without issue, but then later in life you start reacting to it, even to the point of experiencing anaphylaxis, though minor reactions are more common.

Rights of Medication Administration

When a medication is prescribed or ordered for a patient, it is important to ensure that certain “rights” are considered in order to reduce possible errors. These rights are an important aspect of patient care, and when all of them are adhered to, it is possible ensure that potentially harmful, or even deadly, medication errors are avoided. The six rights of medication administration are the following:

1. The right patient
2. The right drug
3. The right dose
4. The right time
5. The right route
6. The right documentation

When medications are taken, there are many differing doses, routes, timings, and medications themselves that can be chosen. As such, it is important to make sure that all of these are the “right” ones for a particular patient. Proper documentation is also important because if medication administration is not documented correctly, then the medication is not considered to have been given properly. We use documentation in hospitals and clinics as a way of knowing what

patient care has been completed, and without proper documentation, we cannot know with certainty what treatment a patient has received.

Medication Responsibilities

When medications are ordered in the hospital, a pathway for medication responsibility must be followed. Some hospitals may have a different process depending on factors such as the adoption of Connect Care in Alberta, for example. Connect Care is a form of a clinical information system (CIS) that is available province-wide in Alberta. Other areas have similar systems, and using these systems should allow for more comprehensive patient care and reduce the need to process paper orders. Many areas do not have this form of electronic health records, so the pathway given below for medication responsibility is still very important to know and helps ensure patient safety. This step-by-step process includes numerous checks at every level on the pathway for medications ordered in the hospital. Each professional in the chain will work to complete the medication order, but also check the order at the same time to decrease errors and ensure that the patient receives the correct medication.

Pathway for medication responsibility:

1. The **physician** writes the order.
2. The **health administrative professional** processes the order.
3. The **charge nurse** checks the order.
4. The **pharmacist** fills the order.
5. The **nursing staff** gives the medication.

Review Exercise



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Drugs.com. (2021, October 20). 18 herbal supplements with risky drug interactions. <https://www.drugs.com/slideshow/herb-drug-interactions-1069>

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7.3 Medication Routes and Forms

Medication Routes and Forms

Medications can be given using many routes, and different forms of medication can be given through those routes. Also, some medications can be given in various routes; for example, Gravol can be given orally, intravenously, and intramuscularly. However, this does not apply to all medications. The route and form a medication is given in will vary depending on the medication itself, the reason for administering the medication, and the patient themselves. Some of the common routes that medications can be given are listed below as well as some of the forms of medication that can be given via those routes.

Orally: The oral route is one of the most common for medication administration. The abbreviation for this route is **po**, and there are many forms of medication that can be given this way. Some examples of oral medications include **tablets**, **capsules** (Figure 7.2), **liquids**, **mixtures**, **elixirs**, **emulsions**, and **syrups**. However, some medications cannot be given orally, and some patients cannot handle oral medication. For example, if a patient has difficulty swallowing or if they are extremely nauseous and vomiting, then medication would not be administered orally. In those cases, the medication would be given through another route.



Fig. 7.2

Sublingually: The sublingual route is similar to oral medication administration but differs in one key aspect. In sublingual medication administration, the medication is given **under the tongue** and dissolves. This is ideal in that the medication does not need to be swallowed and begins working more quickly because it is absorbed through the mucous membranes under the tongue. The abbreviation for this route is **sl**.

Enterally: Medication given via the enteral route is delivered either through a **nasogastric tube (N/G tube)** or a **gastrostomy tube (G tube)** that goes directly into the stomach or small intestines. Most medication that can be given orally can be given in this manner. Medication can be crushed and administered via the tube or can come from the pharmacy already prepared to be administered.

Fig. 7.3

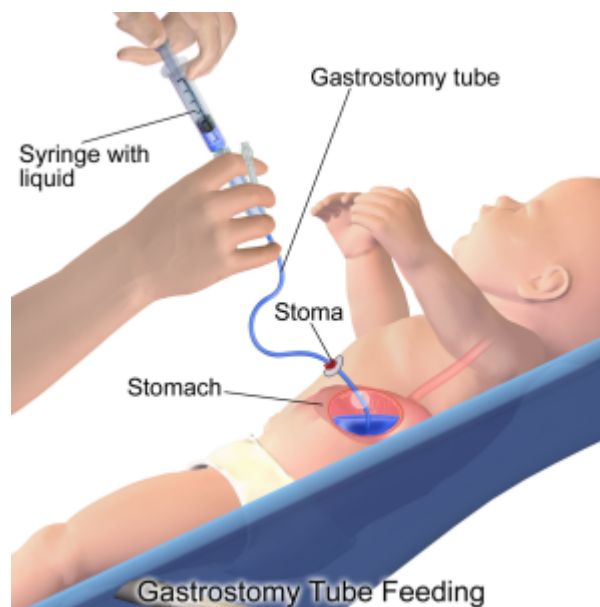
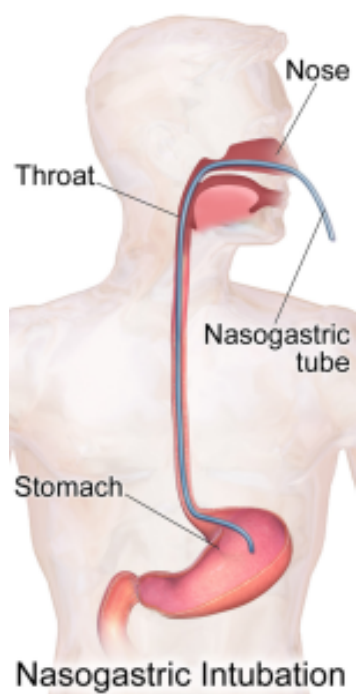


Fig. 7.4

Inhalation: The most common way to administer medication via this route is **inhalers**. There are a number of different types of inhalers, and they vary depending on the medication and the reason for administration. There are also medications that can be given in gas form through the inhalation route. Figure 7.6 shows three different types of **dry powder inhalers**. With these inhalers, the patient breathes in a standard amount of a dry powder for each dose. The blue inhaler (Figure 7.5) is a **metered dose inhaler** that also provides a set dose per inhalation of medication.



Fig. 7.5



Fig. 7.6

Parenterally: There are three common routes that are considered parental: **intravenous (IV)**, **subcutaneous (sc)**, and **intramuscular (IM)**. The intravenous route delivers medication through an IV line that is connected to a small catheter in the patient's vein. This route will be discussed in more detail later in the chapter. The subcutaneous (SC) and intramuscular (IM) routes are both injections, but the subcutaneous route delivers medication into the deepest layer of the skin, which is comprised of fats and tissues, and the intramuscular route (IM) delivers medication into the muscle. All these routes have different benefits and drawbacks; for example, the therapeutic effects of medication given via an IV

occur faster but do not last as long as medication given via other routes. Figure 7.7 below shows varying sizes of syringes, and Figure 7.8 illustrates the difference between SC, IM, and IV medication administration.



Fig. 7.7

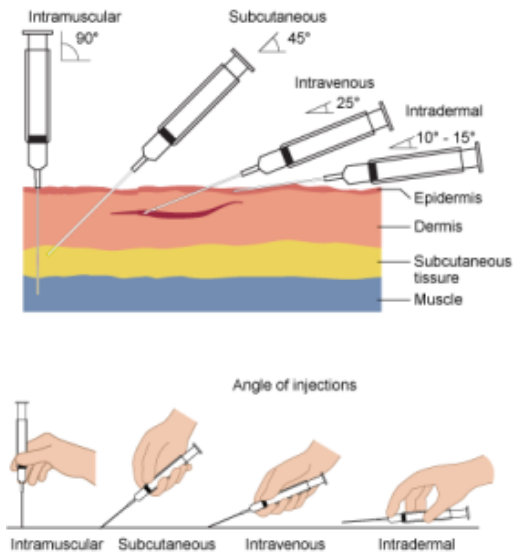


Fig. 7.8

Rectally: The rectal route is used when a patient has issues taking medication orally. It is also commonly used with children because many young patients are unable to take medication orally or have difficulty swallowing medication. Some pain medication can be given through the rectal route in the form of **suppositories**, but others can be given in the form of **creams**, **lotions**, or **ointments**. If a patient is constipated or needs contrast for a scan, then they can be given an **enema**. The abbreviation for the rectal route is **pr**.

Vaginally: Although most suppositories cannot be given vaginally, there are some that can. There are also a number of creams and ointments that can be administered this way. The abbreviation for this route is **pV**.

Drops: Various solutions can be given either into the **eye**, **ear**, or **nose**, depending on the reason for administration. Some common medication types are antibiotics, numbing agents, and lubricating drops. The abbreviation for drops is **gtt**.

Topically: A number of different forms of medication can be given topically, including **lotions**, **creams**, **ointments**, and **powders**. Although many of these are similar in nature, the main difference is the amount of oil or water that is used in combination with the active parts of the medication. Topical medications typically work locally, which means they only have a therapeutic affect on the area they are administered on.

Transdermal patches: This route is very similar to the topical route, but there are differences. Transdermal patches are applied to the skin and left on so the medication can be absorbed slowly. A common example of this is the nicotine patch (Figure 7.9), which is used to help people quit smoking. Other common reasons that medications are given via this route is for pain, heart issues, depression, pregnancy prevention, and nausea. Another difference between transdermal patches and the topical route is that medication given transdermally usually acts systemically, which means it has a therapeutic effect throughout the body rather than just locally.



Fig. 7.9

Review Exercise



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7.4 Intravenous (IV) Medications and Solutions

Intravenous (IV) Solutions

It is relatively commonplace for patients to receive intravenous (IV) infusions when they are in hospital. There are various reasons why a patient may receive IV infusions:

- **To replace lost fluids:** Fluids may need to be replaced because the patient has lost blood or is dehydrated.
 - **To administer medication:** When patients receive medication via the IV route, that medication is combined with an IV solution and usually run as a piggyback to the main line. This is discussed in more detail below, where different types of IVs are explained.
 - **To maintain electrolyte balance:** Electrolytes such as potassium (K), for example, can be given via IV if the patient has low levels of a specific, or all, electrolytes.
 - **Potential to become depleted:** An IV can be run at a low rate to avoid potential loss of fluids or electrolytes if they are likely to become depleted.
 - **Emergency situations:** Emergency situations can occur during surgery or in the emergency department. In these situations, a patient may require various IV medications and fluid replacement.
 - **To administer blood and blood products:** When blood or blood products are administered via an IV line, the line is always run secondary to an IV line of fluid in case the patient has a reaction to the blood product being administered.
-

There are different ways that IV fluids or medications can be given, and most of the subtypes of IV administration are listed below. All involve some form of IV access, which is usually through a small catheter placed into a patient's vein.

- **Primary infusion:** This type of IV administration involves a bag of IV fluid being attached to a primary IV line, which is attached to a small catheter in the patient's vein. It can involve the IV line being attached to a machine or simply use gravity and is measured by drip rates.
- **Piggyback:** In this method, a smaller secondary bag and line is attached to the primary infusion. This is shown in Figure 7.10 below, where you can see the smaller bag hanging from the pole. Typically, medication is added to the secondary bag as a way of slowly administering the medication to the patient.
- **Saline lock:** In this method, shown in Figure 7.11, a small IV line is attached to the catheter inside the patient's vein and "locked" with a saline solution. There is a port on the end where a primary infusion line can be attached if IV fluids are needed. Saline locks allow patients to be mobilized more easily because they can be detached from the longer IV line and pole. Medication can also be given through the saline lock.



Fig. 7.10



Fig. 7.11

- **Direct IV:** In this method, shown in Figure 7.12, medication in a syringe is attached to a port on the IV line and pushed into the line so the patient receives the medication at a faster rate than they would with a piggyback.
- **IV bolus:** A bolus is a large amount of fluid administered in a very short time. It can also be used as a way of administering IV fluids quickly in an emergency situation.



Fig. 7.12

There are various IV solutions that can be used for intravenous infusions, and many of them are used regularly in a

hospital setting. The more common types are listed below, but there are others that may be used on specialty units within the hospital:

1. **Normal saline 0.9%:** This is one of the most commonly used IV solutions and is a mixture of sodium chloride and water. It has many uses in the hospital, the most common being fluid replacement. The abbreviation for this solution is **NS**.
 2. **Normal saline 0.45%:** This is a less common form of normal saline but can be considered **1/2 normal saline** because the percentage of sodium chloride is half what it would be normally.
 3. **2/3 dextrose and 1/3 normal saline:** This solution is a mixture of dextrose (sugar) and normal saline. The common abbreviation is **2/3-1/3**.
 4. **5% dextrose in water:** This solution is a mixture of dextrose (sugar) and water. The percentage indicated can vary depending on the level of dextrose in the solution; for example, it could be 10% or 50%. The abbreviation is **D5W** and again may vary depending on the level of dextrose; for example, 10% dextrose in water would be D10W.
 5. **5% dextrose in saline:** This solution is similar to D5W but is a mixture of dextrose (sugar) and saline instead of water. The level of dextrose can vary, similar to the dextrose and water solution. The abbreviation is **D5NS** and can also vary depending on the level of dextrose.
 6. **Ringer's lactate:** This solution is commonly used for fluid replacement and contains water, sodium chloride, sodium lactate, potassium chloride, and calcium chloride. The abbreviation is **R/L**.
-

Intravenous solutions come in a variety of sizes of bags, and the intended use usually determines the size selected. Primary infusions, for example, often use a larger size, whereas piggybacks use smaller solution bags. Some available sizes include the following:

- 1000 cc (1 litre)
- 500 cc
- 250 cc
- 100 cc
- 50 cc
- 25 cc

Review Exercises



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7.5 Medication Categories

Major Categories for Medications

Medications are placed in different categories depending on the reason they would be taken. Viewing medications according to different classes, or categories, makes it easier to understand why someone would take a certain medication. For the most part, all medications can be placed into one of the categories below, and some medications fall into more than one category. For example, Tylenol is both an analgesic and an antipyretic.

1. Analgesics

An analgesic is used to relieve pain.

Three Types of Analgesics:

- **Mild:** This type of analgesic includes those that can be purchased over the counter. Mild analgesics are drugs such as Tylenol and can be used to relieve mild pain, such as a headache.
- **Narcotic:** Narcotics are used for moderate to severe pain and must be prescribed by a physician. Their use is also strictly controlled because of the potential for abuse or addiction. Patients taking narcotics often experience side effects such as sedation or constipation. Medications such as codeine and morphine would be included in this category of analgesic.
- **Nonsteroidal anti-inflammatory drugs (NSAIDs):** This type of analgesic is used to decrease inflammation. Some medications in this category, such as ibuprofen, which is ideal for muscle pain and cramping, can be purchased over the counter, whereas others, such as naproxen, require a prescription.

2) Anesthetics

An anesthetic is a medication used to reduce or eliminate sensation.

Types of Anesthetics:

- A **general anesthetic** is administered to a patient when they are undergoing a surgical procedure. The purpose is to completely eliminate sensation for the duration of the procedure.
- An **epidural** or **spinal anesthetic** is given to a patient to reduce sensation to a large area without depressing the central nervous system. This type of anesthetic is often used for geriatric patients when undergoing surgery, especially if they have cardiovascular or other health issues. This form of anesthetic is preferred in such cases to decrease possible adverse effects. It is also a way of reducing pain and sensation during childbirth without

potentially causing harm to the unborn child.

- A **local anesthetic** is administered when an isolated part of the body needs treatment. This type of anesthetic is often used for sutures (stitches) or during dental procedures. In most cases, the medication is injected into the surrounding area to decrease or remove sensation in that area.
- A **topical anesthetic** is used for a “numbing” effect. Often it is in the form of a cream or ointment that is applied to an area of the skin or in the mouth for certain dental procedures. Topical anesthetics can also be used for pediatric patients to numb the skin before a local anesthetic is injected.

Key Concept

It is important not to confuse analgesics with anesthetics. Analgesics are used for pain relief, whereas anesthetics remove sensation.

3) Antibiotics, Antifungals, Antituberculars, and Antivirals

a) Antibiotics

Antibiotics are usually prescribed for the treatment of bacterial disorders such as conjunctivitis, pneumonia, meningitis, and septicemia. The first antibiotic was penicillin, which was introduced in 1941, and since then, antibiotics have grown to be one of the most commonly prescribed medications (Turley, 2016). Today, there are many different classes of antibiotics that have been developed. Some of these antibiotics are called **broad spectrum** because they are used to treat a wide variety of bacterial infections. Other antibiotics are used in the treatment of very specific organisms and are not effective against others.

Antibiotics can either be **bactericidal** or **bacteriostatic**. Penicillin and cephalosporin are bactericidal, which means they destroy bacteria by preventing them from making normal cell walls. Most other antibiotics are bacteriostatic, which means they act inside the bacteria by interfering with the chemical activities essential to their life cycle. In essence, this type of antibiotic works by stopping bacteria from multiplying rather than killing them like bactericidal antibiotics do; this gives the body's immune system a chance to fight the remaining bacteria.

Some Types of Antibiotics:

- Penicillin
- Sulfonamides
- Cephalosporin
- Erythromycins
- Quinolones
- Tetracycline

Antibiotic Resistance

The widespread use of antibiotics over the years has led to antibiotic resistance; that is, bacteria that would have normally been killed or halted by the action of an antibiotic have developed a resistance to the medication. Examples of this include **methicillin-resistant staphylococcus aureus (MRSA)** and **vancomycin-resistant enterococci (VRE)**. As a

result, pharmaceutical companies are developing more antibiotics that are specific to certain bacteria. Physicians also try to prescribe the antibiotic that is most likely to eliminate the bacteria present in a patient's body. A **culture and sensitivity (C&S)** test can be done to determine which form of bacteria is present in a wound or infection. This involves taking a swab of the area and sending it to the lab to be tested to see which bacteria is present and determine which antibiotic would be best to treat the underlying infection.

The following links are an AHS campaign, Do Bugs Need Drugs:

[Do Bugs Need Drugs](#)

[Guide to Wise Use of Antibiotics](#)

(Alberta Health Services, 2022; Alberta Health Services 2022a)

b) Antifungals

An antifungal is a substance that kills fungi or inhibits their growth. For example, athlete's foot is a fungal infection of the foot. It is very common worldwide and occurs between the toes and on the soles of the feet.

c) Antituberculars

An antitubercular is any agent or group of medications used to treat tuberculosis.

Key Concept

In order to treat tuberculosis effectively, a patient is required to take two or more medications in combination.

d) Antivirals

An antiviral is any medication that is destructive to viruses. Examples of this include Tamiflu, which is used to treat influenza, and the various medication combinations that are used to treat human immunodeficiency virus (HIV).

4) Antiemetics

Antiemetics are very common medications and are used to relieve nausea and vomiting. Some examples include Gravol, which is available over the counter, and Maxeran, which requires a prescription.

5) Antipyretics

Antipyretics are medications used to reduce fever. Many of the medications in this category can also be found in other categories; for example, Tylenol and Advil, which are also analgesics.

6) Antitussives

Antitussives are medications used to reduce coughs. Many of these are available over the counter and include medications such as Benadryl and Buckley's.

7) Anticoagulants

Anticoagulants are medications that prevent or delay blood clotting. These medications can help patients who have a history of blood clots or are likely to develop them. A history of heart issues and deep vein thrombosis (DVT) would possibly indicate the need for anticoagulant medications.

Key Concept

Blood clotting: The conversion of blood from a free-flowing liquid to a semi-solid gel

Thrombophlebitis: Inflammation of a vein, often accompanied by a clot; can occur following surgery, immobilization, prolonged sitting (as in an airplane), prolonged standing, or trauma to a vessel wall

8) Anticonvulsants

Anticonvulsants are any medication that prevents or reduces the severity of epileptic or other convulsive seizures. Often an electroencephalogram (EEG) is required to determine the type of seizures and which medication would be the best course of treatment.

9) Psychiatric Medications

a) **Antidepressants:** An antidepressant is any medication that prevents or relieves depression. Clinical depression is a mood disturbance characterized by feelings of sadness, despair, and discouragement. There are many kinds of depression, and the condition can range from mild, transient symptoms to severe, prolonged symptoms.

b) **Tranquilizers:** A tranquilizer is any medication used to calm someone who is anxious or agitated and does so

without decreasing their consciousness. An anxiety attack, an acute reaction involving intense anxiety and panic, is one of the disorders that is treated with tranquilizers. These attacks can occur very suddenly and can be brief or last up to an hour or longer.

c) **Antipsychotics:** Antipsychotic medications are used to treat various pathologies such as drug-induced psychosis, schizophrenia, extreme mania, and depression that is resistant to other medications. Because some patients experience differing levels of side effects and sometimes adverse effects, the administration of these medications is strictly monitored.

11) Antihistamines

An antihistamine is a medication used to treat allergies and allergy-related symptoms. Histamine is a naturally occurring substance in the body; however, when someone has allergies, their histamine levels increase dramatically and cause physiological symptoms such as runny nose, red, itchy eyes, and sneezing. Many antihistamines are available as non-prescription medications, but a few require a prescription. Examples of antihistamine medications are Reactine, Alerius, and Claritin.

12) Cardiovascular Drugs

Cardiovascular drugs are medications that act on the heart and blood vessels to treat various conditions. These medications can be given to patients who have hypertension, angina, myocardial infarction, congestive heart failure, arrhythmias, and high cholesterol levels. **Diuretics** are included in this category and are used to decrease edema, or fluid build-up, by increasing urination. They are often referred to as “water pills.”

Key Concept

Hypertension is a common and often asymptomatic disorder that is characterized by elevated blood pressure that persistently exceeds 140/90 mmHg. Recent research indicates that it is best practice to treat patients for hypertension once their blood pressure persistently exceeds 130/90 mmHg. Early intervention at that level includes lifestyle and dietary changes before the introduction of medication. Hypertension is commonly referred to as the “silent killer” because many patients experience no obvious symptoms. **Antihypertensives** are medications given to treat high blood pressure.

13) Endocrine Drugs

Medications in this category are all hormones that act in the same manner as naturally occurring hormones and involve treating disorders of the endocrine glands. Endocrine drugs are either created synthetically (in a lab) or naturally with

animal hormones. They act on various parts of the endocrine system and are used to either increase or decrease levels of hormones depending on the needs of the patient.

a) Antidiabetic Drugs

Any medication used to treat type 1 and type 2 diabetes is considered an antidiabetic drug. These medications are included in the endocrine drug category because diabetes is a considered an endocrine condition.

Diabetes mellitus (DM) is a complex disorder of carbohydrate, fat, and protein metabolism that is primarily the result of a partial or complete lack of insulin secretion by the beta cells of the pancreas or of defects in the insulin receptors (Diabetes Canada, 2022).

- **Type 1 diabetes** occurs when the immune system kills the cells in the pancreas that produce insulin. Type 1 typically develops in childhood or adolescence, but it can also occur in adulthood. Type 1 is always treated with insulin (Diabetes Canada, 2022).
- **Type 2 diabetes** occurs when the body cannot use the insulin that is released or cannot make enough insulin. Ninety percent of people afflicted with diabetes have this type. Type 2 is more common in adults, but it can affect children as well. Type 2 diabetes is managed through meal planning and physical activity, but may also require oral medications to control blood sugar more effectively (Diabetes Canada, 2022).

14) Gastrointestinal Drugs

Gastrointestinal drugs are medications that provide relief of gastrointestinal disorders and symptoms. They are commonly used to treat conditions such as indigestion, heartburn, diarrhea, constipation, and ulcers. Many of these medications are available over the counter and include antacids such as Pepcid-AC which neutralize the acidic secretion of gastric juices.

15) Respiratory Drugs

Medications in this category are used in the treatment of respiratory disorders such as asthma, pneumonia, bronchitis, and emphysema. Any medication that works on the respiratory system is included in this category. Respiratory drugs often come in the form of inhalers, but in some cases, they are in oral or other forms.

16) Sedatives/Hypnotics

Sedatives/hypnotics are medications that depress the central nervous system to promote drowsiness and sleep. It is important to differentiate sedatives/hypnotics from tranquilizers. The purpose of sedatives/hypnotics is to promote drowsiness, whereas tranquilizers are used to calm someone who is anxious or agitated and should not increase drowsiness.

Key Concept

Sleep is essential to the functioning of the body and is the time for rest and regeneration. Studies show that people require at least eight hours of sleep per night in order to be fully functional. Many factors affect our patterns of sleep, including age, physical illness, psychological stress, anxiety, and the effects of medications. It is normal for sleep patterns to change throughout our lifetime, with more sleep required in a 24-hour period when we are young and less as we age.

17) Stimulants

A stimulant is any medication that increases the activity of a body system. **Caffeine** is one of the most common central nervous system stimulants and is sometimes prescribed to counteract migraines, drowsiness, or mental fatigue. Other stimulants include medications for the treatment of attention deficit disorder (ADD).


Review Exercise



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7.6 Review Exercises

Exercises



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CHAPTER VIII

DIAGNOSTIC TESTS AND PROCEDURES

8.1 Introduction to Tests and Procedures

Learning Objectives

By the end of this chapter you will be able to

1. Describe common laboratory procedures
2. Describe common ultrasound procedures
3. Describe common nuclear medicine scans
4. Describe common radiology procedures
5. Describe common clinical procedures
6. List abbreviations and their meanings for common diagnostic tests

Chapter Overview

This chapter will explore diagnostic tests and procedures that are typically performed in a hospital and other medical settings. Tests and procedures occur every day in health care, and many of us have likely had a number of these tests ourselves. This chapter has been organized into lab tests, diagnostic imaging, and clinical procedures. The diagnostic imaging section includes X-rays, ultrasounds, nuclear medicine, and MRIs. Tests and procedures will be explained, abbreviations will be listed where applicable, and important considerations will be discussed. A large assortment of images and some videos will assist you with your learning. Exercises are also provided throughout, as well as a final review to solidify what you have learned.

Attribution

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Betts, J. G., Young, K. A., Wise, J. A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J. E., Womble, M., & DeSaix, P. (2013). *Anatomy and physiology*. OpenStax. <https://openstax.org/details/books/anatomy-and-physiology> licensed under [CC BY 4.0](#)

8.2 Laboratory Tests

Almost everyone has had some form of lab work done, and lab work is completed numerous times a day in hospitals, clinics, and specialized facilities that function only to obtain blood and other samples to be analyzed. In hospitals, patients often have blood drawn at the bedside, and on some specialty units, nurses draw blood from central lines. Usually, for patients in the hospitals, nurses collect urine and swabs of bodily fluids and then send those to the lab for analysis. Although the manner in which samples are collected varies, the end result is the same—the samples are all processed in a lab. The more common types of lab work are discussed below, but of course, there are also other tests that can be ordered and completed. Fig. 8.1 and Fig. 8.2 show samples being analyzed.



Fig. 8.1



Fig. 8.2

Alanine transaminase (ALT): This blood test detects an enzyme called alanine transaminase. ALT is found mostly in the liver and kidneys, and an increase in circulating ALT suggests liver damage or possibly muscle damage.

Albumin: This blood test detects albumin which is a protein found in blood that is produced in the liver and is a carrier

of many lipid-soluble vitamins and other hydrophobic compounds. A decrease in circulating albumin may suggest a nutritional deficiency or poor liver function.

Total protein: Similar to albumin, a measure of total blood protein is useful to assess for malnutrition or possibly chronic disorders such as inflammatory bowel disease.

Alkaline phosphatase (ALP): This blood test measures the level of ALP, an enzyme found in the liver and other tissues such as bone. An elevated ALP level is commonly caused by liver disease or other pathologies that increase cell damage, which leads to the release of ALP in the blood.

Aspartate amino transferase (AST): This blood test measures the level of AST, which is found in the heart and liver and is needed in nitrogen metabolism. It is a useful lab test for detecting liver damage. The ratio of ALT to AST can also be used to differentiate between disorders such as alcoholic versus nonalcoholic fatty liver disease.

Bilirubin: This test measures the amount of bilirubin in blood serum. High levels cause jaundice and suggest liver dysfunction and disease.

Blood urea nitrogen (BUN): This blood test detects urea, which is a waste product of amino acid metabolism and is filtered out of the blood by the kidneys. It is also the primary means of nitrogen disposal. Pathologies that affect the kidneys can affect the amount of urea in the blood.


Calcium (Ca): Calcium is one of the most important minerals in the body and is essential for the proper functioning of muscles, nerves, and cardiac tissue. It is also needed for blood clotting and bone formation. This lab test measures the level of calcium in the blood and will show whether it is elevated or decreased.

Complete blood count (CBC): A CBC test checks the levels of 10 different components of every major cell in your blood. This test is helpful in diagnosing leukemia, infection, blood disorders, anemia, and nutritional deficiencies (Healthline, 2021).

Key Concept

The main components of a CBC are the following:

- **Red blood cells:** Cells that are responsible for carrying oxygen throughout the body
- **White blood cells:** Immune system cells found in the blood
- **Platelets:** Small cells that control blood clotting
- **Hemoglobin:** Protein in the red blood cells that carries oxygen to organs and tissues, and carbon dioxide back to the lungs
- **Hematocrit:** The percentage of blood made up of red blood cells



CBC		
WBC	5.88	[10 ⁹ /L]
RBC	4.45	[10 ¹² /L]
HGB	136	[g/L]
HCT	0.396	[L/L]
MCV	89.0	[fL]
MCH	30.6	[pg]
MCHC	343	[g/dL]
RDW-CV	12.5	[%]
PLT		
MPV		
PdW		[10 ⁹ /L]
Differential		
NEUT	3.47	[10 ⁹ /L]
LYMPH	1.96	[10 ⁹ /L]
MONO	0.31	[10 ⁹ /L]
EO	0.11	[10 ⁹ /L]
BASO	0.02	[10 ⁹ /L]
IG	0.01	[10 ⁹ /L]
NRBC	0.0	[/100WBC]

Fig. 8.3

Cholesterol test: This test measures the amount of cholesterol in the blood. Cholesterol is found in many dietary sources such as animal fats, oils, egg yolks, and milk. Normal values are 120-200 mg/dL, and high levels are associated with blockage of arteries and heart disease.

Key Concept

When assessing cholesterol, the following factors are measured:

- **High-density lipoprotein (HDL):** HDL is desirable because it removes excess cholesterol from peripheral tissues and carries it to the liver for removal or use.
- **Low-density lipoprotein (LDL):** LDL is called “bad cholesterol” because it can contribute to atherosclerosis by depositing excess cholesterol in the walls of blood vessels.
- **Triglycerides:** This is a measurement of circulating triacylglycerols, and increased triglyceride levels may suggest endocrine deficiencies or metabolic defects.
- **Total cholesterol:** This measurement takes into account various forms of cholesterol in circulation. It is the total HDL, LDL, and 20% of the triglyceride measurement.

Creatine kinase (CK) test: Creatine kinase is a blood enzyme normally found in heart muscle, brain tissue, and skeletal muscles. A blood test to check the level of CK can show whether there has been damage to the heart, skeletal muscles, brain, and sometimes other parts of the body (Government of Alberta, 2022).

Creatinine test: This test measures the amount of creatinine, a nitrogen-containing waste material, in blood serum or plasma and is the most commonly used test for kidney function. Creatinine is normally produced as a protein breakdown product in muscle and is excreted by the kidneys in urine. Creatinine levels are a good indicator of how the kidneys are (or are not) working.

Creatinine clearance test: This test measures the rate at which creatinine is filtered from the blood by the kidneys (Cleveland Clinic, 2022). It is used to assess kidney function by comparing the levels of creatinine in urine and in blood. Low levels indicate that the kidneys are not functioning effectively enough to clear creatinine from the bloodstream and then filter it into the urine. Abnormal levels of creatinine could possibly be a sign of kidney failure (Cleveland Clinic, 2022).

Culture: For a culture test, bodily fluids are taken and cultured in the lab to determine whether bacteria, viruses, or fungi are present. Swabs are often used to take samples of bodily fluids from various areas of the body, including the nose, groin, rectum, mouth, and any wounds. The sample is then sent to the lab, and a substance is added to it to increase the growth of bacteria, fungi, or viruses. Some substances grow within a couple days, but others, such as fungi, take longer. If nothing grows, then the culture is negative, but when something does, the growth is analyzed through a microscope to determine what type of virus, bacteria, or fungus is present (Doyle & McCutcheon, 2020). Fig. 8.4 and Fig. 8.5 show examples of cultures and the manner in which growth can appear. The different colours and patterns are indicative of different bacteria, viruses, or fungi.

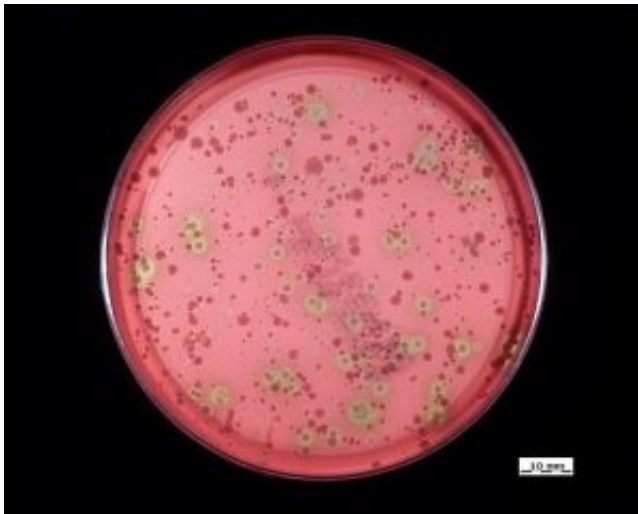


Fig. 8.4

Culture and sensitivity (C&S): This test is similar to the culture test but includes a sensitivity component as well. Sensitivity testing determines the best course of treatment for whatever virus, bacteria, or fungus is present. For example, when bacteria is present, the sensitivity test would determine the best antibiotic to use to treat the infection (Carter & Rutherford, 2020).

Electrolyte panel: This test measures the levels of major electrolytes in the body.

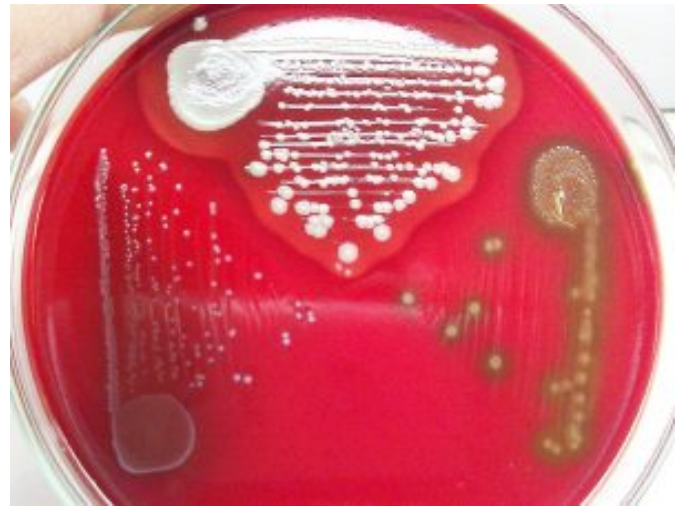


Fig. 8.5

Key Concept

The main components of an electrolyte panel are listed below:

- **Sodium** is vital to many normal body processes, including nerve and muscle function. Low sodium levels (**hyponatremia**) can be suggestive of illness, diarrhea, or malnutrition. On the other hand, high sodium levels (**hypernatremia**) are often caused by dehydration or endocrine disorders such as Cushing's syndrome or diabetes insipidus.
- **Potassium** is critical for the heart to work effectively. High or low potassium levels are often a result of unmanaged diabetes.
- **CO₂ (carbon dioxide, bicarbonate)** is produced from several oxidative pathways and is removed in the

form of bicarbonate or through hemoglobin transport. High CO_2 could suggest a renal, respiratory, and/or metabolic concern.

- **Chloride** is a negatively charged ion that works with the other electrolytes listed above to help regulate both fluid and the acid-base (pH) balance in the body.

Glucose test: This test measures the level of glucose in the blood. Blood glucose levels can be assessed via blood work, at home by the patient, or in the hospital by a nurse at the bedside. Patients with diabetes require regular monitoring of their blood glucose to help them achieve close-to-normal blood glucose levels for as much of the time as possible (Doyle & McCutcheon, 2020). The benefits of maintaining a blood glucose level that is consistently within the range of 4–7 mmol/L will reduce the short-term, potentially life-threatening complications of low blood sugar (**hypoglycemia**) and the severity of the long-term complications of high blood sugar (**hyperglycemia**) (Doyle & McCutcheon, 2020). Fig. 8.6 and Fig. 8.7 show a person taking their own blood sample for glucose testing. Similar, though more complicated, glucose-testing machines can be found on hospital units for nurses to test patients' blood sugar.



Fig. 8.6



Fig. 8.7

Fasting blood sugar (FBS): This test is similar to the glucose test, but it is done first thing in the morning before the person eats or drinks anything that day. This provides a good indication of how the person's body maintains glucose levels.

Glucose tolerance test (GTT): This test assesses how well a person's body can maintain blood glucose levels when sugar is introduced into their diet. The person's blood sugar is checked first thing in the morning, before they eat, and then they ingest a high-sugar drink. After a period of time, their blood sugar is reassessed. Pregnant women are often asked to take this test to assess for gestational diabetes.

Hematocrit: The hematocrit test measures the percentage red blood cells in a sample of whole blood. It determines how much of a person's blood is made up of red blood cells (Carter & Rutherford, 2020).

Human chorionic gonadotropin (hCG): The hormone hCG creates a suitable environment for a developing embryo during pregnancy. A pregnant woman's body increases production of this hormone, and hCG accumulates in the

maternal bloodstream and is excreted in the urine. Detection of hCG can be done through a urine sample, and exact levels can be accessed via a blood test (Betts et al., 2013).

International normalized ratio (INR): This blood test is used to monitor the therapeutic effects of warfarin, an anticoagulant (Ernstmeyer & Christman, 2020).

Prostate specific antigen (PSA): PSA is a protein produced by normal cells of the prostate gland, and this test measures the level of PSA in the blood. The blood level of PSA is often elevated in men with prostate cancer (National Cancer Institute, 2022).

Platelet count: This test measures the number of platelets in a blood sample (Healthline, 2021).

Prothrombin time (PT): This blood test measures how long it takes for a patient's blood to clot. Similar to the INR test, PT is used to monitor the effects of warfarin in preventing clot formation (Ernstmeyer & Christman, 2020).

Partial thromboplastin time (PTT): This blood test is used to monitor how long it takes for a patient's blood to clot but focuses on the effectiveness of anticoagulant therapies. It is used to determine whether therapeutic ranges have been achieved (Ernstmeyer & Christman, 2020).

Red blood cell count (RBC): This test measures the amount of red blood cells in a blood sample (Healthline, 2021).

Fecal occult blood test: This is a test for blood in a fecal sample. A small amount of fecal output is put onto a card, and the sample is viewed under a microscope to look for blood (Carter & Rutherford, 2020). Fig. 8.8 below shows an example of the card that is used for analysis.



Fig. 8.8

Stool culture: In this test, a small fecal sample is collected and analyzed for abnormal bacterial growth using a culture test (Carter & Rutherford, 2020).

Thyroid function test: This test assesses the concentration of various endocrine hormones in the blood (Betts et al., 2013).



Fig. 8.9

Troponin test: This test measures the level of troponin in the blood. The presence of troponin indicates heart injury and is used to determine whether a patient has experienced a heart attack.

Uric acid test: High levels of uric acid in a blood test indicate that the patient may have gout. Gout is a form of arthritis caused by uric acid crystals deposited in a joint, often the big toe (Betts et al., 2013).

Urinalysis (U/A): A urine sample can be assessed by placing a dipstick into the sample (Fig. 8.10) or analyzed in the lab (Fig. 8.11).



Fig. 8.10



Fig. 8.11

Key
Concept

Urine samples can be assessed for many different components, including the following:

- **Specific gravity (SG):** Specific gravity indicates how concentrated the urine is.
- **pH:** Urine is typically slightly acidic, about pH 6, but can range from pH 4.5 to 8.
- **Protein:** An estimate of the amount of albumin in the urine; normally, there should be no protein or just a small amount of protein in the urine.
- **Glucose:** The presence of glucose in urine is called glucosuria and can result from an excessively high glucose level in the blood, such as may be seen in individuals with uncontrolled diabetes.
- **Ketones:** Ketones are intermediate products of fat metabolism and can be produced when an individual does not eat enough carbohydrates, such as in fasting conditions or when eating a high-protein diet; ketones are not normally found in urine.
- **Hemoglobin and myoglobin:** The presence of hemoglobin in a urine sample indicates blood in the urine

(hematuria); a small number of RBCs are normally present in urine, but an increased amount give a positive test result.

- **Leukocyte esterase:** This enzyme is present in most white blood cells (WBCs), and few white blood cells are normally present in urine; however, a significant number of WBCs in urine may indicate inflammation in the urinary tract or kidneys.
- **Nitrite:** Some types of bacteria convert nitrate, which is normally present in urine, to nitrite, which is not normally present.
- **Bilirubin:** Bilirubin is not present in the urine of healthy individuals, and its presence is an early indicator of liver disease.
- **Urobilinogen:** This substance is normally present in urine in low concentrations, but a positive test result may indicate liver disease such as viral hepatitis, cirrhosis, or liver damage from drug use or toxic substances, or conditions such as hemolytic anemia.

Urine for culture and sensitivity: This test involves taking a urine sample to the lab to be cultured in order to detect and identify bacteria in the urine. If bacteria are present, then a sensitivity test is completed (Carter & Rutherford, 2020).

24-hour urine collection: In this test, all urinary output is collected over a 24-hour period. The analysis of urinary output over this extended period of time provides a greater indication of normal or abnormal kidney function (Carter & Rutherford, 2020).

White blood cell count (WBC): This test measures the amount of white blood cells in a blood sample.

Exercise



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8.3 Diagnostic Imaging: Radiology

The Origins of X-Rays

In 1895, German physicist Wilhelm Röntgen was experimenting with electrical current when he discovered that invisible “rays” could pass through his flesh and leave an outline of his bones on a screen coated with a metal compound (Betts et al., 2013). He then made the first record of the internal parts of a living human with an image of his wife’s hand. This record eventually became known as an “X-ray.” Once this discovery was made, advancements came quickly, and by 1900, X-rays had become widely used. They could detect a variety of injuries and diseases, which led to great advancements in patient care and outcomes (Betts et al., 2013). Fig. 8.12 and Fig. 8.13 show some of the early X-rays taken by Röntgen.



Fig. 8.12

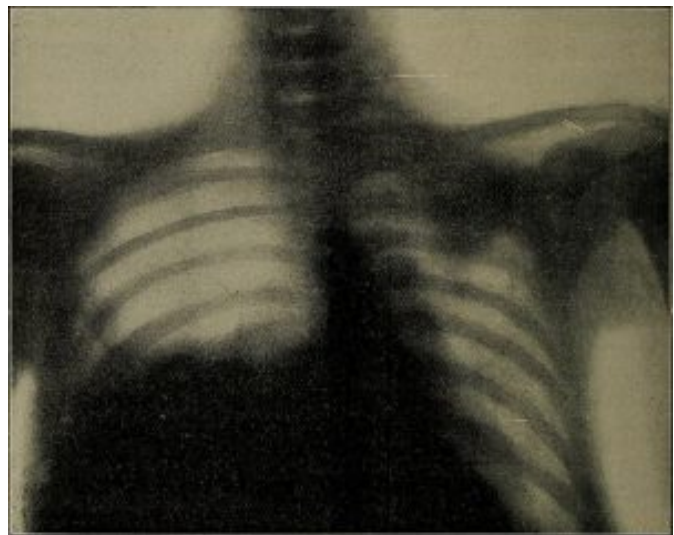


Fig. 8.13

Modern Use of X-Rays

The use of X-rays is commonplace in health care today, and most people have had at least one X-ray (Betts et al., 2013). Even though they are very common, most of us do not know how X-rays work. X-rays are emitted from a specialized machine that directs the rays through a particular part of the body and toward a specially treated metallic plate. The beam of radiation from the X-ray machine results in darkening of the X-ray plate (Betts et al., 2013). Different tissues show up as different shades; X-rays are only slightly impeded by soft tissues, which show up as varying shades of grey, whereas hard tissues, such as bone, block the rays and appear white. Metal and contrast dyes also appear white. Structures containing air will look black. As a result, X-rays are best used to visualize hard body structures such as teeth and bones (Betts et al., 2013).

X-rays can depict a two-dimensional image of any body region but only from a single angle (Betts et al., 2013). If a

more detailed or three-dimensional image is needed, then another form of test would be indicated and these will be discussed later in the chapter. The two figures below show examples of both portable (Fig. 8.14) and stationary (Fig. 8.15) X-ray machines.



Fig. 8.14

Specific Types of X-Rays

A selection of different

types of X-rays and specialty tests are discussed below. They are, of course, not all the possible tests, but they will give you a foundation of knowledge of the common types of X-rays that are key aspects of patient care in a medical setting.

Chest X-ray (CXR): This is a very common form of X-ray and can be used in cases of trauma, pain, or illness. A CXR can help diagnose infections such as pneumonia or an accumulation of fluid such as pleural effusion. It can be very helpful in treating various forms of trauma; for example, in Fig. 8.16, the patient was stabbed with a knife. Fig. 8.17 shows a patient who has an implanted defibrillator but no other anomalies.



Fig. 8.15

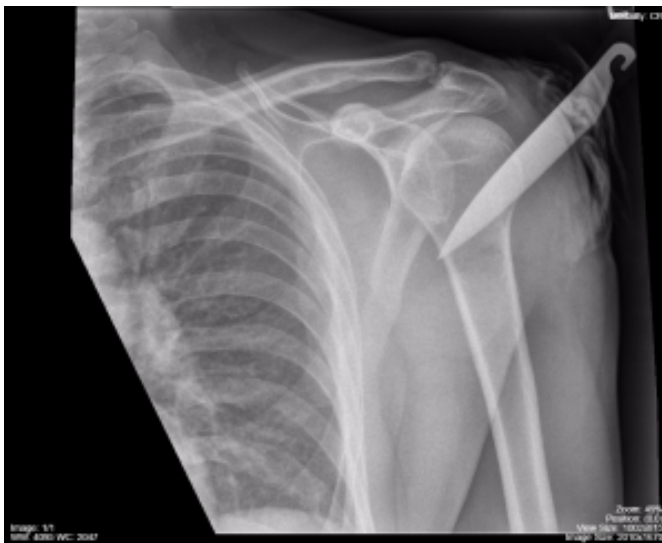


Fig. 8.16

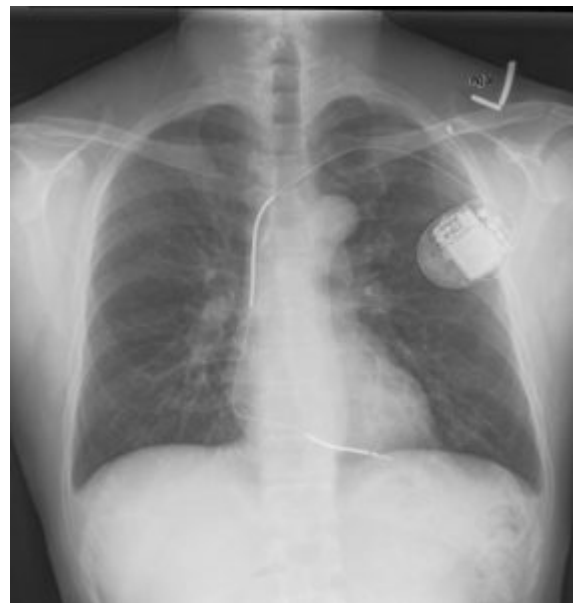


Fig. 8.17

Computed tomography (CT): A CT is a type of X-ray that shows images in cross-section, which provides much more detail and helps to assess a patient. Although not always used, contrast material (dye) can be injected into the bloodstream to highlight structures; for example, for a liver CT. During a CT, the patient lies on a horizontal table, and the X-ray tube, which is in a ring assembly, spins around the patient, as can be seen in Fig. 8.18. Fig. 8.19 shows an example of a CT scan.



Fig. 8.18



Fig. 8.19

Barium (Ba) tests: To better visualize internal organs, some X-rays use a contrast medium called barium that is swallowed or given to the patient in the form of an enema. When tissues are very similar in appearance to the structures around them, the barium helps differentiate them. Malignant tissues, for example, often display differently when contrast is used compared to normal tissues. Fig. 8.20 is an example of an X-ray with barium contrast.

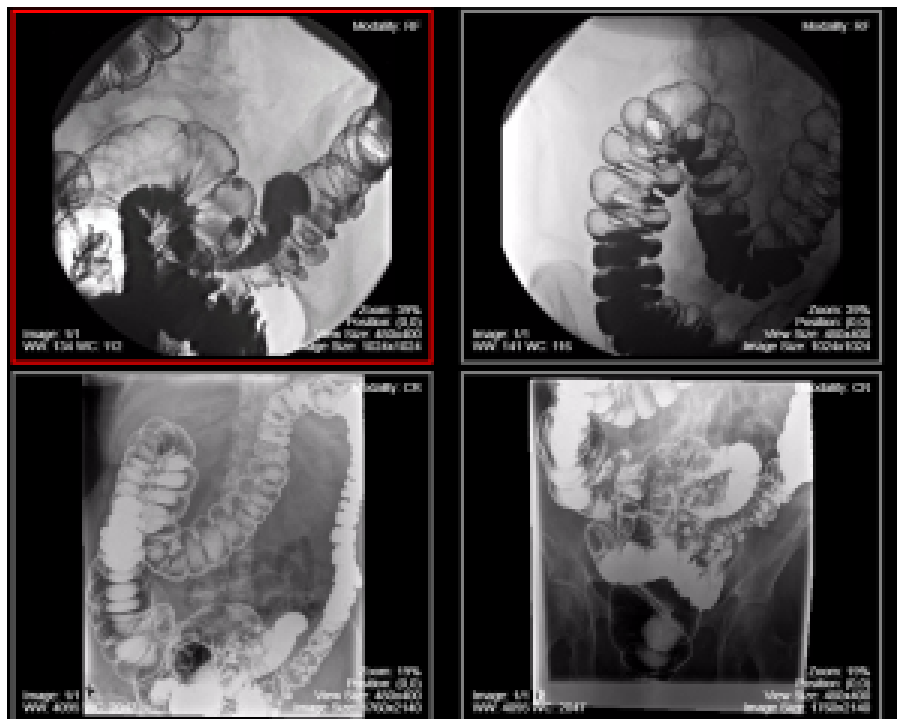


Fig. 8.20

Key Concept

Barium is just one type of contrast medium. There are a number of different forms of imaging contrast (gas, liquid, suspension) that can be delivered by mouth, per rectum, or via intravenous or intraarterial routes. Each delivery mode has unique uses and applications in diagnostic imaging.

Mammography: This test creates images by passing X-rays through breast tissue. Mammography is predominantly used to image female breast tissue, as can be seen in Fig. 8.22, but it is also capable of imaging male breast tissue to assess a palpable nodule or mass. This test is often ordered as part of a regular health screen, as well as in cases where anomalies, such as cysts or tumours, may be present. Fig. 8.21 shows the machine used to take mammograms, and Fig. 8.22 is a mammogram image.



Fig. 8.21

Endoscopic retrograde

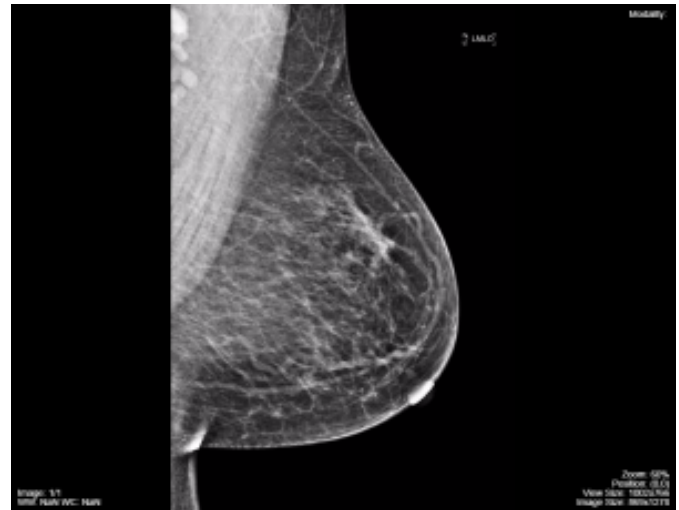


Fig. 8.22

cholangiopancreatography (ERCP): An ERCP is a complex procedure that combines an upper gastrointestinal endoscopy and an X-ray (NIDDK, 2016). It is used to diagnose and treat issues in the bile and pancreatic ducts. Fig. 8.23 shows the procedure being performed, and Fig. 8.24 is an example of how a scan would look when completed.

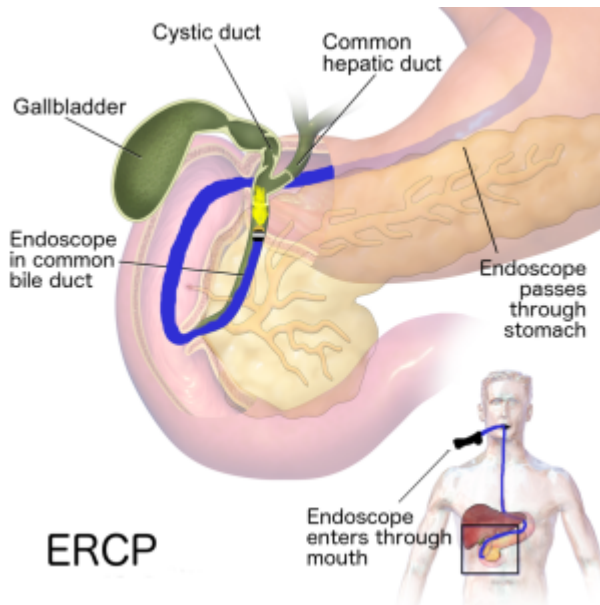


Fig. 8.23



Fig. 8.24

Urography: This test is used to evaluate the kidneys, ureters, and bladder. It can be used to diagnose anomalies such as cancer and assist with assessing patients experiencing abnormal urinary symptoms such as hematuria. Urography is very similar to a **kidney, ureters, bladder (KUB) X-ray**, which also provides imaging of the organs and structures of the urinary and gastrointestinal systems. Fig. 8.25 and Fig. 8.26 show examples of urograms.



Fig. 8.25

Fluoroscopy: This test uses live X-rays to visualize anatomic structures. It is best used to depict active physical movements, including intestinal peristalsis or swallowing; for example, an esophogram and upper gastrointestinal series.



Fig. 8.26

Fluoroscopy is shown in the video below, which shows a patient swallowing barium sulphate and gas-forming granules. The barium can be seen moving down the esophagus and digestive tract while the gas rises to the highest point of the intestinal tract based on the patient's position. The barium and gas help outline the inner lining of the esophagus and the intestines.



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Video credit: Burbridge, B. (n.d.). Fluoroscopy of the pharynx and upper esophagus [Video]. In E. Mah & B. Burbridge, Undergraduate Diagnostic Imaging Fundamentals: Chapter 3: Fluoroscopy. University of Saskatchewan. <https://openpress.usask.ca/app/uploads/sites/34/2019/02/3.17-Fluoroscopy-cine-2.mp4>, licensed under [CC-BY-NC-SA 4.0](#)

Angiography: This test uses a fluoroscopy unit with advanced features, including software applications to assist with complex arterial and body interventional procedures beyond the capabilities of a normal fluoroscopy unit. Fig. 8.27 shows an angiography machine, and Fig. 8.28 provides an example of a cardiac angiogram.



Fig. 8.27

Key
Concept



Fig. 8.28

Cardiac catheterization (often called **cardiac cath** or **coronary angiogram**) involves

placing a very small, flexible catheter into a blood vessel in the groin, arm, or neck (Johns Hopkins, 2022). The catheter is then passed through the blood vessel into the aorta and into the heart. Once the catheter is in position, several tests may be done, including measuring the pressure within the heart chamber, recording oxygen levels, and taking blood samples (Johns Hopkins, 2022). Contrast dye can be injected to check blood flow, while X-rays are used to assist with visualization.

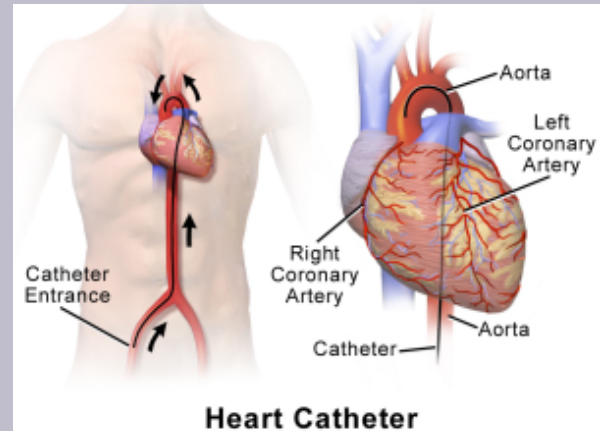


Fig. 8.29

Exercises



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8.4 Diagnostic Imaging: Nuclear Medicine, Ultrasound, and MRI

This section will discuss other common forms of diagnostic imaging. The physician's choice of which type of imaging will be used for a particular patient is determined by the patient's condition, history, need, and the availability of testing. For example, not all hospitals will be able to offer an MRI or nuclear medicine. Three of the more common types of imaging, other than radiology, are discussed in detail below, and examples of scans are provided.

Nuclear Medicine



Fig. 8.30

Nuclear medicine tests and procedures have one main commonality—the use of a radioactive substance to enhance the scan. The patient is injected with a radioactive pharmaceutical agent and becomes the source of the radiation required to produce the nuclear medicine images. The pharmacologic agent concentrates in different organs and tissues based on the patient's physiology and the components of the agent. Fig. 8.30 is an image of a nuclear medicine scanner in a hospital. After the patient is injected with the radioactive pharmaceutical agent, they lie on the machine's table in a supine position while the machine detects the emitted radiation.

A number of areas of the body can be assessed using radioactive substances to enhance the images; for example, a **thyroid scan**, shown in Fig. 8.31, is a common procedure. For **bone scans**, the radioactive substance technetium-99m is used because it contains diphosphonate, which interacts physiologically with living bone. As a result, when the scan is done, radioactivity is shown as arising from the patient's bones. Fig. 8.32 shows an example of a pediatric bone scan. Similarly, a **renal scan** shows the kidneys, ureters, and bladder as the pharmacologic agent is metabolized and concentrated in these tissues. **Lung scans** can be done to provide a better understanding of any pathology that may be present in a patient's respiratory system.

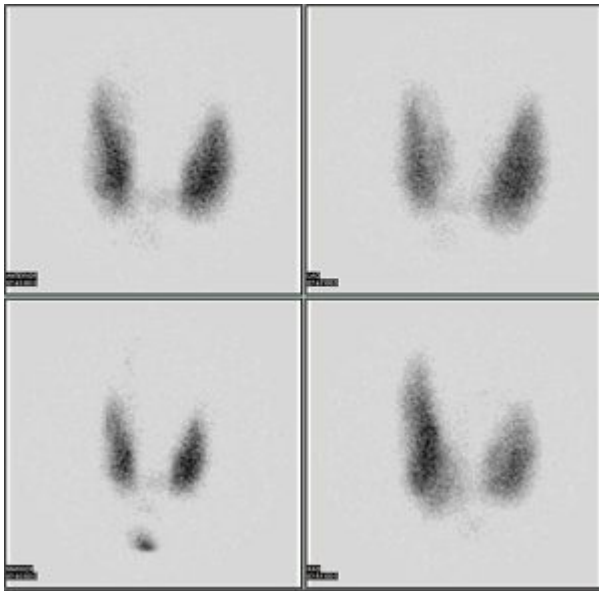


Fig. 8.31

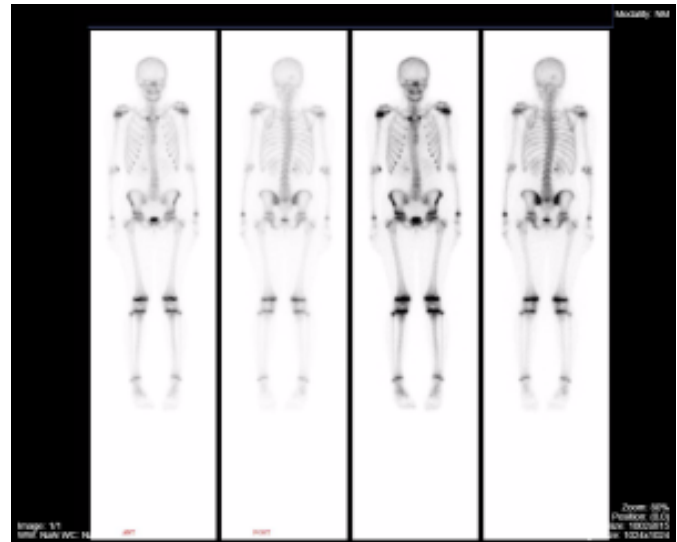


Fig. 8.32

A **multigated acquisition scan (MUGA)** is a diagnostic test used to evaluate the pumping action of the ventricles of the heart (Cleveland Clinic, 2022). Similar to the tests mentioned above, a small amount of radioactive tracer is injected into a patient's vein, then a technician uses a camera to detect the radiation that is released by the tracer. This results in computer-generated, movie-like images of the beating heart. This test results in a very detailed record of the heart's pumping function (Cleveland Clinic, 2022). Fig. 8.33 is an example of a MUGA scan.

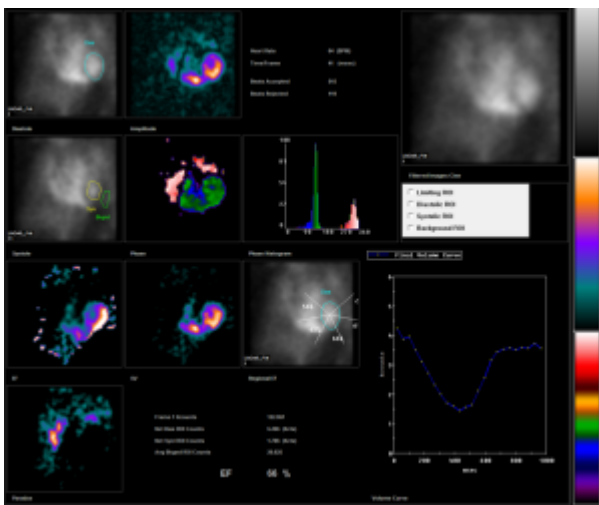


Fig. 8.33



Fig. 8.34

A **positron emission tomography (PET)** scan is an imaging test that is used to reveal the metabolic or biochemical function of tissues and organs (Betts et al., 2013). The PET scanner (Fig. 8.34) also uses a radioactive substance to show both normal and anomalous metabolic activity. PET scans

are often used to diagnose conditions such as heart disease, the spread of cancer, certain forms of infection, brain abnormalities, bone disease, and thyroid disease (Betts et al., 2013).

Positron emission tomography – Computed tomography (PET-CT) is a combination of PET and CT scans. It provides a simultaneous CT scan while the PET scan is being completed (Betts et al., 2013). The appeal of this approach is that it is possible to overlay (fuse) one image with the other to match the activity level of positron emission with the anatomy seen on the CT. Fig. 8.35 and Fig. 8.36 show different forms of PET-CTs, though both are examples of patients with multiple lymphomas.



Fig. 8.35

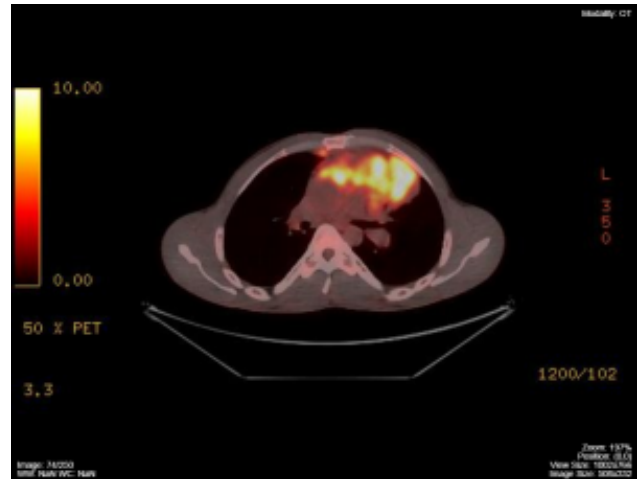


Fig. 8.36

Ultrasound

A majority of the general population has likely had an ultrasound or knows someone who has. Often we think of pregnancy when discussing ultrasounds; however, this type of imaging can be used for many other physiological functions as well. For diagnostic purposes, ultrasounds are used for most parts of the human body. They can assist with studying heart function, blood flow in the neck or extremities, certain conditions such as gallbladder disease, and fetal growth and development.

Ultrasounds rely on high-frequency, inaudible sound arising from a hand-held transducer, or probe, to create images. The transducer emits ultrasounds roughly 5% of the time, then listens for the returning echoes 95% of the time. An acoustic gel is used to help facilitate ultrasound transmission when it is applied to the probe and to the patient's skin to minimize the air-gap between the probe and the skin. The main disadvantages of ultrasound imaging are that the image quality is heavily operator-dependent and that ultrasounds are unable to penetrate bone and gas. Fig 8.37 shows an example of a technician performing an ultrasound on a patient, and Fig. 8.38 is an example of a gallbladder ultrasound.



Fig. 8.37

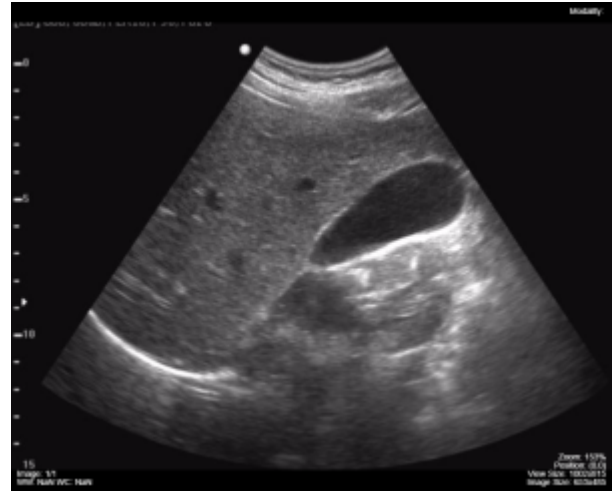


Fig. 8.38

Doppler ultrasound can analyze flowing fluids, the presence of blood clots, and determine whether there is a frequency shift over the length of a structure. Colour can also be applied to the image to represent the direction of blood flow. Blood flowing toward the transducer is orange-red, and blood flowing away is blue. The varying colours in Doppler ultrasounds can be seen in Fig. 8.39 and Fig. 8.40.

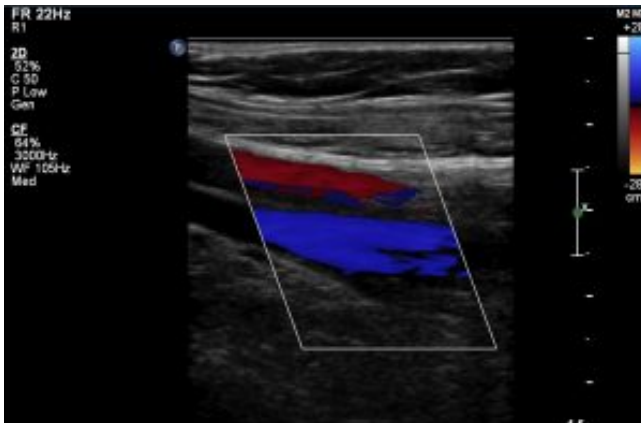


Fig. 8.39

An

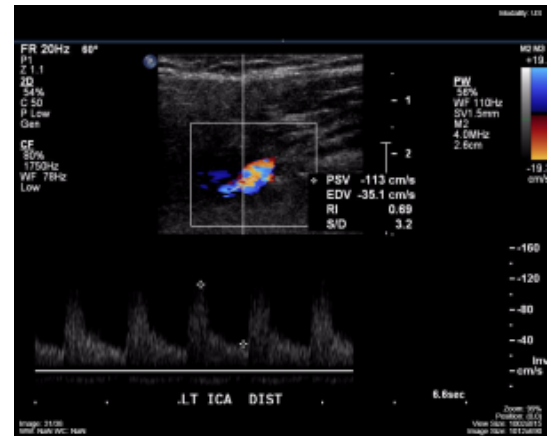


Fig. 8.40

echocardiogram is a type of sonogram that may be ordered if a vascular disorder is suspected. It is a combination of an ultrasound that monitors blood flow and electrodes that monitor heart rhythm. Abnormal heart sounds can indicate a valve or septal disorder, and an echocardiogram can assist with diagnosis.

Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging (MRI) is a noninvasive medical imaging technique based on nuclear magnetic resonance discovered in the 1930s; matter exposed to magnetic fields and radio waves emits radio signals that can be converted to images (Betts et al., 2013). In 1970, a physician named Raymond Damadian noticed that **malignant** tissue gave off different signals than normal body tissue. He applied for a patent for the first MRI scanning device, which was in use clinically by the early 1980s (Betts et al., 2013). The early MRI scanners were crude and basic, but advances in digital

computing and electronics led to advancements in MRIs, which resulted in them becoming the most precise technique for medical imaging, especially to discover tumours. Fig. 8.41 shows an MRI machine, and Fig. 8.42 is a detailed MRI scan of the lumbar spine, which demonstrates the detail available with this form of imaging. MRI also has the significant advantage of not exposing patients to radiation. The drawbacks of MRI scans include their much higher cost and patient discomfort with the procedure (Betts et al., 2013).



Fig. 8.41



Fig. 8.42 lumbar spine

The MRI scanner subjects the patient to such powerful electromagnets that the scan room must be shielded (Betts et al., 2013). The patient must also be enclosed in a metal tube-like device for the duration of the scan, which can sometimes be as long as 90 minutes, and can be uncomfortable and impractical for very ill patients (Betts et al., 2013). The device is also very noisy so that, even with earplugs, patients can become anxious. This problem has been partially overcome with the development of “open” MRI scanning, which does not require the patient to be entirely enclosed in the metal tube. Patients with iron-containing metallic implants, such as internal sutures and prosthetics, cannot undergo MRI scanning because it can dislodge these implants (Betts et al., 2013).

Functional MRIs (fMRIs), which can detect the concentration of blood flow in certain parts of the body, are increasingly being used to study the activity in parts of the brain during various body activities. This technology helps us learn more about the locations of different brain functions and about brain abnormalities.

Exercise



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8.5 Diagnostic Imaging: Example Scans

This section will provide some extra examples of diagnostic imaging scans. They are included purely to add to your knowledge about diagnostic imaging that you have already learned about in this chapter. They are also provided for those with interest in seeing and learning more detail about diagnostic imaging scans.

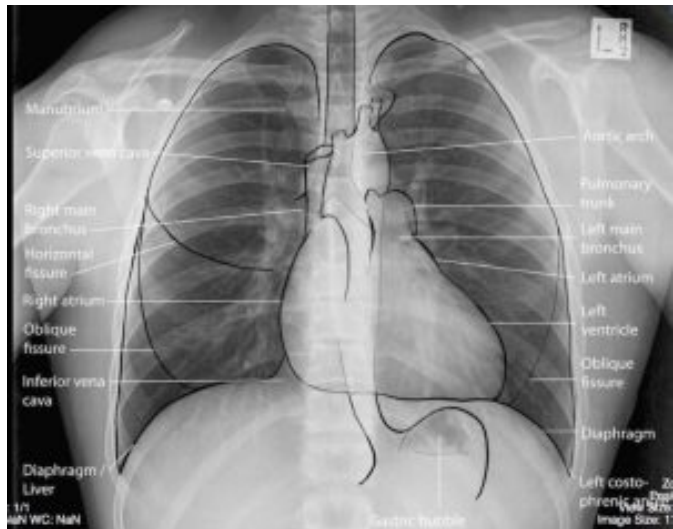


Fig. 8.43

The two images above are chest X-rays (CXR) with an outline added to emphasize the normal physiological structures.

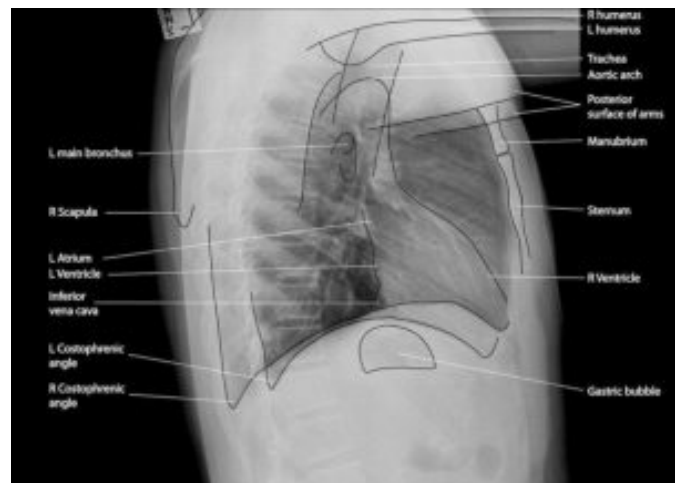


Fig. 8.44



Fig. 8.45

Fig. 8.45 is a chest X-ray (CXR) of a patient with an enlarged aortic knob—the enlarged white area at the top of the chest. Fig. 8.46 is a CXR of a patient with an enlarged heart.



Fig. 8.46

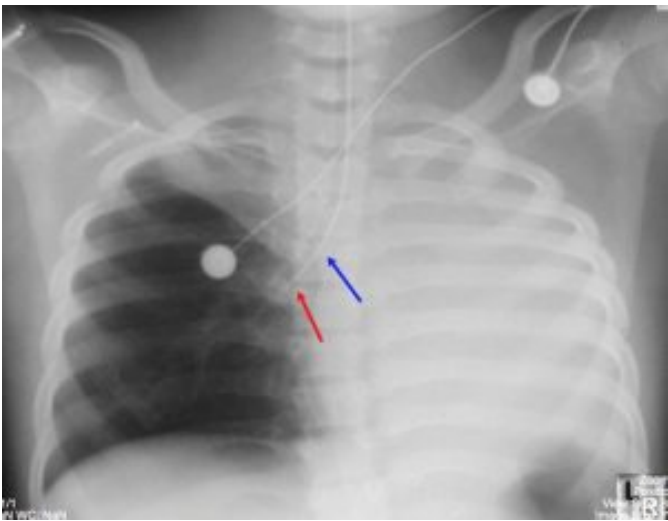


Fig. 8.47

Both images above show patients with atelectasis, a fully or partially collapsed lung. In Fig. 8.47, one lung is fully collapsed (the white area), and in Fig. 8.48, the lower portions of both lung are collapsed.

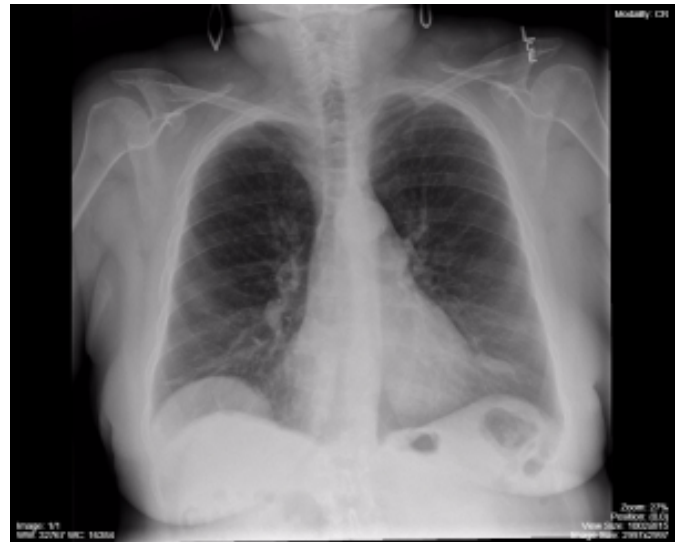


Fig. 8.48



Fig. 8.49

In Fig. 8.49, the patient has large bilateral pleural effusions, a build-up of fluid in the lungs.

The two images below show normal abdominal X-rays; Fig. 8.50 also includes the four abdominal quadrants written on the X-ray. These can then be compared to Fig. 8.52 and 8.53 that show abdominal X-rays of a patient with generalized bowel dilation. Fig. 8.54 which also shows a normal abdominal X-ray; however, you can see the presence of artifacts—a bellybutton piercing and buttons on the patient's clothing. Finally, Fig. 8.55 shows a patient with toxic megacolon.

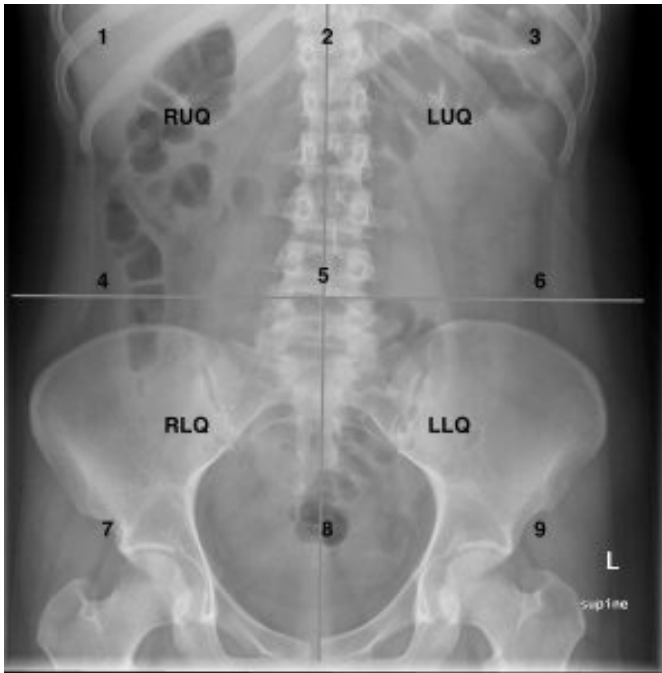


Fig. 8.50



Fig. 8.51



Fig. 8.52



Fig. 8.53



Fig. 8.54



Fig. 8.55



Fig. 8.56



Fig. 8.57

The two figures above are of the same pediatric patient. You can see that the child has

swallowed a foreign object.

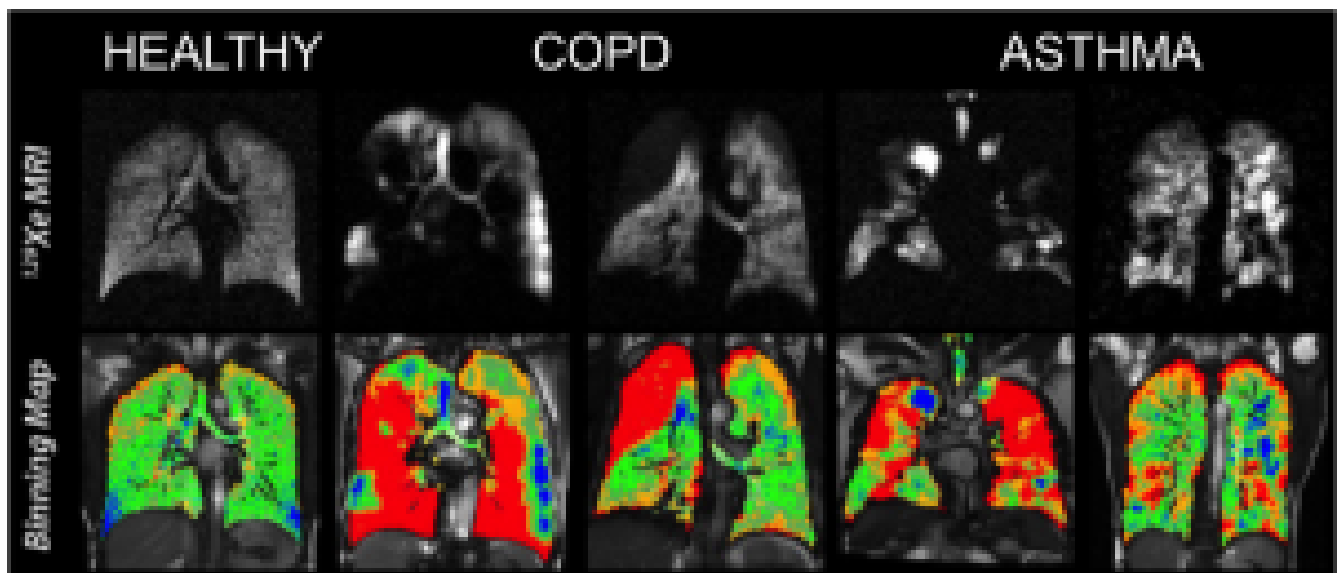


Fig. 8.58

Fig. 8.58 is an MRI showing the difference between healthy lungs, COPD lungs, and lungs affected by asthma.

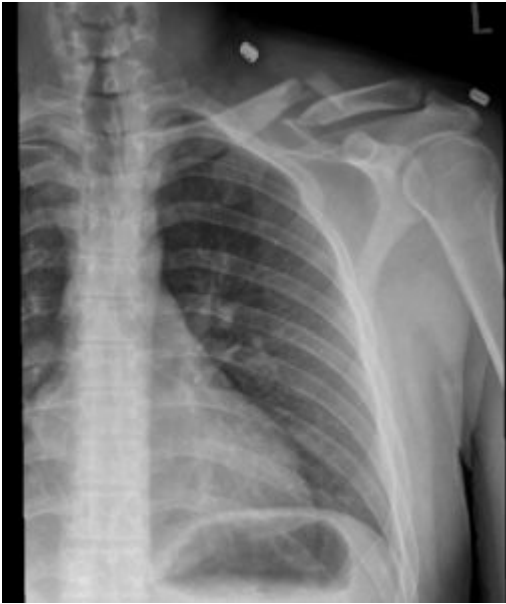


Fig. 8.59



Fig. 8.60

Both images above are of the same patient.

Fig. 8.59 is of the patient's left shoulder pre-operatively with a clavicle fracture; the second image shows the patient post-op with the fracture repaired.



Fig. 8.61



Fig. 8.62

The two figures above are also of the same patient. Fig. 8.61 is an X-ray of the pelvis pre-operatively for a fixation of a pelvic fracture; Fig. 8f.62 shows the patient post-op with the fracture repaired.



Fig. 8.63

Fig. 8.63 shows a pediatric patient with a bullet in their arm, and Fig. 8. 64 is an X-ray of a patient with facial trauma. The final image below is a full-body X-ray of a patient with bilateral femur fractures.



Fig. 8.64



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8.6 Clinical Tests and Procedures

A vast number of clinical tests and procedures are carried out in medical settings every day. This section will focus on the most common ones done in a hospital on a day-to-day basis and are used, in some way, for diagnostic purposes. Although a number of other clinical procedures can be performed, especially on more specialized units in a hospital, those discussed below are a good representation of the clinical tests and procedures you will likely see in your future medical career. Fig. 8.66 and Fig. 8.67 show doctors performing physical examinations on patients.



Fig. 8.66



Fig. 8.67

Amniocentesis: In this procedure, a physician takes a sample of amniotic fluid from a pregnant woman. Not all pregnancies require this test; it is performed to determine whether the fetus has any chromosomal disorders. Amniocentesis may be suggested as an option for a patient if such disorders are suspected or if the patient is over a certain age because that can increase the risk that the fetus may present with a chromosomal disorder. The physician uses a syringe guided by an ultrasound, as shown in Fig. 8.68, to take a sample of amniotic fluid, which is then sent to the lab for analysis.

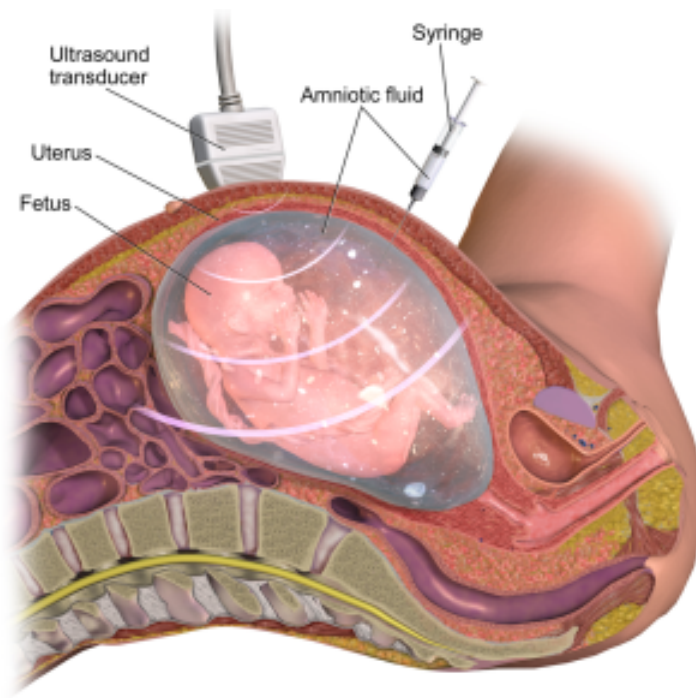


Fig. 8.68

Arthrocentesis: In this test, a syringe is used to remove fluid from a joint. Possible reasons for this procedure would be to test the fluid or to remove fluid that may be causing the patient discomfort (Carter & Rutherford, 2020).

Aspiration: This medical procedure involves the removal of something from the body (NLM, 2022). The substance may vary; however, it could potentially be body fluids, part of a bone, or air. Aspiration is used when a physician performs a biopsy and is the act of using a needle to withdraw a sample to be sent to the lab.

Auscultation: This test involves placing a stethoscope over a part of the body, most often the lungs, heart, or abdomen, and listening for either the lack of sounds or appropriate sounds for that area. Heart sounds can be heard with a classic stethoscope, but with a cardiac stethoscope, as shown in Fig. 8.69, it is also possible to hear the opening and closing of valves within the heart. Listening to lung sounds can determine whether there is equal air entry to both lungs and whether or not fluid is present. Finally, the abdomen can be assessed to determine whether there are bowel sounds, or a lack thereof, which could indicate the absence of movement through the gastrointestinal tract.



Fig. 8.69

Biopsy (Bx): This procedure involves taking a sample of material from the body and sending it to the lab for analysis. Biopsies are often completed to determine whether a growth is cancerous or benign. Fig. 8.7 explains how a liver biopsy is performed, and Fig. 8.71 shows a sample obtained from a biopsy.

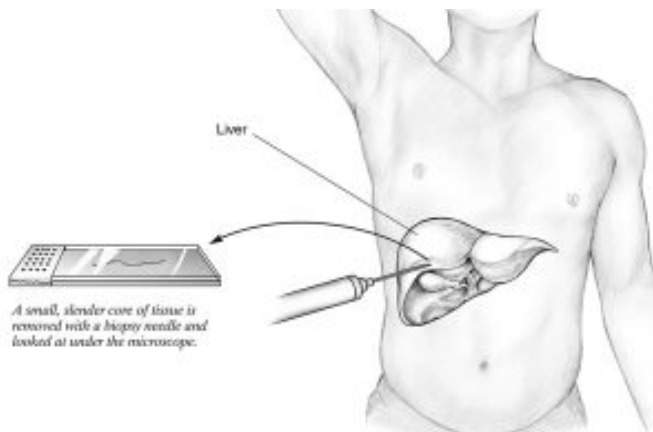


Fig. 8.70



Fig. 8.71

Key Concept

A **bone marrow biopsy** is a specific type of biopsy that involves taking a sample of bone marrow (Carter & Rutherford, 2020). Often, this is used in the diagnosis and treatment of various severe forms of anemia, such as **thalassemia major** and **sickle cell anemia**, as well as some types of cancer, specifically **leukemia**. The instruments used to obtain a bone marrow sample are shown in Fig. 8.72, and Fig. 8.73 shows the procedure and the area of the body that the sample is typically taken from.



Fig. 8.72

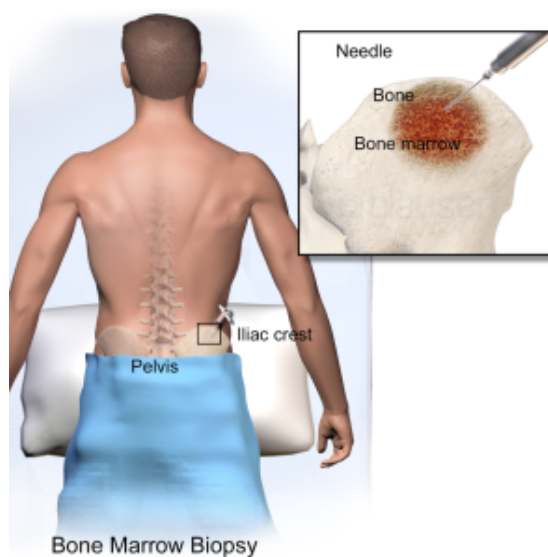


Fig. 8.73

Bronchoscopy: This procedure involves visualization of trachea and bronchi with a bronchoscope. Some common reasons for a bronchoscopy include chronic cough, infection, or an anomaly on a chest X-ray or other scan (Johns Hopkins, 2022). Bronchoscopies can also be used to take samples or remove foreign objects from the airway (Carter & Rutherford, 2020).

Colonoscopy: In this procedure, a colonoscope is used to visualize the large intestine and rectum. A colonoscopy may be recommended for patients who have unexplained weight loss, abdominal pain, changes to bowel movements, or bleeding from the anus (NIDDK, 2017). This procedure can also be beneficial for cancer and polyp screening.

Cystoscopy: This procedure is completed with a cystoscope and, as shown in Fig. 8.74, involves visualizing the bladder. The cystoscope is inserted via the urethra and passed into the bladder (NHS, 2022). This test is used to check for bladder and urethral issues. The images appear similar to what is seen in Fig. 8.75. Patients may have this procedure if they experience hematuria, recurrent urinary tract infections, pelvic pain, or difficulty urinating. Biopsy samples can also be taken during the cystoscopy, and bladder stones may also be removed (Carter & Rutherford, 2020).

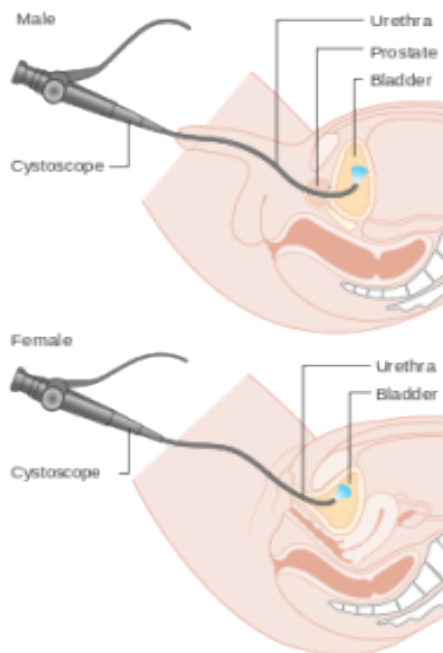


Fig. 8.74

Digital rectal exam (DRE): In this procedure, a physician palpates the

prostate to check for masses or anomalies. This is often done in conjunction with a **prostate-specific antigen (PSA) test** to assess for prostate cancer (Carter & Rutherford, 2020).

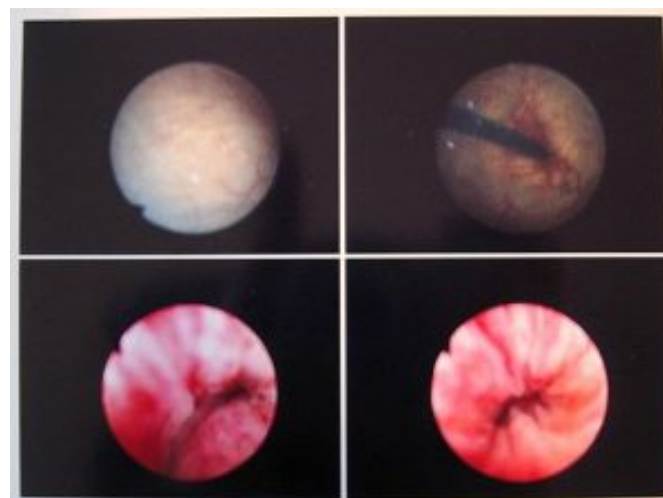


Fig. 8.75

Electrocardiogram (ECG): This procedure can be performed by various medical professionals, including technicians, nurses, or physicians. An ECG is a recording of the electrical activity of the heart. Electrodes are placed on the patient's chest, arms, and legs to create the electrical reading. It only takes a few minutes for the electrocardiograph to produce the electrical record. This test is done to assess for myocardial infarctions, arrhythmias, and other heart issues.

Electroencephalogram (EEG): In an EEG, electrodes are applied to a patient's scalp to measure electrical activity in the brain. This test is used to help diagnose seizures, psychiatric conditions, tumours, and other brain disorders such as inflammation and injuries (Carter & Rutherford, 2020).

Electromyography (EMG): This procedure assesses the function of nerve cells that control muscles. Electrodes can either be attached to the skin or inserted into muscles to record electrical impulses. An EMG can assist with the diagnosis of nerve issues in different muscles and peripheral nerves (Carter & Rutherford, 2020).

Gastroscopy: For this test, a physician places a flexible gastroscope through the patient's mouth and passes it down their throat to the stomach (Cancer Research UK, 2022). This allows the physician to view the entire upper digestive tract and take biopsy samples, which can help in the treatment of conditions such as stomach ulcers (Carter & Rutherford, 2020).

Holter monitor: This test is similar to an ECG, but the main difference is that the patient wears the Holter monitor for a 24-hour period (sometimes longer), and electrical readings are taken for the whole duration. This gives the physician a better idea of the patient's cardiac electrical activity throughout their day, versus an ECG, which only takes readings for a short time. Fig. 8.76 shows a patient wearing a Holter monitor, and Fig. 8.77 is a sample of readings from a Holter monitor.

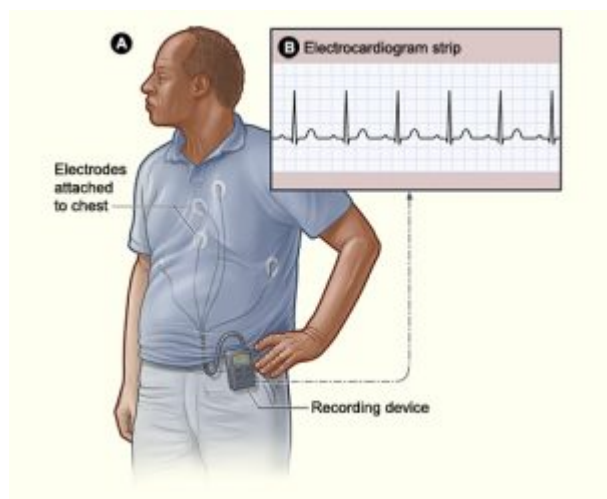


Fig. 8.76

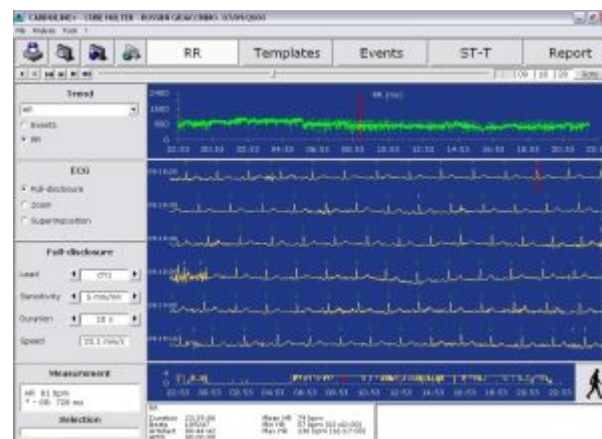


Fig. 8.77

Lumbar puncture (LP): Also known as a **spinal tap**, this procedure involves withdrawing a sample of cerebrospinal fluid from the lower lumbar region, as shown in Fig. 8.78. The sample is taken from that location in the spine because the spinal cord ends in the upper lumbar region. Samples of cerebrospinal fluid are analyzed in the lab to diagnose, or rule out, diseases that affect the nervous system.

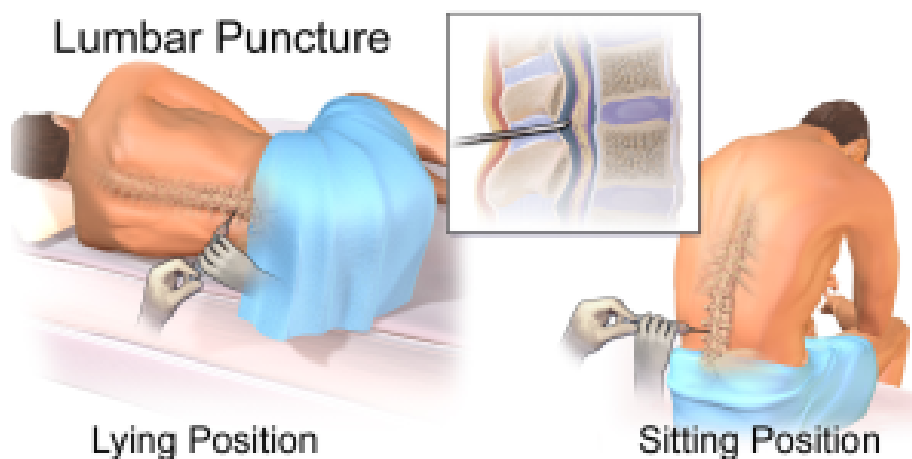


Fig. 8.78

Ophthalmoscopy: This procedure can be completed by a physician or a specialist of the eye and involves visualization of the exterior and interior of a patient's eye. It can assist with the diagnosis of eye injuries and pathologies such as glaucoma and cataracts (Carter & Rutherford, 2020).

Otoscopy: Using an otoscope, a physician will visualize the inner ear, tympanic membrane, and ear canal during this assessment. Otoscopy may be done for various reasons, including pain or foreign objects in the ear, or pathologies such as infections that affect the ear (Carter & Rutherford, 2020). The procedure is shown in Fig. 8.79, and Fig. 8.80 is an example of what a physician may see when performing the procedure.



Fig. 8.79

Palpation: Physicians, nurses, and other healthcare professionals use palpation in their assessment of patients. To perform the procedure, the healthcare professional uses their hands to

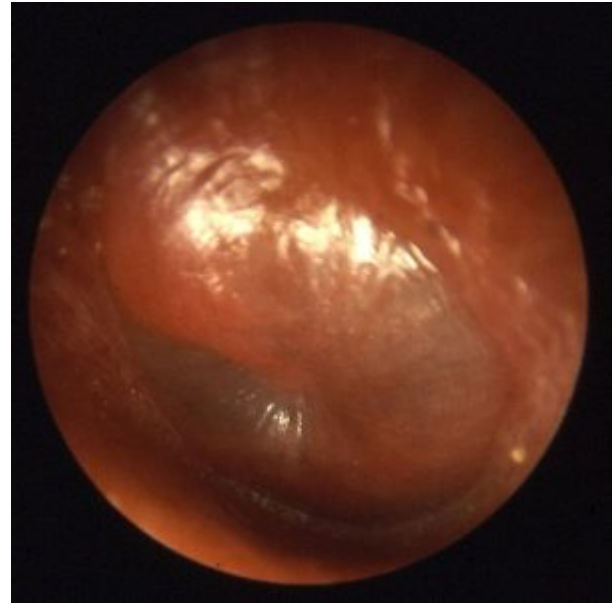


Fig. 8.80

assess for pain, tenderness, and distention. An abdominal assessment, for example, often involves palpating the four abdominal quadrants for bladder or bowel distention. Pain or tenderness could possibly indicate an inflammatory condition or bowel obstruction (Doyle & McCutcheon, 2020).

Pap smear: Also referred to as a **pap test**, this procedure involves collecting cells from the cervix. This is done to test for changes in the cells that may indicate cancer or to assess whether cancer may develop in the future (Mayo Clinic, 2022a). A pap smear should be part of regular health screening for women, and the interval between tests varies depending on age and prior medical history.

Percussion: This is similar to palpation in that it involves a physical assessment of the patient using the hands. In this case, however, it involves tapping, which produces different sounds and this helps determine if the underlying tissues are filled with air, fluid or a solid tissue. For example, over the abdomen, to assess for rigidity and pain (Doyle & McCutcheon, 2020).

Paracentesis: This procedure uses a hollow needle to remove fluid from the abdominal cavity (Fig. 8.81). Paracentesis is performed when a person has a swollen, painful abdomen and problems breathing because there is too much fluid in the abdomen (Canadian Cancer Society, 2022a). Removing the fluid helps relieve these symptoms, and often the fluid, shown in Fig. 8.82, is sent to the lab for analysis.

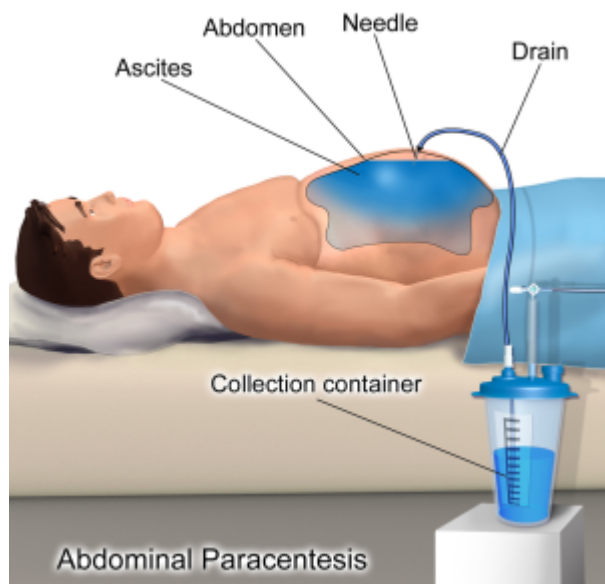


Fig. 8.81



Fig. 8.82

Phlebotomy: A very common procedure, phlebotomy involves taking blood from a vein, often in the arm, and then sending the blood to the lab for analysis (WebMD, 2022). This procedure can assist with the diagnosis of many different pathologies and illnesses.

Spirometry: This test assesses how well the lungs are working by measuring air volume. Measurements are taken for respiratory volume, tidal volume, expiratory reserve volume, residual volume, and respiratory capacity. All of these factors play a role in the amount of air we breathe in, keep in our lungs after expiration, and breathe out (Carter & Rutherford, 2020). Fig. 8.83 demonstrates how the procedure is completed as the patient breathes into the machine.



Fig. 8.83

Stress test: Also known as an **exercise stress test**, this procedure shows how well a patient's heart works during physical activity (Mayo Clinic, 2022b). It usually involves having the patient walk on a treadmill, as seen in Fig. 8.84, or ride a stationary bike. While the patient is moving, heart rhythm, blood pressure, and breathing are monitored. This test is typically ordered when a patient has a history of cardiac illness or concerns.



Fig. 8.84

Thoracentesis: This procedure drains fluid from the space between the lungs and the wall of the chest (the pleural space), as shown in Fig. 8.85. A hollow needle or plastic tube is inserted through the chest wall to remove fluid (Canadian Cancer Society, 2022b). This alleviates breathing difficulty and can help diagnose lung issues because a fluid sample is usually sent to the lab for analysis (Carter & Rutherford, 2020). Fig. 8.86 shows a chest X-ray of a patient who requires a thoracentesis for pleural effusion, a condition in which there is fluid build-up in the pleural space, as shown by the white area where the lung should be.

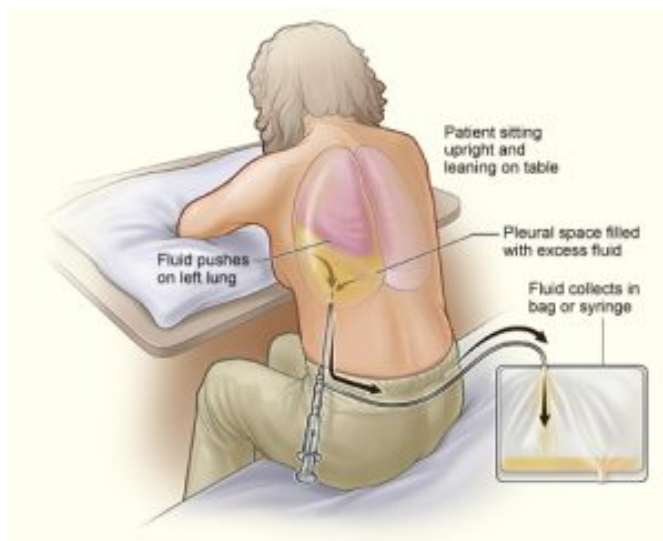


Fig. 8.85



Fig. 8.86



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8.7 Review Exercises

The following final review exercises cover much of the content from this chapter. It is important that you review the entire chapter in addition to completing this review in order to have a full understanding of all the concepts covered in Chapter 8.

Final Review



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CHAPTER IX

MEDICAL PROFESSIONALS AND SPECIALTIES

9.1 Introduction to Medical Professionals and Specialties

Learning Objectives

By the end of this chapter, you will be able to

1. Describe the major specialty areas of medicine and the education requirements for physicians and surgeons in these areas
2. Name medical professionals and healthcare providers
3. List the combining forms relating to each medical specialty
4. Name the types of units that are commonly found in the hospital environment
5. Describe common hospital terms and combining forms
6. List the common abbreviations for medical professionals and hospital units

Chapter Overview

There are a number of different specialties and medical professionals involved in any medical setting. This chapter will give you an overview of the most common physician specialties and other medical professions that are involved in the everyday care of patients. Some professionals are more active in patient care, whereas others are only called in when needed, which means their involvement may be limited. This chapter will also provide you with a list of common units in hospitals. Throughout the chapter, you will encounter new combining forms and abbreviations. There are, of course, other professionals and hospital units that you may encounter, especially in more specialized practice areas; however, the overview in this chapter will hopefully provide you with a foundation from which to learn more during your future professional practice. There are exercises throughout, as well as scenarios that will help you apply the knowledge you have learned.

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9.2 Physician Training and Specialties

Physician Education and Training

Physician training can vary, but it generally follows a similar path, which begins with a bachelor's degree, then medical school, a qualifying exam, residency, and finally a licensing exam (Canadian Medical Association, 2022). The focus of residency will vary depending on the area of specialization. Residency can be a couple of years long, or possibly even seven years in some cases. For example, a residency in family medicine is shorter than one in neurosurgery (Canadian Medical Association, 2022).

When working in a hospital, you may see many different titles for physicians based on where they are in their training. There may also be **medical students** who are still in medical school and working with another physician (Albany Medical School, 2022). An **intern** is a physician who has completed medical school and is in their first year of residency. **Residents** are physicians who are still completing their residency and are working under a fully credentialed attending physician. An **attending physician** has completed their residency and is certified in their chosen specialty. They make the decisions when it comes to patient care and supervise the work of medical students, residents, and interns (Albany Medical School, 2022).

Physician Specialties

There are a number of different specialties that a physician can complete, and they may change specialties during their career. Some of the more common specialties are described below, along with reasons why a patient might be referred to them.

Anesthesiologists work mostly with patients undergoing surgery. They use their knowledge of pharmacy and physiology to ensure that patients remain unconscious or with no sensation during their surgical procedures (Canadian Medical Association, 2022). The name of this specialty includes the combining form **esthesi/o**, which means “sensation, so the literal translation would be “specialist in no sensation.” In Fig. 9.1, you can see an anesthesiologist at work protecting a patient’s airway during surgery.



Fig. 9.1

Cardiologists are medical doctors who specialize in diagnosing and treating heart disease. They do not perform surgery but treat common cardiac issues such as arrhythmias, congestive heart failure, and other cardiac pathologies.

Cardiovascular surgeons perform surgical treatments for the heart and other thoracic organs. They do not provide ongoing care such as cardiologists do, but they complete the required patient assessments, surgical procedures, and immediate aftercare.

Clinical immunologists and allergists diagnose and treat diseases of the immune system. They may see patients with suspected or diagnosed allergies and other conditions related to the immune system.



Fig. 9.2

Key
Concept



Fig. 9.3

The

skin testing that is done for allergies is completed by a **clinical immunologist** or **allergist** in order to identify allergens. In skin testing, allergen extracts are injected into the epidermis, and the patient's skin will react to any allergens within 30 minutes. Redness and swelling at the site of a particular allergen means that the patient is likely allergic to the substance that was introduced. It is possible to test for many allergens at the same time (Betts et al., 2013). Fig. 9.2 shows an example of a skin test that has been completed, but the patient has not (yet)

reacted to the substances. In Fig. 9.3, the patient has reacted to some of the allergens, as shown by the redness and swelling at some of the sites.

Dermatologists have specialized training in treating diseases, disorders, and injuries related to the integumentary system and its accessory structures. They may assess and treat symptoms or pathologies such as dermatitis, growths, skin cancers, and rashes. There are also a number of subspecialties such as cosmetic dermatology, dermatopathology, and pediatric dermatology.

Emergency practitioners work in emergency departments to provide care to acutely ill or injured patients. Their patients can present with a variety of different pathologies and injuries (Canadian Medical Association, 2022).

Endocrinologists focus on the treatment of endocrine system disorders that affect hormone levels and may treat patients who have either high or low levels of certain hormones. The name of this specialty has the combining form **endocrin/o**, which means “endocrine glands.”

Key Concepts

A **thyroid specialist** is an endocrinologist whose subspecialty is the treatment of disorders of the thyroid gland such as hypothyroidism and hyperthyroidism.

A **diabetes specialist** is an endocrinologist whose subspecialty is the treatment of diabetes.

Family practitioners, which includes both family physicians and general practitioners, provide services to all patients regardless of age, sex, or health condition. They treat patients on an ongoing basis for any medical needs and perform any necessary physical assessments (Canadian Medical Association, 2022).

Gastroenterologists focus on the diagnosis and treatment of conditions affecting the digestive system. They may treat patients with an array of digestive pathologies that could include gastroesophageal reflux disease (GERD), Crohn’s disease, and ulcerative colitis.

Geriatricians treat older patients, often over 75 years of age, for any medical needs and assessments they may require (Canadian Medical Association, 2022). The name of this specialty has the combining form **ger/o**, which means “old age.”

Gynecologists focus on the diagnosis, treatment, management, and prevention of diseases and disorders of the female reproductive system. A patient may see this specialist if they have conditions such as pelvic inflammatory disease, endometriosis, or other pathologies that affect the female reproductive system. The name of this specialty has the combining form **gynec/o**, which means “woman” or “female.”

Hematologists are physicians who diagnose and treat blood disorders. They are very knowledgeable about different blood conditions and laboratory procedures. A patient could be referred to this physician if they have a blood disorder related to clotting, anemia, hemophilia, or other blood-related factors.

Infectious disease specialists have additional training in infectious diseases. A patient would be referred to them if they potentially have some form of infectious disease. This specialist can assist with the diagnosis, treatment, and ways of decreasing the spread of an illness.

Nosocomial infections are infections that occur during a patient's time in the hospital and are of concern to infectious disease specialists and other medical professionals. These infections can be caused by many different types of bacteria and antibiotic-resistant organisms. The term **nosocomial** has the combining form **comi/o**, which means “to care for,” and **nos/o**, which means “disease.”

Another concept that is important for all physicians and other medical professionals to be aware of are adverse conditions that result from treatment. The medical term for this is **iatrogenic**, from the combining form **iatr/o**, which means “treatment,” and the suffix **-genic**, which means “producing, originating, causing.” An iatrogenic condition could take the form of an adverse effect from a medication or other treatment that a patient may receive in the hospital.

Nephrologists are specialists in kidney diseases. They treat patients with kidney failure and other pathologies that relate to the kidneys.

Neurologists are medical doctors who complete specialized training in the prevention, diagnosis, and treatment of disorders and conditions related to the brain, spinal cord, nerves, and muscles. They may treat pathologies such as multiple sclerosis, epilepsy, tremors, cerebral palsy, Alzheimer's disease, and Parkinson's disease.

Neurosurgeons do not treat patients with neurological conditions long term, but instead perform surgical procedures on the brain or other parts of the nervous system. They provide surgical procedures for patients with tumours, growths, or trauma to the brain.

Obstetricians provide care to the mother and fetus through pregnancy and labour, and to the mother during the postpartum period. Obstetricians study both obstetrics and gynecology and are referred to as **OB/GYNs**, which means “obstetrics and gynecology.” Fig. 9.4 is an image of a baby being born, and you can see the obstetrician providing care to both the infant and mother. The combining form **obstetr/o**, which means “midwife,” is found in the medical term for this specialty.



Fig. 9.4

Oncologists treat patients who have cancer and malignancies in any area of the body (Canadian Medical Association, 2022).

Ophthalmologists screen, diagnose, and manage the care of patients with optical, medical, and surgical diseases or disorders of the eye (Canadian Medical Association, 2022).

Otorhinolaryngologists (ENTs) specialize in the treatment of conditions in the ears, nose, and throat. They may see patients with hearing difficulties, difficulty swallowing, issues with balance, or tinnitus.

Orthopedists provide diagnosis, treatment, rehabilitation, and prevention of diseases of the bones, joints, ligaments, muscles, tendons, and nerves (Canadian Medical Association, 2022). The combining form **orth/o** in this medical term means “straight”; the reason is that orthopedists originally only provided care for children who had limbs that were not straight. The name of the specialty has not changed, but the scope of practice has increased.

Orthopedic surgeons are physicians who complete additional specialized training in the prevention, diagnosis, treatment, and surgery of disorders and diseases related to the musculoskeletal system. They may treat patients who have injuries to their musculoskeletal system from trauma or from complications of aging or repetitive use.

Pathologists are specialist physicians who study aspects of disease. They often work in the lab, studying samples from patients and working to assist in the diagnosis and prognosis of disease and illness.

Pediatricians provide ongoing care to children, as can be seen in Fig. 9.5, for any medical needs they may have. These doctors can provide both long-term and acute care, and children can be referred to them from family physicians if they require more specialized care (Canadian Medical Association, 2022). The combining form **ped/o** in this medical term means “child.”



Fig.9.5

Psychiatrists are specialist who provided treatment for diseases of the mind. They complete comprehensive assessments and diagnose and plan care for patients who are experiencing various forms of mental illness and emotional and behavioural disorders (Canadian Medical Association, 2022).

Pulmonologists, often also referred to as a **respirologists**, are concerned with the diagnosis and treatment of diseases related to the respiratory system. Respiratory medicine also requires in-depth knowledge of internal medicine. Patients may see this specialist if they have asthma, chronic obstructive pulmonary disease (COPD), emphysema, or other respiratory signs or symptoms.

Radiologists are specialists who use imaging techniques in the study, diagnosis, and treatment of disease. Their role

is often as a consultant to other physicians for patients who require diagnostic imaging (Canadian Medical Association, 2022). A radiologist can be seen in Fig. 9.6 completing an assessment of an imaging scan in preparation for the scan to be sent to the patient's primary physician. The combining form **radi/o** in this medical term means "X-ray."

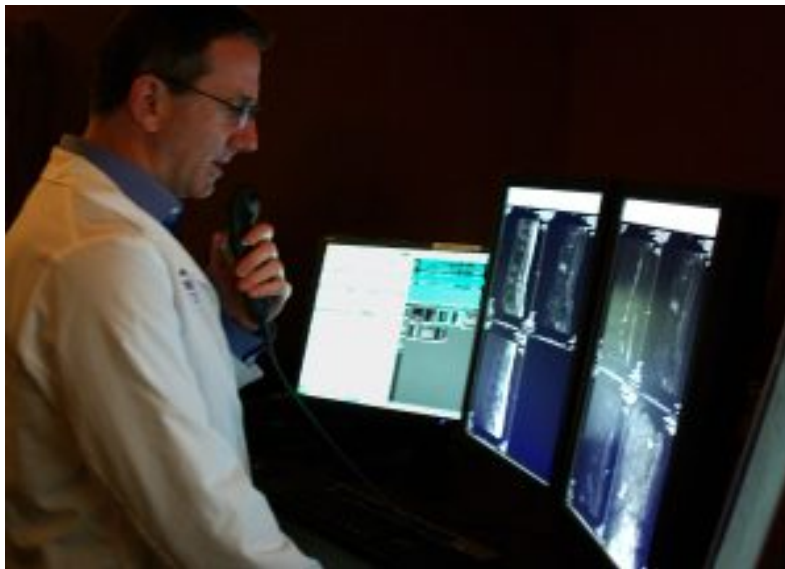


Fig. 9.6

Radiation oncologists are physician specialists who provide care to patients with malignant tumours and other diseases requiring radiation treatment (Canadian Medical Association, 2022).

Rheumatologists are medical doctors who have specialized as internists in the subspecialty of rheumatology. They treat systemic diseases that affect the joints and muscles, including autoimmune disorders that affect multiple body systems, as well as rheumatoid arthritis, lupus, and psoriasis. The combining form **rheumat/o** in this medical term means "flow" or "fluid."

Thoracic surgeons specialize in either thoracic surgery or cardiothoracic (heart and chest) surgery and care. A patient would require care from a thoracic surgeon if they need surgery that involves an opening into the chest or thoracic cavity.

Urologists are involved in the diagnosis and treatment of urinary and male genitourinary system conditions, disorders, and diseases such as prostate disease and renal and bladder dysfunctions. This physician does not only provide diagnosis and treatment, but also performs surgical repair. Common patient conditions that they treat include kidney stones, kidney failure, benign prostatic hyperplasia, and bladder dysfunction. It is important to note that this specialist provides care and assessment for both male and female urinary systems.

Vascular surgeons treat diseases of the blood and lymphatic vessels. They repair and replace diseased or damaged vessels, remove plaque from vessels, insert venous catheters, and perform traditional surgery (Betts et al., 2013).

Exercise



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9.3 Healthcare Practitioners

There are a number of regulated healthcare practitioners who are involved in the day-to-day care of patients both in and outside the hospital. The most common healthcare practitioners found in the hospital and community are discussed below. In health care, there are a number of professionals who work collaboratively to provide the best possible care for patients. Working as a team ensures that patients receive the required holistic care needed for optimal health outcomes.



Fig. 9.7

Chiropractors are trained in the prevention, assessment, and treatment of the musculoskeletal system, including the spine and the nervous system. They focus on patient education and treatment, providing spinal adjustments, nutrition information, and injury prevention. They do so without the use of pharmaceuticals or surgical procedures (Carter & Rutherford, 2020). Fig. 9.7 shows a chiropractor educating a patient about their spine and the required treatment for their condition.

Dietitians assess, plan, implement, and evaluate interventions related to the nutritional needs of patients. They work with patients with regular dietary needs, as well as those on therapeutic diets. They also provide dietary education to patients, families, and other healthcare providers. In addition, dietitians work with other members of the healthcare team when a client has dietary needs related to physical disorders such as dysphagia.

Health care aides (HCAs) generally work in hospitals and long-term care facilities and assist patients with daily tasks such as bathing, dressing, feeding, and toileting.

Kinesiologists work in a variety of healthcare settings and help patients with pain management, injury prevention, and health promotion through a focus on biomechanics (Carter & Rutherford, 2020).

Midwives work in hospitals, birthing centres, community clinics, and patients' homes. They provide gynecological exams, family planning advice, prenatal care, and management of low-risk labour and delivery. Most midwives are nurses with advanced training.

There are different types of **nurses** in medical settings:

- **Licensed practical nurses (LPNs)** typically work in hospitals and provide patient care such as collecting patient assessment information, administering medications, and performing nursing procedures according to their scope of practice. LPNs generally complete a two- to three-year diploma and must write a licensing exam.
- **Registered nurses (RNs)** provide similar patient care as LPNs but with an increased scope of practice. They also use the nursing process as a critical-thinking model as they make decisions and use clinical judgement regarding patient care. RNs must complete a four-year degree and pass a licensing exam in order to practice. A group of RNs can be seen in Fig. 9.8.



Fig. 9.8

Key Concept

Nurse practitioners (NPs) are RNs who complete two years of additional graduate work and licensing. They work in a variety of settings and complete physical examinations, diagnose and treat common acute illnesses, and manage chronic illnesses. NPs can work independently, order laboratory and diagnostic tests, and prescribe medications.

Occupational therapists (OTs) work in a variety of settings in the hospital and the community. They assess, plan, implement, and evaluate many different types of interventions, including those that help patients achieve their highest possible level of independence in activities of daily living such as bathing, grooming, eating, and dressing. They also provide adaptive devices such as long shoehorns so patients can put their shoes on, sock pulls for pulling on socks, or adaptive cutlery to facilitate independent eating. OTs can also assess the home for safety and evaluate the patient's need for assistive devices for when they are discharged from the hospital or rehabilitation facility.

Pharmacists work in hospitals, medical centres, and the general community. They ensure medication safety and are a vital resource for other medical professionals who have questions or concerns about the medications being administered to patients. Pharmacists not only ensure that patients get the correct medication and dosing, but also that

they have the guidance they need to use the medication safely and effectively. Fig. 9.9 shows a group of pharmacists working in a community setting.



Fig. 9.9

Physician assistants (PAs) require a bachelor's degree plus two or three years of additional physician assistant training (Albany Medical College, 2022). They are licensed to practise medicine under the supervision of a physician in a clinic or hospital. PAs can diagnose and treat patients and prescribe medicine, and some may be surgical assistants (Albany Medical College, 2022).

Physiotherapists (PTs) practise in all healthcare environments, including the home, hospital, and general community. They are licensed healthcare professionals who assess, plan, implement, and evaluate interventions, including those related to the patient's strength, mobility, balance, gait, coordination, and joint range of motion. Treatments may include exercises, massage, joint manipulation, and occupational retraining (Carter & Rutherford, 2020).

Podiatrists provide care and services to patients who have issues with their feet. Patients with diabetes often have foot problems, so podiatrists work with them to clip toenails and provide foot care to prevent injuries and other complications.

Psychologists provide mental health services to patients with mental health concerns or disorders. They cannot prescribe medications but can assist with various forms of counselling and provide psychological support to patients in the hospital and community.

Respiratory therapists (RTs) work in hospitals to treat patients with respiratory-related conditions. Their specialized respiratory care includes managing oxygen therapy, drawing arterial blood gases, managing patients on specialized oxygenation devices such as mechanical ventilators, CPAP, and Bi-PAP machines, and administering respiratory medications such as inhalers and nebulizers. They also serve as an integral part of code teams during cardiac and respiratory arrests. Fig. 9.10 shows an RT providing complex care to a patient in critical condition.



Fig. 9.10

Social workers work in hospitals and the community to provide psychological support to patients and connect them with community resources. They ensure continuity of care and make sure the patient has the resources they require when they leave the hospital.

Speech therapists assess, diagnose, and treat communication and swallowing disorders. They may help patients with **aphasia** or swallowing disorders such as **dysphagia**. They treat patients in collaboration with other members of the healthcare team.

Exercise



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9.4 Additional Healthcare Providers

There are additional healthcare providers that a patient might see in a hospital; however, these providers may be encountered less often because, in most cases, they are only intermittently involved in patient care. For example, a patient would see an MRI technologist only if they required an MRI, or a phlebotomist only if the patient required blood to be drawn. All healthcare providers are important for thorough and safe patient care.

Administrative support staff work in areas such as **patient information**, where they direct visitors to locations in the hospital, or **patient registration**, where they are responsible for admitting and registering patients in any department in the hospital (Alberta Health Services, 2022d).

Cardiology technologists perform diagnostic tests such as electrocardiograms (ECGs), stress testing, Holter monitor testing, ambulatory blood pressure testing, and pacemaker monitoring and programming.

Cardiovascular perfusionists are responsible for operating the heart-lung bypass machine during open heart surgery. They also monitor patients' vitals and administer IV fluids and medications.

Diagnostic vascular technologists, also known as **registered vascular sonographers**, are technologists that image the vascular system.

Diagnostic medical sonographers use high-frequency sound waves to produce quality diagnostic images for a variety of ultrasound procedures such as the one seen in Fig. 9.11. They examine many parts of the body, including breasts, uterus and ovaries, testes, prostate gland, heart and blood vessels, and organs in the abdomen (Alberta Health Services, 2022a).



Fig. 9.11

Electroneurophysiology technologists (ENPs) perform electroencephalograms (EEGs) and a few other specialized tests.

During an EEG, the electrical activity of the brain is recorded through electrodes on the patient's head, as can be seen in Fig. 9.12 (ACMDTT, 2022a).



Fig. 9.12

Environmental services professionals are responsible for cleaning, sanitizing, and maintaining hospital units, clinical areas, and non-clinical treatment areas in the hospital. They clean rooms after patients are discharged and prepare them for new patients to be admitted.

Health information management professionals (HIM) organize and release information in accordance with the *Health Information Act*. Patients and their authorized representatives or third parties can access medical records from this department if they are authorized (Alberta Health Services, 2022b).

Hospital unit clerks (HUCs) are a vital part of the day-to-day operations on a hospital unit. They are responsible for transcribing and processing physician orders, including medication, laboratory, diagnostic imaging, and treatment orders. They also answer phones, book patients for tests and treatments, and maintain patient records and charts (Alberta Health Services, 2022c).

Magnetic resonance imaging (MRI) technologists produce diagnostic images by using equipment that generates radio waves and a strong magnetic field, as can be seen in Fig. 9.13. They use their extensive knowledge of anatomy, pathology, and physiology to obtain images and monitor patients during scans (ACMDTT, 2022e).



Fig. 9.13

Medical laboratory technologists (MLTs) perform complex analyses of tissue, blood, and other body fluids.

Medical laboratory assistants (MLAs) spend the majority of their time processing samples and, in some unique cases, collecting them.

Medical radiological technologists use imaging, such as X-rays and computerized tomography (CT), to assist in the diagnosis and treatment of diseases (Ernstmeyer & Christman, 2021).

Nuclear medicine technologists use equipment to acquire scans of areas such as the thyroid, heart, bones, and kidneys. These images enable physicians to diagnose and monitor a patient's response to various treatments. In order to complete a nuclear medicine scan, they must use some form of radioactive contrast material.

Patient food services staff provide quality food services to patients to support optimal patient outcomes and quality of life. Any changes to patient diets, nutrition requirements, or late admissions to the unit must be communicated to food services to ensure that patients receive the correct diets at their bedside (Alberta Health Services, 2022e).

Phlebotomists are professionals trained to draw blood, and when more than a few drops of blood are required, phlebotomists perform a venipuncture, typically using a vein in the arm (Betts et al., 2013). They also perform capillary sticks on fingers, as seen in Fig. 9.14, earlobes, or the heel of an infant when only a small quantity of blood is required. An arterial stick is collected from an artery and used to analyze blood gases. After collection, blood may be analyzed by a medical laboratory or possibly used for transfusions, donations, or research (Betts et al., 2013).



Fig. 9.14

Porters transport patients throughout the hospital for tests or radiology treatments. They may transport patients in wheelchairs or on their beds or stretchers depending on the patients' requirements.

Protective services professionals work in medical facilities to ensure the well-being of patients, healthcare professionals, and visitors. They prevent losses, damage, and disruptions in the hospital, and respond to crime, fire, accidents, and other incidents. They are also the department to call if there are any safety issues on a unit (Alberta Health Services, 2022f).

Prosthetists design, fit, and supply patients with artificial body parts such leg and arm prostheses. They also adjust prostheses to ensure proper fit, patient comfort, and optimal functioning (Ernstmeyer & Christman, 2021).

Recreation therapists (RTs) work with patients who have physical, mental, cognitive, or social limitations that can affect their ability to participate in leisure activities. The aim of the recreation therapist is to use recreation and leisure to create optimal health and well-being (Alberta Health Services, 2022g).

Radiation therapists are key members of a cancer treatment team (Alberta College of Medical Diagnostic and Therapeutic, 2022c). They are responsible for accurately planning and administering radiation treatments for cancer patients. They have expert knowledge in patient care and anatomy, as well as in radiation physics and radiation protection for the safe operation of the equipment. They are also knowledgeable about patient care considerations, spend time educating patients, and often, due to the ongoing nature of patient treatments, establish a ongoing therapeutic relationship with the patients they provide radiation treatments to (ACMDTT, 2022c).

Spiritual care professionals provide spiritual and emotional support to patients, their families, and healthcare professionals in the hospital (Ernstmeyer & Christman, 2021). They can assist patients and others from any religion or culture (Ernstmeyer & Christman, 2021).

Exercise



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9.5 Hospital Units

There are a number of different units in the hospital, and they vary depending on the size of the hospital and the population it provides care for. For example, a rural hospital will likely not have many of the units discussed here, but a large hospital in a city centre will often have them all plus more. The list below will provide a sample and overview of possible units that may be seen in a healthcare setting, but it is not all-encompassing. There is also a discussion of common pathologies and conditions that would cause a patient to be admitted to these units; however, this would be in an ideal setting, and sometimes, due to bed shortages, there may be patients with other reasons for admission present on any given unit.

Hospital Units

Burn Unit: This unit provides care to patients who have suffered advanced and complicated burn injuries (Washington State Department of Health, 2022). These patients have complex and intensive care requirements because a number of complications, including infections, are common when a patient has severe burns.

Cardiology Unit: This unit focuses on care for patients whose main reason for admission is cardiac-related. It would not, ideally, care for a patient in the acute phase of a myocardial infarction but would handle the aftercare once the patient was somewhat stabilized. The unit would also have patients with congestive heart failure, unstable blood pressure, and other cardiac pathologies.

Coronary Care Unit (CCU): This specialized intensive care unit provides care for patients with more complex and unstable cardiac issues. Acute cardiac events such as a myocardial infarction or even open heart surgery would be reasons for admission to this unit (Washington State Department of Health, 2022).

Day Surgery Unit: Patients come to this unit if they are to undergo less-complicated surgeries that do not require an overnight hospital stay. Often patients arrive in the morning and then leave once the procedure is complete and their condition is stable (Whitlock, 2020).

Dialysis (Renal) Unit: Patients on this unit often come in for dialysis, as can be seen in Fig. 9.15, and then leave once the procedure is complete. Often the same patients come in weekly or a few times a week for dialysis. These patients have some level of kidney failure or other pathology, and their kidneys can no longer filter their blood. Some units are designed so the patients stay on the unit because their condition will not allow them to go home between treatments.



Fig. 9.15

Emergency Room (ER): Patients typically access the ER if they need emergency care. The medical professionals on this unit treat a vast array of urgent and acute injuries and pathologies. For example, a patient may have had a motor vehicle accident or a myocardial infarction and requires immediate care.

Gastroenterology Unit: Patients are admitted to this unit if they have a pathology that affects their stomach or intestines. Common conditions could be exacerbations (worsening of symptoms) of Crohn's disease or ulcerative colitis.

Gynecology Unit: This unit focuses on treating ailments of the female reproductive system. Patients could be experiencing fibroid tumours, exacerbations of endometriosis, uterine bleeding, or other disorders. However, patients would not go to this unit for pregnancy-related issues.

Geriatric Unit: Patients on this unit can be admitted for various reasons, but the main thing they have in common is age. Geriatric patients are generally over the age of 75, though that may vary depending on the policy and specific cutoff age for geriatric status in the local area.

Intensive Care Unit (ICU): In this unit, seriously ill patients receive intense and specialized care such as monitoring and advanced life support (Washington State Department of Health, 2022). The patients are often intubated and have machines breathing for them, as shown in Fig. 9.16. They also receive one-on-one nursing care (Washington State Department of Health, 2022).



Fig. 9.16

Labour and Delivery (L&D) Unit: Patients only come to this unit if they are in labour or at risk for immediate labour. Patients would not come to this unit if they were early on in their pregnancy or for fertility issues. Once the patient has delivered the baby, the mother and infant stay on the unit until stable, but they are often discharged within a day or two at the most.

Medicine Unit: This unit provides care for a vast array of illnesses. Patients would not be treated for conditions that require more complex care, but they often have pathologies such as pneumonia, bronchitis, or mobility issues, or they are waiting for placement in another facility, such as long-term care. Often a patient's condition does not warrant being on a more specialized unit, but rather the patient may have a number of comorbidities (more than one condition or disease at the same time).

Nephrology Unit: Patients on this unit have a pathology that affects the kidneys. They may require dialysis, which is often done in a dialysis unit (see above), but they may have other pathologies such as kidney stones, blockages, or other issues with kidney function.

Neurology Unit: There are a number of conditions that can affect the nervous system, and those would be prevalent in patients on this unit. For example, a patient may have had a stroke that was treated in the acute phase but now requires aftercare. Other conditions treated on this unit include head trauma, epilepsy, neuromuscular disorders, or tumours.

Neonatal Intensive Care Unit (NICU): This unit is similar to the ICU (see above) but provides advanced care for newborn infants who require monitoring and advanced life support (Washington State Department of Health, 2022). One type of NICU can be seen in Fig. 9.17.



Fig. 9.17

Oncology Unit: Patients on this unit have been diagnosed with some form of cancer.

Operating Room (OR): This is where surgeries for both in-patients and outpatients are performed; an example of surgery taking place in an operating room is shown in Fig. 9.18 (Whitlock, 2020). If the patient is to remain in the hospital, they will be moved to the recovery room (see below), then to the surgery unit for post-operative care.



Fig. 9.18

Outpatient Department (OPD): This unit treats patients who do not need to stay in the hospital overnight. They have complex needs but can return home in the evening. Patients come to the hospital for some form of treatment, such as rehabilitation, mental health care, or medication, then leave the OPD afterwards (Whitlock, 2020).

Orthopedic Unit: Patients admitted to this unit have issues with their bones or joints. In many cases, they have had an injury and require substantial aftercare and rehabilitation. Patients may also have a chronic anomaly to their bones that requires intervention and treatment.

Palliative Care Unit: This unit provides care for patients at the end of life (Whitlock, 2020). When there are no other treatment options for patients and their health condition is terminal, they can come to this unit, where the focus of care is on patient comfort (Whitlock, 2020).

Pre-admission Clinic (PAC): This area of the hospital is where patients go before surgery and before they are admitted to the hospital, so they can prepare and be educated about the procedure they will be having. The healthcare professionals on this unit ensure that patients are prepared and in the condition needed for surgery to be performed.

Pediatric Unit: This unit may be a general pediatric unit or a specialized one for certain conditions such as trauma or pulmonary conditions, but the focus is on providing care to patients under the age of 18 (Washington State Department of Health, 2022).

Pediatric Intensive Care Unit (PICU): This unit is similar to the ICU (see above), but the advanced care provided is for pediatric patients—children under the age of 18—who require intensive care and advanced life support (Washington State Department of Health, 2022).

Postpartum Unit: This unit admits women who have been on the L&D unit and have given birth. In some cases, either the mother or infant require more long-term care, so they are transferred to the postpartum unit. The infant could have issues with jaundice, feeding, or elimination (bowel or bladder issues), or the mother may have had a complicated cesarean section or difficult delivery.

Psychiatry/Mental Health Unit: There are various kinds of mental health units in a hospital. Some have locked units where patients are under constant observation, others have patients who stay on the unit all the time, and still others allow patients to leave during the day and return in the evening. However, all the patients on this type of unit have some form of mental health diagnosis and are receiving care for that condition.

Pulmonary Unit: Patients on this unit have some form of acute or chronic pulmonary condition; for example, injuries to the lungs such as atelectasis or pleural effusion. They might also have chronic conditions such as uncontrolled asthma, bronchitis, COPD, or inflammation or infection in the respiratory system.

Recovery Room (RR): Patients are taken to this unit after surgery to wait for the anesthesia to wear off; an example of a recovery room can be seen in Fig. 9.19 (Whitlock, 2020). Patients remain in the recovery room until they are able to breathe on their own and respond appropriately to healthcare providers. Once stable, they will either return to the day surgery unit if they are to be discharged that day or they go back to the surgery unit they were admitted to.



Fig. 9.19

Rehabilitation: This area may be in the hospital or is a separate facility, but patients go to rehabilitation to increase their strength and improve their functioning so they can go home (Washington State Department of Health, 2022). After an injury or surgery, patients who require more time and rehabilitation before they can return home are admitted to a rehabilitation unit or facility.

Specialty Clinics: Depending on the hospital, these clinics can be numerous and vary greatly. There can be diabetes clinics, kidney clinics, blood pressure clinics, and intravenous therapy clinics. There may be other clinics as well, and the number and types of specialty clinics will depend on the size of the hospital and the population they provide care for (Ernstmeier & Christman, 2021).

Surgery Units: There are many specialty surgery units in a hospital; for example, a thoracic unit that focuses on chest surgeries, or units that focus on neurological or gynecological surgeries. These units will have patients who have had surgeries that relate to the specialty area. There are also general surgery units that will have patients who have had a variety of procedures; however, those procedures will not be specialized or require complex care. Instead, patients on those units will have had routine procedures such as an appendectomy. It is important to note that patients on these units are admitted because they either require surgery or have just had surgery. Also, surgery does not actually occur on these units—the patients leave the unit to go to the OR, as discussed above, then return to the surgery unit for post-op care.

Urology Unit: Patients are admitted to this unit because they have a pathology or anomaly that relates to the urinary system and/or male genitourinary system. Conditions, disorders, and diseases such as prostate disease and renal and bladder dysfunctions may require a patient to be admitted to this unit depending on the severity of the patient's condition.



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9.6 Hospital Scenarios

The following scenarios were designed to help you practise and apply what you have learned in this chapter. Although the focus of the scenarios is on material from this chapter, there is some content from earlier chapters. Each of the three scenarios follows the path a patient might take through the hospital. Fill in the blanks by dragging the correct medical term, hospital unit, or key concept to the correct position in the story. Once all the words have been put into the story, it is complete and you can check your answers to see how you did.

Scenarios

Scenario 1



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Scenario 2



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9.7 Review Exercises

The following review exercises cover most of the medical terms, healthcare professionals, concepts, and combining forms from this chapter. It is important that you review all the content in this chapter in addition to completing this review to have a full understanding of all the concepts covered in Chapter 9.

Combining Form Review



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Abbreviation Exercise



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Review



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Glossary

abdominal

Pertaining to the abdomen

abduction

The act of moving (taking) away from

adenoidectomy

removal of a gland

adenoiditis

Inflammation of the adenoids

adenoma

A mass or tumour in a gland

adrenal glands

Pertaining to near the kidneys; small, triangular glands located on top of the kidneys

adrenalectomy

Removal of one or both adrenal glands

adrenopathy

Disease of the adrenal glands

alveolar

Pertaining to the alveoli

amenorrhea

No menstruation or no menstrual flow

amniocentesis

A surgical puncture to remove fluid from the amniotic sac

anal

Pertaining to the anus

analysis

To separate; for example, in a urinalysis

anemia

The condition of no blood

angina

Chest pain

angiogram

A record of the blood vessels

angioplasty

The surgical repair of a blood vessel

antepartum

Before birth

anterior

Pertaining to the front

antibiotic

Pertaining to against life

antigen

To produce against bacteria or viruses that enter the body

aortic

Pertaining to the aorta

aphakia

The condition of no lens of the eye

aphasia

No speech

apnea

No breathing

appendectomy

Removal of the appendix

appendicitis

Inflammation of the appendix

arachnophobia

Aversion to or fear of spiders

arrhythmia

Pertaining to an irregular heart rhythm

Arteriolitis

Inflammation of the arterioles

arteriosclerosis

The hardening of an artery

arthralgia

The condition of pain in the joints

arthritis

Inflammation of the joints

arthrogram

A record (scan) of a joint

asthma

A chronic respiratory condition characterized by narrowing and swelling of the airways

atherosclerosis

Hardening (of the arteries) with plaque

atrophy

No nourishment or development

audiometer

An instrument used to measure hearing (sound)

audiometry

The process of measuring hearing (sound)

aural hematoma

A mass of blood within the ear

autopsy

To view self

axillary

Pertaining to the armpit

balanitis

Inflammation of the penis

bilateral

Pertaining to two (or both) sides

binocular

Pertaining to two eyes

biology

The study of life

biopsy

To view life

bradycardia

condition of a slow heart rate

bronchiectasis

A chronic condition in which the walls of the bronchi thicken because of inflammation and infection

bronchioles

pertaining to the bronchial tubes

bronchiolitis

Inflammation of the bronchioles

bronchitis

Inflammation of the bronchial tubes

bronchoscopy

The process of visually examining the bronchial tubes

bronchospasm

A spasm or contraction in the bronchial tubes

carcinogenic

Producing or causing cancer

carcinoma

A cancerous mass or tumour

cardiologist

A specialist in the study of the heart

cardiology

The study of the heart

cardiomegaly

Enlargement of the heart

cardiomyopathy

Disease condition of the heart muscle

carpals

Pertaining to the wrists

cephalic

Pertaining to the head

cerebellitis

Inflammation of the cerebellum

cerebral

Pertaining to the cerebrum

cerebrovascular accident

Pertaining to a cerebrum blood vessel accident, which is commonly known as a stroke or abbreviated as CVA

cervical

Pertaining to the cervix

chemotherapy

Treatment with drugs

cholecystectomy

Removal of the gallbladder

cholecystostomy

An opening into the gallbladder; often done for drainage

chondrocytes

Cells in cartilage; the only cells found in healthy cartilage

chronic

Pertaining to time; sometimes meaning over a period of time

chronic obstructive pulmonary disease

A chronic inflammatory condition of the lungs; often abbreviated as COPD

coccygeal

Pertaining to the coccyx

colectomy

Removal of part of the colon

colitis

Inflammation of the colon

colonography

The processing of a recording (often a CT scan) of the colon

colonoscope

An instrument used to visually exam the colon

colonoscopy

The process of visually examining the colon

colostomy

An opening into the colon

colpotomy

An incision into the vagina (usually the back wall of the vagina)

coronary

Pertaining to the heart

costectomy

Removal of all or part of a rib

craniotomy

Cutting into the skull

cryotherapy

Treatment with cold

cutaneous

Pertaining to the skin

cyanotic

Bluish or purplish discolouration caused by oxygen deficiency in the blood

cystitis

Inflammation of the urinary bladder

cystoscope

An instrument to visually examine the urinary bladder

cytology

The study of cells

dehydration

The condition of down (too little) water

dermal

Pertaining to the skin

dermatologist

A specialist in the study of the skin

dermatology

The study of the skin

diagnosis

A state of complete knowledge (this term is an exception to the rules; the suffix **-sis** means "state of")

dialysis

To break down completely, as in kidney dialysis

duodenoscope

An instrument used to view the duodenum

durotomy

An incision into the dura mater

dysentery

Condition of painful intestines

dyspepsia

Painful digestion

dysphagia

Difficulty eating

dysphasia

Difficulty speaking

dysplasia

An abnormal formation or growth

dyspnea

Pain or difficulty breathing

dysuria

Painful urination

ectopic

Pertaining to out of place or position; often used in reference to an ectopic pregnancy, which is a pregnancy that occurs outside its normal location in the uterus

electrocardiogram

A record of electricity in the heart

electrocardiograph

An instrument used to record the electrical activity of the heart

electrocardiography

The process of recording the electricity of the heart

electroencephalogram

A record of electricity in the brain

encephalopathy

A disease or disorder of the brain

endocrine

To secrete within; for example, endocrine glands secrete hormones

endometrial

Pertaining to within the uterus

endoscope

A instrument used to visually examine within (the body)

enteritis

Inflammation of the intestines

epidermal

Pertaining to above the skin

epidural

Pertaining to upon the dura mater

epiglottitis

Inflammation of the epiglottis

epithelial

Pertaining to the surface layer of the skin

erythrocyte

A cell that is red; red blood cell

esophageal

Pertaining to the esophagus

esophagogastrectomy

Removal of part of the esophagus and stomach

euphoria

A state of goodness

excision

To cut out

exocrine

To secrete outside; for example, exocrine glands

extracorporeal shock wave lithotripsy

A procedure that breaks up stones using a series of shock waves generated by a machine called a lithotripter

extravascular

Pertaining to outside the vascular system

gastralgia

The condition of pain in the stomach

gastric

Pertaining to the stomach

gastroenteritis

Inflammation of the stomach and intestines

gastroscopy

The process of visually examining the stomach

glycosuria

Condition of sugar in urine

gynecology

The study of women

hematemesis

Vomiting blood

hematology

The study of blood

hematoma

A mass of blood

hematuria

Condition of blood in urine

hemigastrectomy

Removal of half the stomach

hemiplegia

Paralysis of half the body, usually caused by a cerebrovascular accident (stroke)

hemodialysis

Separating or breaking down blood completely

hemoglobin

A protein in the blood that carries oxygen

hemorrhage

Excessive discharge of blood, often from a trauma

hepatitis

Inflammation of the liver

hepatoma

A mass or tumour on the liver

hydrocele

Swelling in the scrotum caused by an accumulation of fluid

hyperglycemia

The condition of high blood sugar

hyperpituitarism

An overactive pituitary gland

hyperplasia

Enlargement of an organ or tissue caused by an increase in the number of cells

hypertension

Pressure that is high; high blood pressure

hyperthyroidism

A condition of high thyroid

hypertrophy

Excessive development

hypophysectomy

Surgical removal of the pituitary gland

hypotension

Pressure that is low; low blood pressure

hypothyroidism

A condition of low thyroid

hysterectomy

Removal of the uterus

ileostomy

An opening (stoma) in the ileum

incision

The process of cutting into

inguinal

Pertaining to the groin

intercellular

Pertaining to between cells

intercostal

Pertaining to between the ribs

intra dermal

Pertaining to within the skin

intrauterine

Pertaining to within the uterus

intravenous

Pertaining to within a vein

ischemia

Blood held back or to hold back blood

jejunoileitis

Inflammation of the jejunum and ileum (a type of Crohn's disease)

laparoscope

An instrument to visually examine the abdomen

laparotomy

Cutting into the abdomen

laryngitis

Inflammation of the larynx

lateral

Pertaining to the side

leukemia

A condition of the white blood cells; usually cancer

leukocyte

A cell that is white; white blood cell

ligamentitis

Inflammation of a ligament

lumbar

Pertaining to the loins or waist

lymphadenectomy

Removal of a lymph node

lymphangitis

Inflammation of the lymph vessels or lymphatic system

lymphocyte

A type of white blood cell in the immune system; the main type of cell in lymph

macrocephalus

Pertaining to a large head or cranium

macrophage

A type of large white blood cell that surrounds and kills microorganisms, removes dead cells, and stimulates other immune system cells

malignant

Growing in an uncontrolled or invasive way; typically refers to cancer that has spread to nearby organs or tissues

mammogram

A record of the breast

mammography

The process of recording an X-ray of the breast

mastectomy

Removal of one or both breasts

mediastinotomy

An incision into the mediastinum

medullary

Pertaining to the medulla oblongata

meningitis

Inflammation of the meninges

menorrhagia

Excessive discharge of blood during menstruation

menorrhea

Discharge or flow of menses; normal menstrual flow

metastasis

To change place

microscope

An optical instrument used to view small particles by magnifying the particles

multipara

Many births; refers to a woman who has had two or more live births

muscular

Pertaining to muscle

myalgia

The condition of pain in the muscles

myectomy

Removal of part or all of a muscle

myelitis

Inflammation of the spinal cord

myeloma

A malignant tumour in the bone marrow

myositis

Inflammation of muscle

myringoplasty

Surgical correction of the eardrum

nasal

Pertaining to the nose

necrosis

An abnormal condition of death

neonatal

Pertaining to new birth

neoplasm

New formation or growth

neoplastic

Pertaining to new growth (note that the spelling is an exception to the rules)

nephrectomy

Removal of a kidney

nephritis

Inflammation of the kidneys

nephrosis

An abnormal condition of the kidney

neural

Pertaining to the nerves

neuralgia

The condition of pain in the nerves

neurologist

A specialist in the study of nerves (nervous system)

neurology

The study of the nerves (nervous system)

neuropathy

A disease condition of the nerves

nulliparous

No birth; a woman who has never given birth

ocular

Pertaining to the eye

oliguria

Very little urine; this condition is characterized by below-normal output of urine of approximately 300 to 500 mL per day

oncology

The study of tumours

onycholysis

The separation or break down of a fingernail or toenail

oocyte

A cell in the ovaries

oophorectomy

Removal of the ovaries

ophthalmologist

A specialist in the study of the eye

ophthalmology

The study of the eye

ophthalmoscopy

The process of visually examining the eye

optical

Pertaining to the eye

oral

Pertaining to the mouth

orchidotomy

An incision into the testis

orchioplasty

Surgical repair of the testes

orchitis

Inflammation of the testis

orthodontist

A dentist who specializes in straightening teeth and correcting bites

osteoarthritis

Inflammation of the bones and joints

osteomyelitis

Inflammation of the bone and muscle

otalgia

The condition of pain in the ear

ovarian

Pertaining to the ovaries

pancreatic

Pertaining to the pancreas

pancreatitis

Inflammation of the pancreas

pancytopenia

Deficiency in all blood cells (red blood cells, white blood cells, and platelets)

paracentesis

Removal of fluid from the peritoneal cavity

paraplegia

Paralysis of the lower half of the body

parathyroid

Pertaining to beside the thyroid

parathyroidectomy

Removal of the parathyroid gland

pathology

The study of disease

pelvic

Pertaining to the pelvis

pericardium

A structure surrounding the heart

peritoneal

Pertaining to the peritoneum

pharyngectomy

Removal of part of the pharynx

pharyngitis

Inflammation of the pharynx

phlebitis

Inflammation of the vein

phlebotomy

An incision into a vein

phrenic nerve

The nerve that controls the diaphragm

pilosebaceous

Pertaining to the hair and sebaceous glands

pleuritis

Inflammation of the pleura

pneumonia

Pertaining to the lungs; a serious lung infection caused by a virus or bacteria

pneumonitis

Inflammation of the lungs

pneumothorax

An accumulation of air in the space between the pleura

polydactyly

Pertaining to many digits

polydipsia

Much thirst

polyuria

Much urine or producing much urine

postmortem

Death after or after death

precancerous

Pertaining to before cancer; many colon polyps are this type

proctologist

A specialist in the study of the anus and rectum

prognosis

Knowledge before or making a prediction of the outcome

prolapse

To fall forward

prostatectomy

Surgical removal of part or all of the prostate

prosthesis

To place in front; an artificial limb

prothrombin

Pertaining to before clotting

psychiatrist

A specialist in the treatment of the mind

psychiatry

Treatment of the mind

psychologist

A specialist in the study of the mind

psychology

The study of the mind

psychosis

An abnormal condition of the mind

pulmonary

Pertaining to the lungs

pyeloplasty

Surgical correction of the renal pelvis

quadriplegia

Paralysis of all four extremities

radiotherapy

Treatment with X-rays

rectal

Pertaining to the rectum

relapse

To slide back

remission

To send back

renal

Pertaining to the kidneys

resection

To cut back

retinopathy

A disease condition of the retina

retrohepatic

Pertaining to behind the liver

retroperitoneal

Pertaining to behind the peritoneum

rhinitis

Inflammation of the nose

rhinorrhea

Discharge from the nose

sacroiliitis

Inflammation of the sacrum and ileum (around the joint)

salpingectomy

Removal of the fallopian tubes

salpingitis

Inflammation of the fallopian tubes

sarcoma

A tumour or mass in the flesh

scrotitis

Inflammation of the scrotum

septicemia

Infection of the blood

sigmoidoscopy

The process of viewing the sigmoid colon

spinal stenosis

Narrowing of the space within the spine; can cause compression of the spinal nerves

splenectomy

Removal of the spleen

spondylosis

A degenerative condition of the spine caused by ongoing wear and tear

stomatologist

A specialist in the study of the mouth

subdural

Pertaining to under the dura mater

subhepatic

Pertaining to below the liver

subscapular

Pertaining to below the scapula

suprapubic

Pertaining to above the pubic region

symbiotic

Pertaining to together in life

syndrome

A group of signs and symptoms that combine to form a syndrome

tachycardia

condition of a fast heart rate

tendinopathy

Disease condition of a tendon

tenotomy

An incision into a tendon

thoracic

Pertaining to the chest

thrombocyte

A cell that clots (platelet)

thymocyte

An immunity cell in the thymus gland

thyroadenitis

Inflammation of the thyroid gland

thyroidotomy

An incision into the thyroid gland

tonsillectomy

Removal of the tonsils

tonsillitis

Inflammation of the tonsils

tracheostomy

An incision into the trachea

tracheotomy

To cut into the windpipe (trachea)

transdermal

Pertaining to across the skin

triceps

An arm muscle with three attachment points (lateral, medial, and long) that joins the humerus and scapula to the ulna

trichotillomania

A mental illness characterized by the compulsion to pull out one's own hair

tympanostomy

A small tube inserted into the eardrum

ultrasonogram

A record beyond sound

ultrasonography

The process of recording beyond sound

ungiectomy

The surgical removal of a fingernail or toenail

unilateral

Pertaining to one side

uremia

A blood condition with urea (a waste product)

ureteroscopy

The process of visually examining the ureters (upper urinary tract)

urethritis

Inflammation of the urethra

urethrotomy

An incision into the urethra

urologist

A specialist in the study of the urinary tract

uterotomy

An incision into the uterus

vaginitis

Inflammation of the vagina

vascular

Pertaining to the blood vessels

vasectomy

A surgical procedure for male sterilization

vasoconstriction

Narrowing of a blood vessel

venulectasia

A large, palpable type of spider vein that is usually purple

vertebral

Pertaining to the vertebra

vesicostomy

An incision into the urinary bladder