Figure 6.28 Chewable aspirin are used for patients experiencing a MI

Mechanism of Action

Aspirin inhibits platelet activation and aggregation.

Indications for Use

Aspirin is indicated in patients with established peripheral arterial disease or a history of recent myocardial infarction (MI) or stroke to reduce the rate of MI and stroke. It is also indicated to reduce the rate of myocardial infarction (MI) and stroke in patients with ST-elevation and non–ST-segment elevation ACS.

Nursing Considerations Across the Lifespan

It is important to remember that the effects of these medications last the life of the platelet (7-10 days), so aspirin will need to be withheld for several days before surgery or certain procedures to prevent excessive bleeding. In elderly patients, there is an increased risk of bleeding events with concurrent use of clopidogrel plus aspirin. Aspirin is contraindicated in children under the age of 12 with flu-like symptoms due to the risk of Reye's syndrome.

Overdose is irreversible.

Clopidogrel is metabolized to its active metabolite by CYP2C19. Concomitant use of drugs that inhibit the activity of this enzyme results in reduced plasma concentrations of the active metabolite of clopidogrel and a reduction in platelet inhibition.

Adverse/Side Effects

Increased risk of bleeding.

Black Box Warning: Reduced effectiveness for patients referred to as "CYP2C19 poor metabolizers."

Patient Teaching & Education

Patients should report tinnitus, unusual bleeding of the gums, bruising, or blood in the stool to the healthcare provider immediately. While on antiplatelet therapy, patients should avoid alcohol to prevent gastric irritation. Additionally, patients should avoid NSAIDs while receiving antiplatelet therapy.
uCentral from Unbound Medicine. https://www.unboundmedicine.com/ucentral

Now let's take a closer look at the medication grid for acetylsalicylic acid and clopidogrel in Table 6.12f.
This work is a derivative of Daily Med by U.S. National Library of Medicine in the public domain.

Table 6.12f Acetylsalicylic Acid and Clopidogrel Medication Grid

Class/ Subclass	Prototype-generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Antiplatelets	acetylsalicylic acid (Aspirin) clopidogrel	Administer with food to reduce risk of GI upset and bleeding Monitor for bleeding Effects last for 7-10 days	Reduce risk of MI and stroke	Increased risk of bleeding

Alteplase (tPA)

Alteplase (tPA) is a thrombolytic used to break up clots. It has a very short half-life of 5 minutes so it can open a clogged artery rapidly. It is often given with heparin to prevent reocclusion of the affected blood vessel. There is also a smaller dosage form that is used to flush clogged IV or arterial lines.
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 443-454. Elsevier.

Mechanism of Action

Alteplase binds to fibrin in a thrombus and converts the entrapped plasminogen to plasmin, thus breaking down the clot.

Indications for Use

Alteplase is indicated for the acute treatment of myocardial infarction (MI), stroke, or massive pulmonary embolism (PE). It is also used to clear central lines such as a peripherally inserted central line catheter (PICC).

Nursing Considerations Across the Lifespan

The drug is contraindicated in situations in which the risk of significant bleeding is greater than the potential benefit such as:

- Active internal or intracranial bleeding
- History of recent stroke
- Recent (within 3 months) intracranial or intraspinal surgery or serious head trauma
- Presence of intracranial conditions that may increase the risk of bleeding (e.g., some neoplasms, arteriovenous malformations, or aneurysms)
- Current severe uncontrolled hypertension

Significant post-administration monitoring is performed due to the risk of life-threatening bleeding.

Adverse/Side Effects

This drug can cause significant, sometimes fatal, internal or external bleeding, especially at arterial and venous puncture sites. Avoid intramuscular injections and perform venipunctures carefully and only as required. It can increase the risk of thrombo-embolic events in patients with high likelihood of left heart thrombus, such as patients with atrial fibrillation.

Patient Teaching & Education

Patients must institute bleeding precautions to prevent complications of therapy.

Now let's take a closer look at the medication grid for alteplase in Table 6.12g.

Table 6.12g Alteplase Medication Grid

Class/ Subclass	Prototype-generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Thrombolytic	alteplase (tPA)	Contraindicated in many conditions where the risk of bleeding outweighs the potential benefit	Break down a life-threatening clot in MI, stroke, or massive PE	Risk of severe bleeding that can be fatal

6.13 Erectile Agents

Open Resources for Nursing (Open RN)

Sildenafil (Viagra) is commonly known to treat erectile dysfunction. This medication was originally developed for improvement of pulmonary hypertension, but has been found to be useful for additional indications. However, patients taking this medication cannot take nitroglycerin due to severe

hypotension.

Mechanism of Action

Sildenafil inhibits phosphodiesterase (PDE-5) in the pulmonary smooth muscle and corpus cavernosum. This allows for relaxation in the smooth muscle.

Indications for Use

Sildenafil is used in the treatment of pulmonary hypertension and erectile dysfunction.

Nursing Considerations Across the Lifespan

Pediatric patients have shown to have an increase in mortality with sildenafil.

Dose adjustments are needed for patients with hepatic and renal impairment.

Use cautiously with geriatric patients with decreased hepatic, renal, and cardiac functions.

Adverse/Side Effects

Patients taking sildenafil may expect to experience hypotension, visual or hearing loss, priapism (male), headache, or vaso-occlusive crisis. If patients have priapism that lasts longer than 4 hours, they should seek medical attention.

Patient Education & Teaching

Patients should be instructed to take medications as directed and should seek immediate medical attention if chest pain occurs. Patients need education regarding the need to report priapism lasting longer than 4 hours or if they notice any dizziness or decrease in hearing ability.

Now let's take a closer look at the medication grid on sildenafil in Table 6.13.

Table 6.13 Sildenafil Medication Grid

Class/ Subclass	Prototype-generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Phosphodiesterase inhibitor	sildenafil	Do not administer with organic nitrates If priapism persists longer than 4 hours,	Decrease pulmonary hypertension Improving erectile	Hypotension Visual loss, hearing loss

		seek medical attention	dysfunction symptoms	Priapism Headache Vaso-occlusive crisis due to sickle cell anemia

6.14 Module Learning Activities

Open Resources for Nursing (Open RN)

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=2800#h5p-31

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=2800#h5p-32

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=2800#h5p-33

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=2800#h5p-43

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VI: Glossary

Open Resources for Nursing (Open RN)

Afterload: The tension that the ventricles must develop to pump blood effectively against the resistance in the vascular system.

Anticoagulant: Any substance that opposes coagulation.

Arrhythmia: A deviation from the normal pattern of impulse conduction and contraction of the heart, which if serious and untreated, can lead to decreased cardiac output and death.

Arteriosclerosis: A condition when compliance in an artery is reduced and pressure and resistance within the vessel increase. This is a leading cause of hypertension and coronary heart disease, as it causes the heart to work harder to generate a pressure great enough to overcome the resistance.

Artery: A blood vessel that carries blood away from the heart (except for pulmonary arteries that carry oxygenated blood from the lungs back to the heart).

Atherosclerosis: A buildup, called plaque, that can narrow arteries enough to impair blood flow.

Blood pressure: A type of hydrostatic pressure, or the force exerted by blood on the walls of the blood vessels or the chambers of the heart.

Capillaries: Smallest arteries where nutrients and wastes are exchanged at the cellular level.

Cardiac Output (CO): To calculate this value, multiply stroke volume (SV), the amount of blood pumped by each ventricle, by heart rate (HR), in contractions per minute (or beats per minute, bpm). It can be represented mathematically by the following equation: $CO = HR \times SV$.

Cerebrovascular Accident (CVA): Lack of blood flow to the brain that can cause irreversible brain damage, often referred to as a "stroke."

Coagulation: The formation of a blood clot.

Compliance: The ability of any compartment to expand to accommodate increased content. The greater the compliance of an artery, the more effectively it is able to expand to accommodate surges in blood flow without increased resistance or blood pressure. Veins are more compliant than arteries and can expand to hold more blood. When vascular disease causes stiffening of arteries, compliance is reduced

and resistance to blood flow is increased.

Contractility: The force of contraction of the heart.

Diastole: The period of relaxation that occurs as the chambers fill with blood.

Edema: The presence of excess tissue fluid around the cells.

Embolus: When a portion of a thrombus breaks free from the vessel wall and enters the circulation. An embolus that is carried through the bloodstream can be large enough to block a vessel critical to a major organ. When it becomes trapped, an embolus is called an embolism. In the heart, brain, or lungs, an embolism may accordingly cause a heart attack, a stroke, or a pulmonary embolism.

Fibrillation: An uncoordinated beating of the heart, which if serious and untreated, can lead to decreased cardiac output and death.

Fibrinolysis: The gradual degradation of a clot.

Hemostasis: The process by which the body temporarily seals a ruptured blood vessel and prevents further loss of blood.

Hyperlipidemia: Elevated cholesterol levels in the blood that increase a patient's risk for heart attack and stroke.

Hypertension: Chronically elevated blood pressure.

Hypervolemia: Excessive fluid volume caused by retention of water and sodium, as seen in patients with heart failure, liver cirrhosis, and some forms of kidney disease.

Hypovolemia: Decreased blood volume that may be caused by bleeding, dehydration, vomiting, severe burns, or by diuretics used to treat hypertension. Treatment typically includes intravenous fluid replacement.

International Normalized Ratio (INR): A blood test used to monitor the effects of warfarin and to achieve therapeutic range, generally between 2.0 and 3.5 based on the indication.

Ischemia: Reduced blood flow to the tissue region "downstream" of the narrowed vessel.

Loop of Henle: A component of the nephron where loop diuretics act to eliminate sodium and water.

Myocardial Infarction (MI): Commonly referred to as a heart attack, resulting from a lack of blood flow (ischemia) and oxygen to a region of the heart, resulting in death of the cardiac muscle cells.

Negative Inotropic factors: Factors that decrease contractility.

Partial Thromboplastin Time (PTT): A blood test used to monitor how long it takes for a patient's blood to clot. PTT is used for patients receiving IV heparin therapy to achieve therapeutic range. Dosage is considered adequate when the activated partial thromboplastin time (APTT) is 1.5 to 2 times the normal or when the whole blood clotting time is elevated approximately 2.5 to 3 times the control value.

Positive inotropic factors: Factors that increase contractility.

Preload: The amount of blood in the atria just prior to atrial contraction.

Prothrombin Time (PT): A blood test that measures how long it takes for a patient's blood to clot. PT is used to monitor the effects of warfarin in preventing clot formation.

Renin-Angiotensin-Aldosterone System (RAAS): Renin converts the plasma protein angiotensinogen into its active form—Angiotensin I. Angiotensin I circulates in the blood and is then converted into angiotensin II in the lungs. This reaction is catalyzed by the angiotensin-converting enzyme (ACE). Angiotensin II is a powerful vasoconstrictor, greatly increasing blood pressure. It also stimulates the release of ADH and aldosterone, a hormone produced by the adrenal cortex. Aldosterone increases the reabsorption of sodium into the blood by the kidneys, causing reabsorption of water and increasing blood volume and raising blood pressure.

Sinoatrial (SA) node: Normal cardiac rhythm is established by the sinoatrial (SA) node. The SA node has the highest inherent rate of depolarization and is known as the pacemaker of the heart.

Sinus rhythm: Normal electrical pattern followed by contraction of the heart.

Stroke Volume (SV): The amount of blood that both ventricles pump during each contraction, normally in the range of 70–80 mL.

Systole: The period of contraction that the heart undergoes while it pumps blood into circulation.

Thrombus: An aggregation of platelets, erythrocytes, and WBCs trapped within a mass of fibrin strands that adhere to the vessel wall and decrease the flow of blood or totally block the flow of blood.

Transient Ischemic Attack (TIA): Occurs when blood flow is interrupted to the brain, even for just a few seconds, resulting in loss of consciousness or temporary loss of neurological function.

Veins: Blood vessels that conduct blood toward the heart (except for pulmonary veins that carry deoxygenated blood from the heart to the lungs).

Venous reserve: Volume of blood located in venous networks within the liver, bone marrow, and integument.

VII

Gastrointestinal

7.1 Gastrointestinal Introduction

Open Resources for Nursing (Open RN)

Learning Objectives

- Cite the classifications and actions of gastrointestinal system drugs
- Give examples of when, how, and to whom gastrointestinal system drugs may be administered
- Identify the side effects and special considerations associated with gastrointestinal system drug therapy
- Identify considerations and implications of using gastrointestinal system medications across the lifespan
- Apply evidence-based concepts when using the nursing process
- Identify indications and adverse/side effects associated with the use of herbal supplements
- Identify and interpret related laboratory tests

Gastrointestinal complaints are a commonplace occurrence. How many times have you heard someone complaining of an upset stomach, heartburn, nausea, constipation, or diarrhea? Occasionally, these ailments will go away on their own…but if they do not, there are a variety of medications that can be used to treat the disease or symptom. Treatment can involve both the use of prescription and nonprescription drug therapy, in addition to nonpharmacological interventions. In this chapter, you will learn about medications used to treat common disorders within the gastrointestinal system.

Prior to the examination of specific medication classes, it is important to have a clear understanding of the various components that make up the gastrointestinal system. Use the following "Basics" section to review selected anatomy and physiology of the gastrointestinal system.

7.2 Basics: Gastrointestinal System Review

Open Resources for Nursing (Open RN)

Overview of Gastrointestinal System and Processes

There are several supplementary sources you can use to review anatomy and physiology information that is important to know to understand how GI medications work. Figure 7.1 "Components of the Digestive System" by CNX OpenStax is licensed under CC BY 4.0 Access for free at https://openstax.org/books/anatomy-and-physiology/pages/23-1-overview-of-the-digestive-system illustrates the anatomical components of the gastrointestinal system. Links are provided below to the OpenStax *Anatomy and Physiology* book for further details regarding the following selected areas: overview of the digestive system, digestive system processes and regulation, the stomach, the small and large intestines, and chemical digestion and absorption. Box 7.2 contains links to supplementary videos further explaining the gastrointestinal system and digestive system. Medications related to hyperacidity, bowel disorders, and nausea and vomiting will be discussed in this chapter with reference to how they target pathophysiological concepts related to these organs and processes.

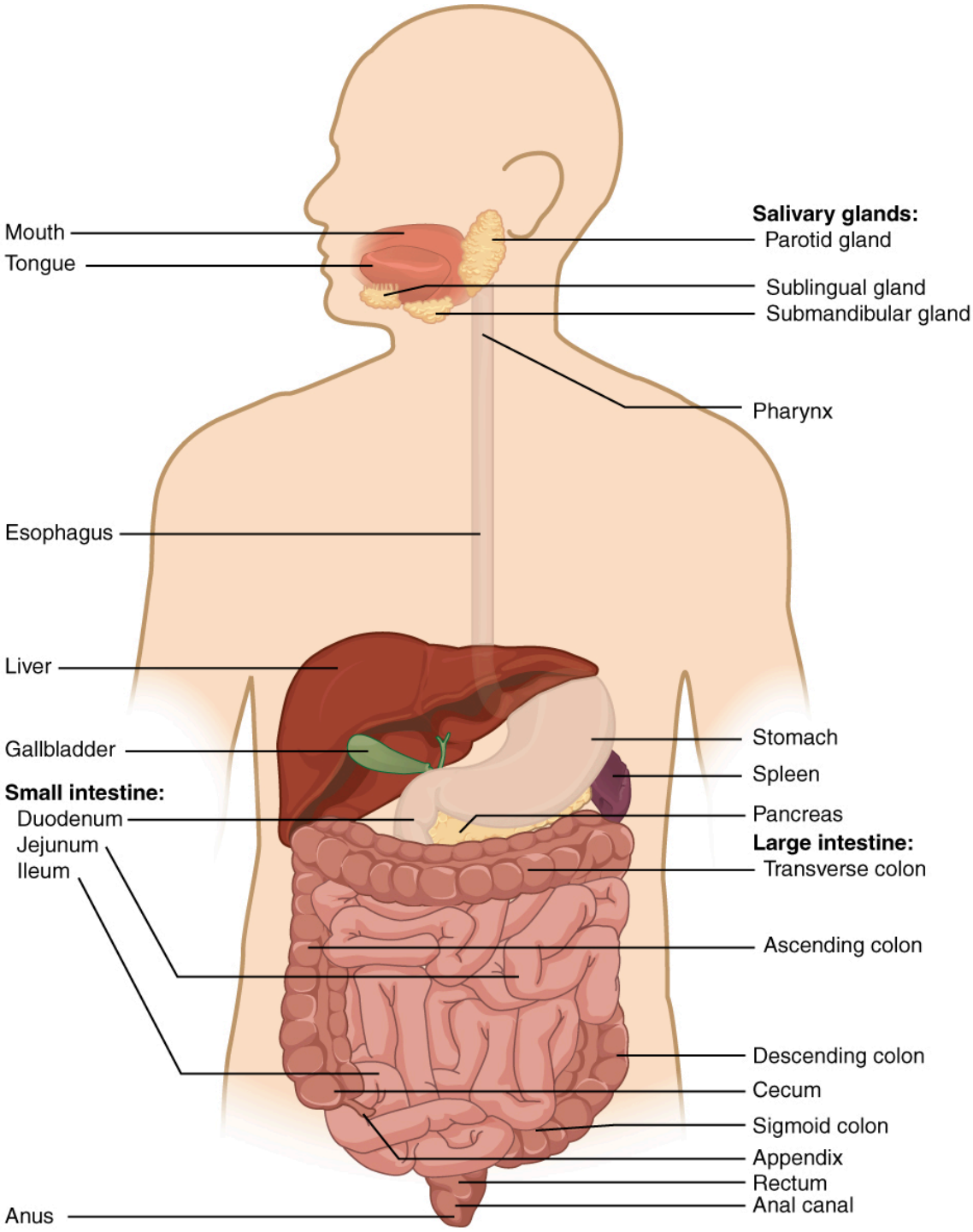

Figure 7.1 Components of GI System

Links to Open Stax A&P detailed content related to this module:

Overview of the Digestive System

Digestive System Processes and Regulation

The Stomach

The Small and Large Intestines

Chemical Digestion and Absorption: A Closer Look

Box 7.2 – Video links reviewing the gastrointestinal system and digestive processes

Gastrointestinal System Review

Forciea, B. (2015, March 18). *Anatomy and Physiology of the Digestive System* [Video]. YouTube. All rights reserved. Video used with permission. https://youtu.be/1ssJV-EpfiQ.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/pharmacology/?p=1186#oembed-1

Ted Ed review of digestive system

Bryce, E. (2017, December 14). *How Your Digestive System Works.* [YouTube]. https://youtu.be/Og5xAdC8EUI.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://wtcs.pressbooks.pub/pharmacology/?p=1186#oembed-2

Khan Academy review of GI system

7.3 Anti-Ulcer Medications

Open Resources for Nursing (Open RN)

Pathophysiology

The stomach contains cells that secrete different substances as part of the digestive process: parietal cells, chief cells, and surface epithelium cells. See an image of the stomach and these cells in Figure 7.2.

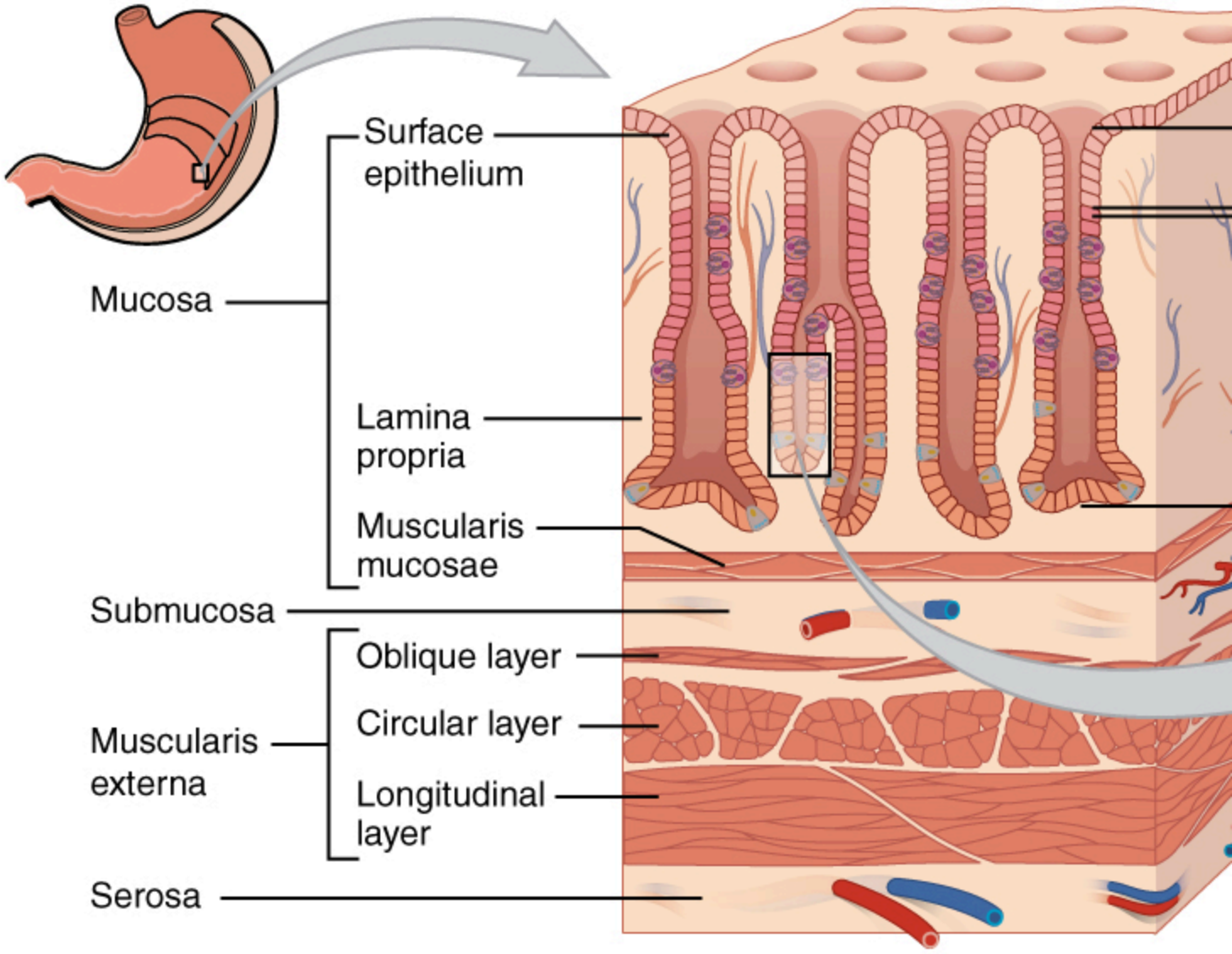

Figure 7.2 An image of the stomach with surface epithelium cells in the mucosa, and an enlarged image of the gastri

Surface epithelium cells are found within the lining of the stomach and secrete mucus as a protective coating. Parietal cells and chief cells are found within the gastric glands. **Parietal cells** produce and secrete hydrochloric acid (HCl) to maintain the acidity of the environment of a pH of 1 to 4. Parietal cells also secrete a substance called **intrinsic factor**, which is necessary for the absorption of vitamin B12 in the small intestine. Parietal cells are the primary site of action for many drugs that treat acid-related disorders. Chief cells secrete pepsinogen that becomes **pepsin**, a digestive enzyme, when exposed to acid. The stomach also contains enteroendocrine cells (ECL or enterochromaffin-like cells) located in the gastric glands that secrete substances including serotonin, histamine, and somatostatin. G cells in the stomach secrete gastrin that promotes secretions of digestive substances. Although these cells play an important role in the digestive system, acid-related diseases can occur when there is an imbalance of secretions. The most common mild to moderate hyperacidic condition is **gastroesophageal reflux disease (GERD)**, often referred to by patients as heartburn, indigestion, or sour stomach. GERD is caused by excessive hydrochloric acid that tends to back up, or reflux, into the lower esophagus. See Figure 7.3 for an illustration of GERD.

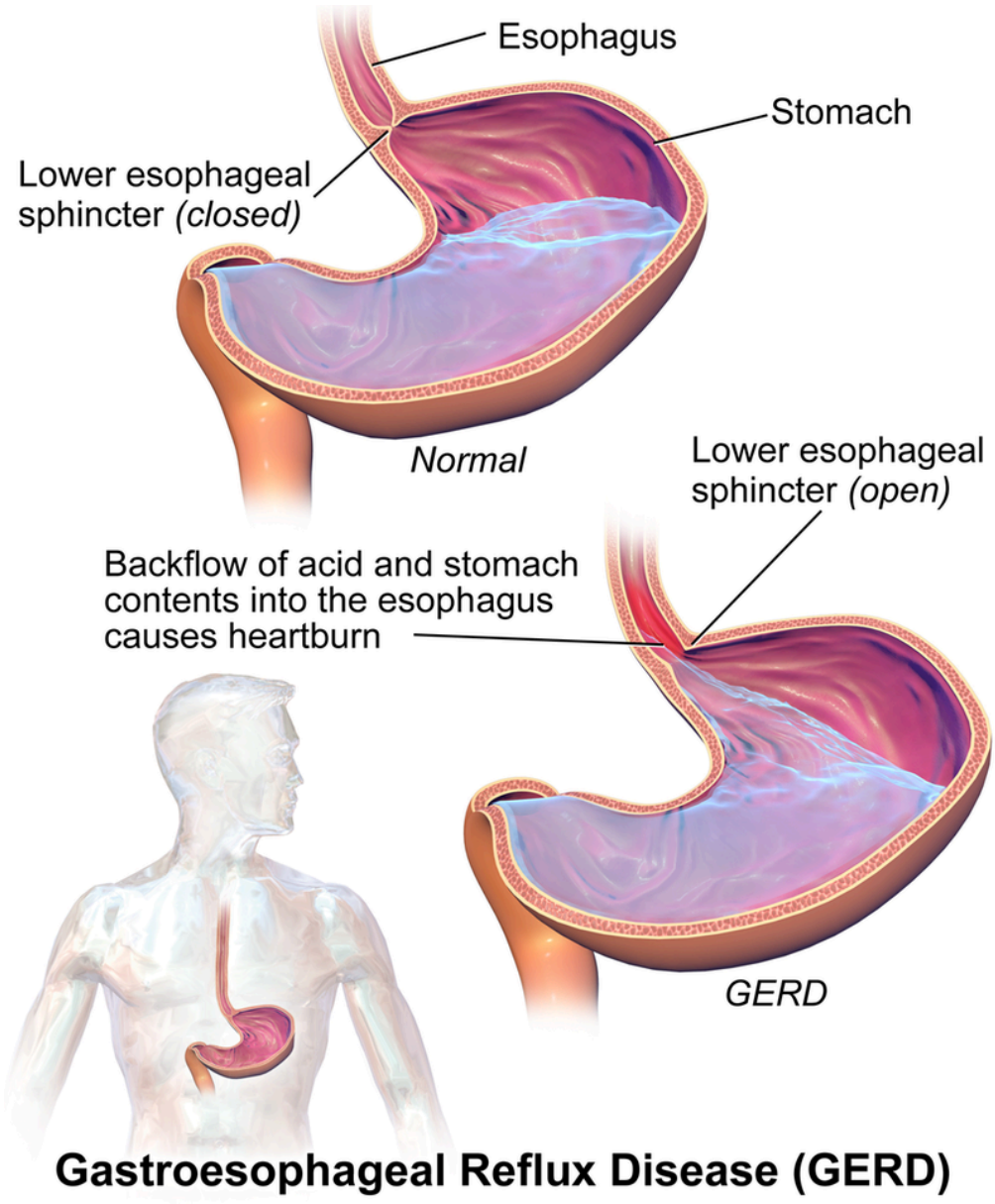

Figure 7.3 Illustration of GERD

Peptic ulcer disease (PUD) occurs when gastric or duodenal ulcers are caused by the breakdown of GI mucosa by pepsin, in combination with the caustic effects of hydrochloric acid. PUD is the most harmful disease related to hyperacidity because it can result in bleeding ulcers, a life-threatening condition.

Stress-related mucosal damage is another common condition that can occur in hospitalized patients leading to PUD. Thus, many post-operative or critically ill patients receive medication to prevent the formation of a stress ulcer, which is also called **prophylaxis**.

Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process*. pp. 782-862. Elsevier.

See an image of a duodenal ulcer in Figure 7.4.

Figure 7.4 Image of a duodenal ulcer

Links to supplementary videos illustrating heartburn and gastric ulcers:

Heartburn
MedlinePlus. Bethesda (MD): National Library of Medicine (US); [updated 2019 October 23]. Heartburn; [updated 2019 October 2; cited 2019 October 27] https://medlineplus.gov/ency/anatomyvideos/000068.htm

Gastric ulcer
Blausen Medical. (2015, November 17). *Gastric Ulcers* [Video].https://blausen.com/en/video/gastric-ulcers/#

Overall Nursing Considerations for Hyperacidity Medications

Assessments: Whenever a nurse administers hyperacidity medications, there are common assessments that should be documented, such as an abdominal assessment and documentation of bowel patterns. During therapy, the nurse should continue to assess for potential medication interactions and side effects and be aware that vitamin B12 malabsorption may occur whenever stomach acidity levels are altered. Based on the category of medication, renal and liver function may require monitoring. Additionally, if a patient complains of chest pain, the nurse should perform a complete focused cardiac assessment and not assume it is GI-related because patients may erroneously attribute many cardiac conditions to "heartburn."

Implementation: The nurse should read the drug label information and follow the recommendations for administering hyperacidity medications with other medications or the intake of food. Cultural preferences should also be accommodated when safe and feasible because the patient may believe in alternative methods for treating GI discomfort. A written plan of care with modifications for safe use of medications with these alternative methods may be required.

Evaluation: Patients should experience improvement of symptoms within the defined time period; if not, the provider should be notified. Increased pain or new symptoms of coughing/vomiting of blood should be immediately reported because these symptoms can be signs of a life-threatening bleeding ulcer.

Hyperacidity Medication Classes

There are four major classes of medications used to treat hyperacidity conditions: antacids, H2-receptor antagonists, proton pump inhibitors, and mucosal protectants. Each class of medication is further described below.

Antacids

Antacids (see Figure 7.5

) are used to neutralize stomach acid and reduce the symptoms of heartburn. There are many OTC medications available for this purpose, such as calcium carbonate, aluminum hydroxide, and magnesium hydroxide. Calcium carbonate is the prototype discussed as an example. Be sure to read drug label information regarding antacids as you administer them because each type has its own specific side effects. Many antacids also contain simethicone, an antiflatulent used for gas relief. Simethicone is further described in the medication grid below.

Figure 7.5 Antacids

Indications

Antacids are used to relieve heartburn, acid indigestion, and upset stomach.

Mechanism of Action

Antacids neutralize gastric acidity and elevate the pH of the stomach. Elevated pH also inactivates pepsin, a digestive enzyme.

Specific Administration Considerations

Calcium carbonate comes in various formations such as a tablet, a chewable tablet, a capsule, or liquid to take by mouth. It is usually taken three or four times a day. Chewable tablets should be chewed thoroughly before being swallowed; do not swallow them whole. The patient should drink a full glass of water after taking either the regular or chewable tablets or capsules. Some liquid forms of calcium carbonate must be shaken well before use. Do not administer calcium carbonate within 1-2 hours of other medicines because calcium may decrease the effectiveness of the other medicine. Calcium carbonate may be contraindicated in patients with preexisting kidney disease because it may cause **hypercalcemia**. Common side effects of calcium carbonate include constipation and **rebound hyperacidity** when it is discontinued.

A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Patient Teaching & Education

In addition to the information under "Specific Administration Considerations," patients should be reminded to take OTC meds appropriately as prescribed and to not exceed the maximum dose. Other interventions to prevent hyperacidity can also be recommended, such as smoking cessation and avoiding food and beverages that can cause increased acidity (alcohol, high-fat or spicy foods, and caffeine).

Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process. pp. 782-862. Elsevier*.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach*. pp. 443-454. Elsevier.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

H2-Receptor Antagonist

A common H2-receptor antagonist is famotidine. It is available OTC and is also often prescribed orally or as an IV injection in the hospital setting. Other H2-receptor antagonists include cimetidine and ranitidine. Cimetidine has a high risk of drug interactions, especially in elderly patients because of its binding to **cytochrome P-450 enzymes** in the liver, which affects the metabolism of other drugs.

Figure 7.6 OTC Famotidine

Indications

Famotidine (see Figure 7.6

) is used to treat GERD, peptic ulcer disease, erosive esophagitis, and hypersecretory conditions, or as adjunct treatment for the control of upper GI bleeding. OTC famotidine is also used to treat heartburn or sour stomach.

Mechanism of Action

H2-receptor antagonists block histamine's action at the H2 receptor of the parietal cell, thus reducing the production of hydrochloric acid.

Specific Administration Considerations

To prevent symptoms, oral famotidine is taken 15 to 60 minutes before eating foods or drinking drinks

that may cause heartburn. Preexisting liver and kidney disease may require dosage adjustment. Famotidine is supported by evidence as safe for use in pediatric patients younger than 1 year old, as well as in geriatric patients.

Patient Teaching & Education

Patients taking the oral suspension should be instructed to shake it vigorously for 5 to 10 seconds prior to each use.

Lilley, L., Collins, S., Snyder, J. (2014). *Pharmacology and the Nursing Process*. pp. 782-862. Elsevier.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach*. pp. 443-454. Elsevier.

The medication may cause constipation so fluids and high-fiber diet should be encouraged. Additionally, smoking interferes with histamine antagonists and should be discouraged.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Proton Pump Inhibitors

A common proton pump inhibitor (PPI) is pantoprazole (see Figure 7.7). It may be prescribed in various routes including orally, with an NG tube, or as an IV injection in the hospital setting. Other PPIs include esomeprazole, lansoprazole, and omeprazole. PPIs are more powerful than antacids and H2-receptor antagonists.

Figure 7.7 OTC Omeprazole

Indications

Pantoprazole is used to treat damage from gastroesophageal reflux disease (GERD) in adults and children five years of age and older by allowing the esophagus to heal and prevent further damage. It is also used to treat conditions where the stomach produces too much acid, such as Zollinger-Ellison syndrome in adults. PPIs may also be given in combination with antibiotics to treat *H.Pylori* infections, a common cause of duodenal ulcers.

Mechanism of Action

PPIs bind to the hydrogen-potassium ATPase enzyme system of the parietal cell, also referred to as the "proton pump" because it pumps hydrogen ions into the stomach. PPIs inhibit the secretion of hydrochloric acid, and the antisecretory effect lasts longer than 24 hours.

Specific Administration Considerations

Packets of delayed-release granules must be mixed with applesauce or apple juice and taken by mouth or given through a feeding tube. Consult the labeling of concomitantly used drugs to obtain further information about interactions because PPIs can interfere with the liver metabolism of other drugs. IV pantoprazole can potentially exacerbate zinc deficiency, and long-term therapy can cause hypomagnesemia, so the nurse should monitor for these deficiencies.

Patient Teaching & Education

In addition to the considerations above, instruct patients to call their provider if their condition does not improve or gets worse, especially if bleeding occurs.

Lilley, L., Collins, S., Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 782-862. Elsevier.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 443-454. Elsevier.

Use of alcohol, NSAIDS, or foods that cause GI irritation should be discouraged.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27; https://medlineplus.gov/ency/anatomyvideos/000068.htm

Mucosal Protectants

Sucralfate is a mucosal protectant used to cover and protect gastrointestinal ulcers.

Indications

Sucralfate is used in the treatment of ulcers.

Mechanism of Action

Sucralfate locally covers the ulcer site in the GI tract and protects it against further attack by acid, pepsin, and bile salts. It is minimally absorbed by the gastrointestinal tract.

Specific Administration Considerations

Administer sucralfate on an empty stomach, 2 hours after or 1 hour before meals. Constipation may

occur. Sucralfate should be cautiously used with patients with chronic renal failure or those receiving dialysis due to impaired excretion of small amounts of absorbed aluminum that can occur with sucralfate.

Patient Teaching & Education

In addition to the considerations above, instruct patients to call their provider if their condition does not improve or gets worse.

Lilley, L., Collins, S., Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 782-862. Elsevier.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A Patient-Centered Nursing Process Approach.* p.188-194 and 604-633. Elsevier.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Antiflatulent

Simethicone is an antiflatulent that is commonly found in other OTC antacids (see Figure 7.8). It is also safe for use in infants. Gas commonly occurs in the GI tract due to digestive processes and the swallowing of air. Gaseous distension can also occur postoperatively.

Figure 7.8 OTC Simethicone

Indications

Simethicone is used to treat the symptoms of gas such as uncomfortable or painful pressure, fullness, and bloating.

Mechanism of Action

Simethicone works by altering the elasticity of the mucous-coated gas bubbles, which cause them to break into smaller bubbles, thus reducing pain and facilitating expulsion.

Specific Administration Considerations

Simethicone is usually taken four times a day, after meals and at bedtime. For liquid form, shake drops before administering.

Patient Teaching & Education

Patients can be instructed about other measures to assist with gas expulsion such as changing position, ambulation, avoiding the use of straws, and tapering intake of beans and cruciferous vegetables.
Lilley, L., Collins, S., Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 782-862. Elsevier.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 443-454. Elsevier.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=1194#h5p-18

Now let's take a closer look at the medication grids comparing medications used to treat hyperacidity in Table 7.3.
Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 782-862. Elsevier.

,

McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 443-454. Elsevier.

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Medication grids are intended to assist students to learn key points about each medication. Because information about medication is constantly changing, nurses should always consult evidence-based resources to review current recommendations before administering specific medication. Basic information related to each class of medication is outlined below. Detailed information on a specific medication can be found for free at Daily Med. On the home page, enter the drug name in the search bar to read more about the medication. Prototype/generic medications listed in the grids below are also hyperlinked directly to a Daily Med page.

Table 7.3 Medication Grid Comparing Hyperacidity Medications

Class	Prototype	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Antacid	calcium carbonate	Do not administer within 1-2 hours of other medications Drink a full glass of water after administration Use cautiously with renal disease	Decreased symptoms of heartburn or sour stomach	Constipation Hypercalcemia Rebound hyperacidity when discontinued
H2 blocker	famotidine	Administer 15 to 60 minutes before eating foods or drinking drinks that may cause heartburn Preexisting liver and kidney disease may require dosage adjustment	Decreased symptoms of heartburn or sour stomach Decreased pain if ulcers are present	Side effects: headache, dizziness, constipation, and diarrhea Immediately report increased pain or other signs of bleeding ulcers such as coughing/ vomiting of blood Hypersensitivity; anaphylaxis and serious skin reactions Potential zinc, magnesium, or B12 deficiency
Proton Pump Inhibitor	pantoprazole	Delayed release can be taken with or without food Administer granules with apple juice or applesauce	Decreased symptoms of heartburn and pain	Headache, abdominal pain, diarrhea, constipation Acute renal dysfunction Osteoporosis-related bone fracture Acute lupus erythematosus

				Immediately report increased pain or other signs of bleeding ulcers such as coughing/ vomiting of blood
Mucosal protectants	sucralfate	Administer sucralfate on an empty stomach, 2 hours after or 1 hour before meals Use cautiously used patients with chronic renal failure	Healing of ulcer	Constipation
Antiflatulant	simethicone	Shake drops before administering	Relief of gas discomfort	None

Critical Thinking Activity 7.3
Image of lightbulb in a circle

A patient who recently underwent surgery has a medication order for daily pantoprazole. The nurse reviews the patient's medical history and finds no history of GERD or peptic ulcer disease. The patient does not report any symptoms of heartburn, stomach pain, or sour stomach. The nurse reviews the physician orders for an indication for this medication before calling the provider to clarify.

What is the likely indication for this drug therapy for this patient?

Note: Answers to the Critical Thinking activities can be found in the "Answer Key" sections at the end of the book.

7.4 Antidiarrheal Medications and Laxatives

Open Resources for Nursing (Open RN)

The digestive system is continually at work, but unless something goes amiss, you don't notice your digestive system working. This section will focus on bowel disorders that occur in the lower intestine during the final step of digestion called **defecation**, when undigested materials are removed from the body as feces. During this final step, the large intestine absorbs water and changes the waste from liquid into stool; then peristalsis helps move the stool into the rectum. Diarrhea and constipation occur when conditions occur that affect this final step of defection.

The process of defecation begins when mass movements force feces from the colon into the rectum, stretching the rectal wall and provoking the defecation reflex, which eliminates feces from the rectum. This parasympathetic reflex is mediated by the spinal cord. It contracts the sigmoid colon and rectum, relaxes the internal anal sphincter, and initially contracts the external anal sphincter. Figure 7.9

reviews the anatomy of the rectum and its external and internal sphincters. The presence of feces in the anal canal sends a signal to the brain, which gives the person the choice of voluntarily opening the external anal sphincter (defecating) or keeping it temporarily closed. If defecation is delayed until a more convenient time, it takes a few seconds for the reflex contractions to stop and the rectal walls to relax. The next mass movement will trigger additional defecation reflexes until defecate occurs.

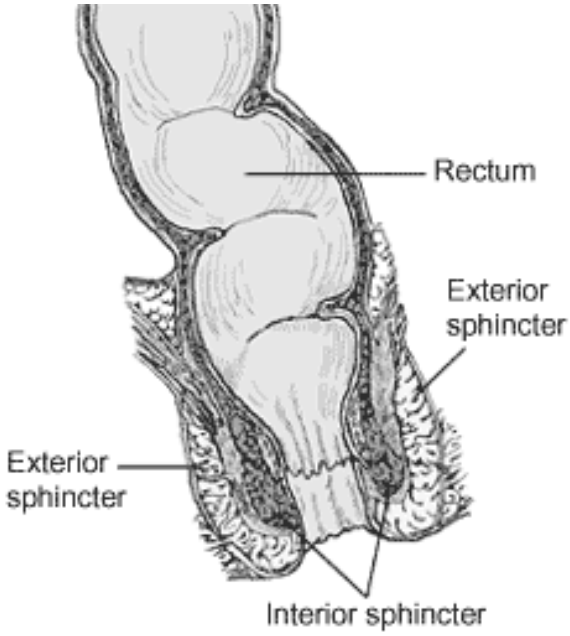

Figure 7.9 Anatomy of the Rectum

If defecation is delayed for an extended time, additional water is absorbed, making the feces firmer and potentially leading to constipation. Alternatively, if the waste matter moves too quickly through the intestines, not enough water is absorbed, and diarrhea can result. Figure 7.10

demonstrates the Bristol Stool Chart that is used to assess stool characteristics ranging from very constipated to diarrhea.

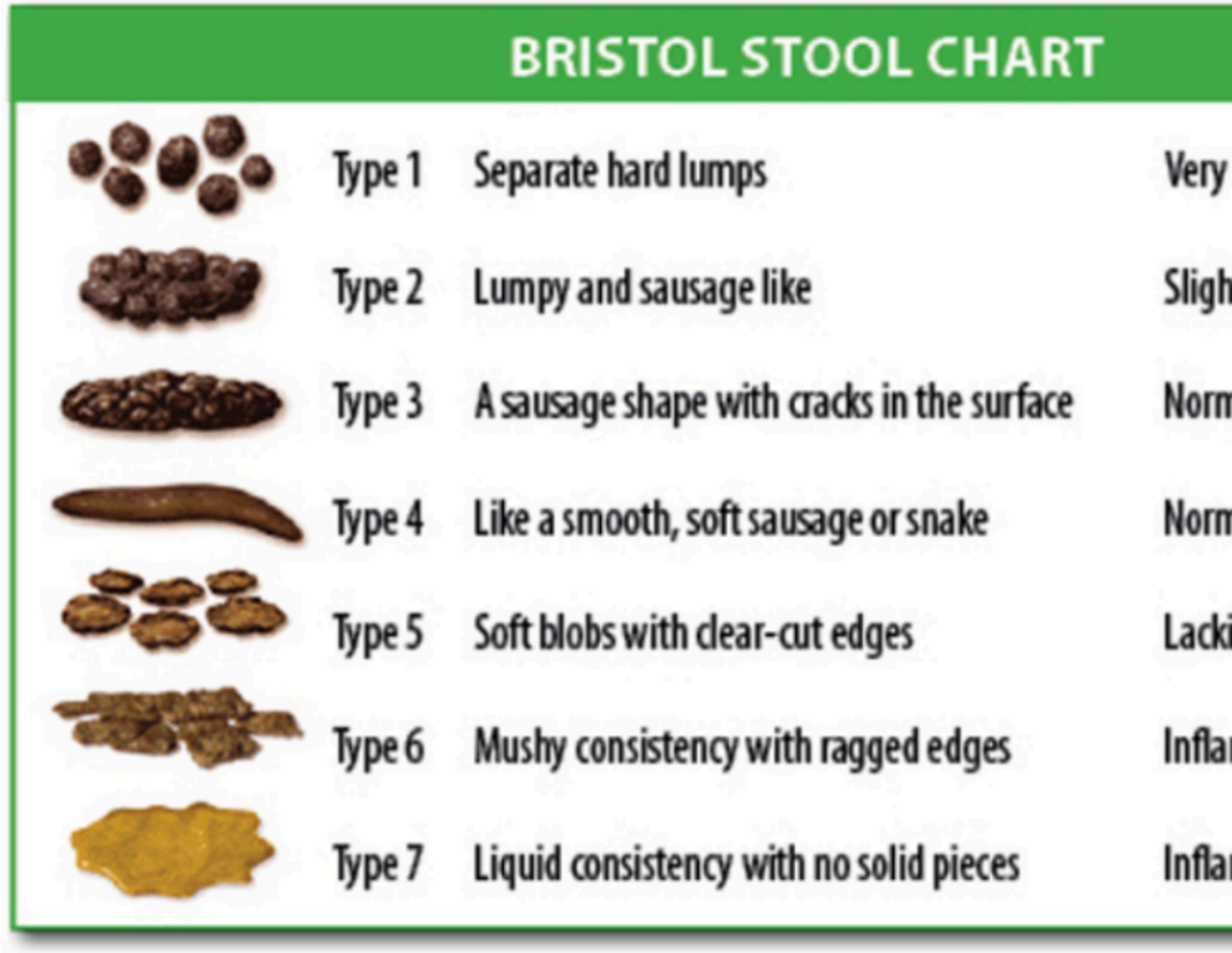

Figure 7.10 Bristol Stool Chart

You can further review how the digestive system works at the following links:

Digestive System Processes and Regulation

Your Digestive System and How it Works

National Institute of Diabetes and Digestive and Kidney Diseases, National Institute of Health. (2018). *Treatment for constipation.* https://www.niddk.nih.gov/health-information/digestive-diseases/constipation/treatment.

Video on Digesting Food

7.4a Antidiarrheals

Pathophysiology

Diarrhea is defined as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual). Frequent passing of formed stools is not considered diarrhea. Diarrhea has multiple causes such as bacteria from contaminated food or water; viruses such as influenza, norovirus, or rotavirus; parasites found in contaminated food or water; medicines such as antibiotics, cancer drugs, and antacids that contain magnesium; food intolerances and sensitivities; and diseases that affect the colon, such as Crohn's disease or irritable bowel syndrome.
A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm
The most severe threat posed by diarrhea is dehydration caused by the loss of water and electrolytes. Diarrheal disease is a leading cause of child mortality and morbidity throughout the world due to dehydration; frail elderly are also at risk. When severe diarrhea occurs, assessment for dehydration and electrolyte imbalances receive top priority and rehydration with oral rehydration solutions or IV fluids may be required.
World Health Organization. (2017, May 2). *Diarrhoeal disease.*https://www.who.int/en/news-room/fact-sheets/detail/diarrhoeal-disease.
Common medications used to manage the symptoms of diarrhea are discussed below.

Nursing Considerations

Assessment

When administering antidiarrheals, the nurse should document an abdominal assessment, frequency of bowel movements and stool characteristics, and if there is skin breakdown in the anal area. Dehydration is a serious risk in patients with severe diarrhea, so priority assessments and documentation relate to monitoring for dehydration, especially in vulnerable populations of infants, children, and elderly. If signs of dehydration occur, the provider should be immediately notified and treatment initiated for dehydration.

Implementation

Teach the patient to not exceed dosages of OTC medications because life-threatening adverse effects may occur. Probiotics have been found to be likely safe in all populations, and the nurse can advocate for the use of probiotics in patients with diarrhea or those at risk for diarrhea because of other medications prescribed. In addition to teaching about medication therapy, nurses can also teach patients with diarrhea other nonpharmacological interventions, such as replacing fluid and electrolytes by drinking water, sports drinks, or sodas without caffeine; and eating soft, bland food like bananas, rice, and toast. Children with severe diarrhea may also require oral rehydration solutions to replace lost fluids and electrolytes. The nurse should also keep in mind that antidiarrheals should be used very cautiously with children because some categories are contraindicated.

Evaluation

Because antidiarrheals treat the symptoms of diarrhea but do not eliminate the cause of it, if symptoms do not resolve within 48 hours, the provider should be notified and other potential causes of diarrhea

investigated. Monitor for serious adverse effects such as increased bleeding in patients taking salicylates and for abnormal heart rhythms in patients taking loperamide and notify the provider immediately. Evaluation for dehydration should continuously occur until the condition resolves.

Antidiarrheal Medication Classes

There are three common mechanisms of action of **antidiarrheal** medications: adsorbents, which help eliminate the toxin or bacteria from the GI tract; **antimotility** agents, which slow peristalsis; and probiotics, which help to restore the normal bacteria found in the lower intestine. Oral rehydration agents may also be used in patients with diarrhea to replace fluid and electrolyte loss, but they do not treat the diarrhea. Antibacterial agents may also be used to treat diarrhea caused by specific infections, such as campylobacter or giardia, but they are not routinely needed.
World Health Organization. (2017, May 2). *Diarrhoeal disease.*https://www.who.int/en/news-room/fact-sheets/detail/diarrhoeal-disease

Adsorbents

Adsorption is the adhesion of molecules to a surface. This process differs from absorption, where a substance is dissolved or penetrates into a surface. Bismuth subsalicylate (brand name Pepto Bismol) is an example of an adsorbent (see Figure 7.11
"PeptoBismol Bottle.JPG" by ParentingPatch is licensed under CC BY-SA 3.0
).

Figure 7.11 Bismuth Subsalicylate

Mechanism of Action Adsorbent medications work by coating the walls of the GI tract and binding the causative bacteria or toxin for elimination from the GI tract through the stool.
Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 782-862. Elsevier.

Bismuth subsalicylate also decreases the flow of fluids and electrolytes into the bowel, reducing inflammation within the intestine.
A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Specific Administration Considerations Bismuth subsalicylate contains salicylate. It should be avoided if the patient has an allergy to salicylates (including aspirin) or if the patient is taking other salicylate products such as aspirin. It should not be used if the patient has an ulcer, a bleeding problem, or bloody or black stool. Children and teenagers who have or are recovering from chicken pox or flu-like symptoms should not use this product. When using this product, if changes in behavior with nausea and vomiting occur, consult a doctor because these symptoms could be an early sign of Reye's syndrome, a rare but serious illness. Liquid products should be shaken well before use. Tablets should be swallowed whole and not chewed unless they are a chewable tablet. Medication can cause a black or darkened tongue. If symptoms worsen, a fever, or ringing in the ears occurs, or if diarrhea lasts longer than 48 hours, contact the provider.

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A.D.A.M. Medical Encyclopedia [Internet]. A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Patient Teaching & Education

Patients should be advised to take medication as directed. They should be aware of potential color changes to stool that may occur and that the medication contains aspirin. They should discontinue the medication if tinnitus occurs.
uCentral from Unbound Medicine. https://www.unboundmedicine.com/ucentral

Antimotility

Antimotility medications help to treat diarrhea by slowing peristalsis. There are two categories of antimotility medication: anticholinergics and opiate-like medication.

Anticholinergics

Mechanism of Action Hyoscyamine is an anticholinergic that works on the smooth muscle of the GI tract to inhibit propulsive motility and decreases gastric acid secretion.

Specific Administration Considerations Read drug label information for all contraindications, including but not limited to, glaucoma, myasthenia gravis, and paralytic ileus. Diarrhea may be an early symptom of incomplete intestinal obstruction, and the use of this drug would be inappropriate and possibly harmful. CNS symptoms and other adverse effects may occur that are common with anticholinergic medications.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Patient Teaching & Education

Patients should receive instruction that these medications may cause dizziness and drowsiness. If patients experience dry mouth, frequent oral hygiene may alleviate discomfort.
uCentral from Unbound Medicine. https://www.unboundmedicine.com/ucentral

Opioid-like medication

Mechanism of Action Loperamide has an opioid-like chemical structure but causes fewer CNS effects. It works by decreasing the flow of fluids and electrolytes into the bowel and by slowing down the movement of the bowel to decrease the number of bowel movements (see Figure 7.12

).

Figure 7.12 Loperamide

Specific Administration Considerations Loperamide should not be given to a child younger than two years of age because of the risk of serious breathing and heart problems. Taking more than the prescribed dose can cause a serious abnormal heart rhythm that can lead to death. Read the drug label carefully for information about interaction with other medications, especially antidysrhythmics and antipsychotics.
This work is a derivative of Daily Med by U.S. National Library of Medicine in the public domain.
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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Patient Teaching & Education

Patients should take medications as directed. They should also avoid alcohol and other CNS depressants. The medications may cause drowsiness.
uCentral from Unbound Medicine. https://www.unboundmedicine.com/ucentral

Probiotics

Probiotics are used for the prevention and treatment of diarrhea. They are often used concomitantly with antibiotics to prevent the common associated side effects of diarrhea (see Figure 7.13

). An example of a probiotic is lactobacillus.

Figure 7.13 Probiotics come in several forms

Mechanism of Action Probiotics help replenish normal bacterial flora in the gastrointestinal tract.

Specific Administration Considerations/ Patient Teaching & Education Side effects of probiotics are mild such as gas and bloating. Probiotics are safe for use in children.

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm

Now let's take a closer look at medication grids comparing medications used to treat diarrhea. (See Table 7.4a

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A.D.A.M. Medical Encyclopedia [Internet]. Atlanta (GA): A.D.A.M., Inc.; ©2019. Heartburn; [reviewed 2019 May 10; cited 2019 October 27]. https://medlineplus.gov/ency/anatomyvideos/000068.htm
.)

Medication grids are intended to assist students to learn key points about each medication. Because information about medication is constantly changing, nurses should always consult evidence-based resources to review current recommendations before administering specific medication. Basic information related to each class of medication is outlined below. Detailed information on a specific medication can be found for free at Daily Med. On the home page, enter the drug name in the search bar to read more about the medication. Prototype/generic medications listed in the grids below are also

hyperlinked directly to a Daily Med page.

Table 7.4a Comparison of Medications Used to Treat Diarrhea

Class	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Adsorbents	bismuth subsalicylate (Pepto Bismol)	Avoid if taking other salicylates Do not use in children or teenagers recovering from chicken pox or flu-like symptoms as may cause Reye's syndrome Do not use if patient has an ulcer, bleeding problem, or bloody or black stool	Decreased diarrhea symptoms	May cause black or darkened tongue Contact provider if symptoms worsen, a fever, or ringing in the ears occurs, or if diarrhea lasts longer than 48 hours
Anticholinergic	hyoscyamine	Contraindicated in glaucoma, myasthenia gravis, or paralytic ileus	Decreased diarrhea symptoms	May cause CNS and other adverse effects associated with anticholinergic medication
Opiate-like medication	loperamide (lmodium)	Contraindicated in children younger than 2 and with several other medications; read drug label information before administering	Decreased diarrhea symptoms	Black Box Warning: May cause abnormal heart rhythm
Probiotics	lactobacillus	Pediatric dosing is age based and varies by product	Prevention of diarrhea or decreased symptoms of diarrhea	Mild such as gas and bloating

Image of lightbulb
Critical Thinking Activity 7.4a in a circle

1. A patient has been prescribed loperamide for diarrhea associated with gastroenteritis. The patient begins to complain of "heart palpitations." What is the nurse's next best response?
2. A child, aged 6, has diarrhea. The mother asks the nurse what OTC medications she can provide to her child to help resolve the diarrhea. What is the nurse's best response?

Note: Answers to the Critical Thinking activities can be found in the "Answer Key" sections at the end of the book.

7.4.b Constipation

Pathophysiology

Constipation is defined as "three or fewer bowel movements in a week; stools that are hard, dry or lumpy; stools that are difficult or painful to pass; or the feeling that not all stool has passed."
National Institute of Diabetes and Digestive and Kidney Diseases, National Institute of Health. (2018). *Symptoms and causes of constipation.*https://www.niddk.nih.gov/health-information/digestive-diseases/constipation/symptoms-causes
If defecation is delayed for an extended time, additional water is absorbed, thus making the feces firmer and potentially leading to constipation. There are several causes of constipation, such as lack of proper fluids or fiber in the diet, lack of ambulation, various disease processes, recovery from surgical anesthesia and opiates, and side effects of many medications. A list of these potential causes can be found in Figure 7.6.
National Institute of Diabetes and Digestive and Kidney Diseases, National Institute of Health. (2018). *Symptoms and causes of constipation.*https://www.niddk.nih.gov/health-information/digestive-diseases/constipation/symptoms-causes
Because there are several potential causes of constipation, treatment should always be individualized to the patient. Many times, constipation can be treated with simple changes in diet, exercise, or routine. However, when medications are also needed to resolve constipation, there are several categories of laxative medications that work in different ways. Classes of laxative medications are described below.

Figure 7.6 Common Causes of Constipation

Medications	Antacids that contain aluminum and calcium
	Anticholinergics and antispasmodics
	Anticonvulsants—used to prevent seizures
	Calcium channel blockers
	Diuretics
	Iron supplements
	Medicines used to treat Parkinson's disease
	Narcotic pain medicines
	Some medicines used to treat depression
Health and Nutrition Problems	Not eating enough fiber
	Not drinking enough liquids or dehydration
	Not getting enough physical activity
	Celiac disease
	Disorders that affect the brain and spine, such as Parkinson's disease
	Spinal cord or brain injuries
	Diabetes
	Hypothyroidism
	Inflammation linked to diverticular disease or proctitis
	Intestinal obstructions, including anorectal blockage and tumors

Daily Routine Changes	Pregnancy
	Aging
	Traveling
	Ignoring the urge to have a bowel movement
	Medication changes
	Change in diet

Nursing Considerations

Assessment

The nurse should assess for the potential cause of the patient's constipation and appropriately individualize the treatment and patient education. The nurse should document an abdominal assessment that includes discomfort, distention, and decreased bowel sounds. The date of the last bowel movement should also be documented. The patient may be asked additional history questions such as the appearance of the stool to determine if it is hard and dry, if passing the stool is difficult or painful, or if there is a feeling of incomplete emptying.

Implementation

Many facilities have a bowel medication protocol with progressive treatment of constipation ranging from stool softeners to stimulants to enemas, depending on the length of time since the last bowel movement. Medications should be administered according to label instructions, and the patient should be instructed when to expect a bowel movement will occur. Measures to prevent constipation should also be discussed with the patient.

Patient teaching for all classes of laxative medications should be individualized based on the cause of constipation. Measures to prevent constipation should be reviewed with the patient, such as:

- Getting enough fiber in the diet
- Drinking plenty of water and other liquids
- Getting regular physical activity
- Trying to have a bowel movement at the same time every day

National Institute of Diabetes and Digestive and Kidney Diseases, National Institute of Health. (2018). *Treatment for constipation*. https://www.niddk.nih.gov/health-information/digestive-diseases/constipation/treatment

Evaluation

If a bowel movement does not occur within the expected timeframe, the provider should be notified and other causes investigated for individualized treatment. It is imperative that good documentation of bowel movements and communication among staff occur when constipation is being treated with various medications. If there is a complete absence of bowel sounds, worsening distension or abdominal pain, a smearing of stool, or other findings indicating that a paralytic ileus or blockage may be occurring, the

provider should be immediately notified.

Laxative Classes

There are five categories of laxative medications commonly used to treat constipation: fiber supplements, **stool softeners**, **osmotic agent**, lubricants, and **stimulants** (See Table 7.4b.1). Fiber supplements and stool softeners are often used daily to prevent constipation, whereas the other laxative categories are used to treat constipation. Table 7.4b1 compares the mechanism of action for each laxative category and includes common prototype and OTC brand names.

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National Institute of Diabetes and Digestive and Kidney Diseases, National Institute of Health. (2018). *Treatment for constipation*. https://www.niddk.nih.gov/health-information/digestive-diseases/constipation/treatment.

,

Drugs.com [Internet]. *Fleet mineral oil enema (rectal)*; © 1996-2018 [updated 1 October 2019; cited 27 October 2019]. https://www.drugs.com/mtm/fleet-mineral-oil-enema-rectal.html

Table 7.4b1 Categories of Laxatives Used to Treat Constipation

Category	Prototypes	Mechanism of Action
Fiber supplements	psyllium (Metamucil)	Bulk forming to facilitate passage of stool through rectum
Stool softeners	Docusate (Colace)	Facilitates movement of water and fats into stool
Osmotic agents	Milk of Magnesia; polyethylene glycol (PEG) 3350 (Miralax)	Causes water to be retained with the stool, increasing the number of bowel movements and softening the stool so it is easier to pass
Lubricants	mineral oil enema (Fleet)	Coats the stool to help seal in water
Stimulants	Bisacodyl (Dulcolax)	Causes the intestines to contract, inducing stool to move through the colon

Fiber supplements

Psyllium (brand name Metamucil) is an example of a common OTC fiber supplement (see Figure 7.14

).

Figure 7.14 Psyllium in powder form

Mechanism of Action Psyllium adds bulk to the stool to facilitate passage through the rectum.

Specific Administration Considerations When administering, put one dose into an empty glass and mix with at least 8 ounces of water or other fluid. Taking this product without enough liquid may cause choking. Stir briskly and drink promptly. If mixture thickens, add more liquid and stir. Administer at least 2 hours before or 2 hours after other medications as it can affect absorption. Psyllium usually produces a bowel movement within 12 to 72 hours. It may cause bloating and cramping.

Patient Teaching & Education When teaching patients how to take psyllium at home, in addition to the above considerations, advise them to start with 1 dose per day but may gradually increase to 3 doses per day as necessary to maintain soft stools.

Stool Softeners

Docusate is a common OTC stool softener that is also used frequently in health care settings.

Mechanism of Action: Docusate facilitates movement of water and fats into stool to make it soft and improve regularity of bowel movements.

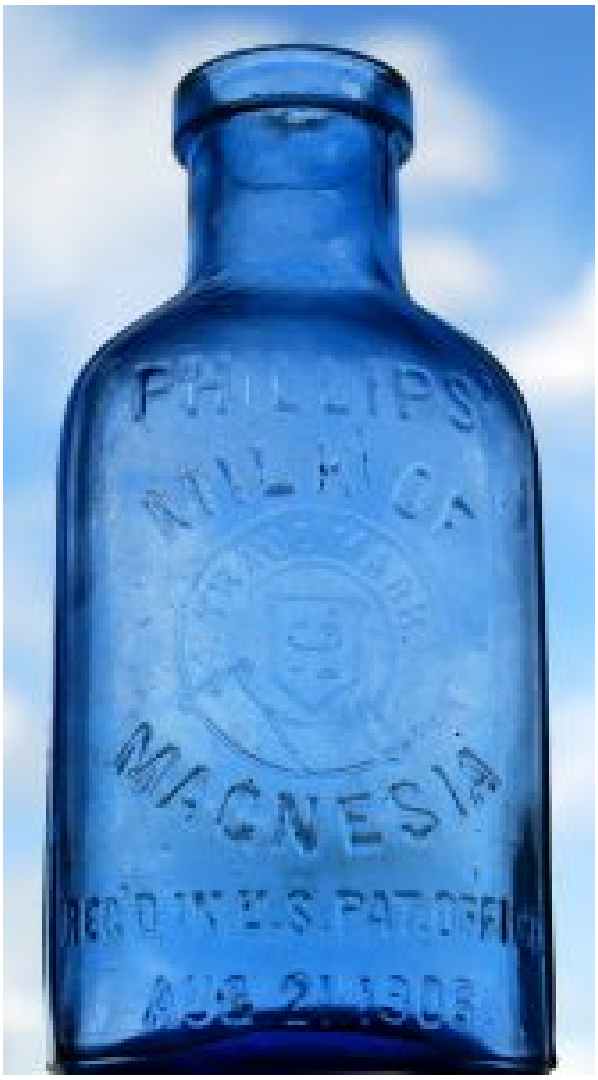
Specific Administration Considerations: Docusate usually produces a bowel movement in 12 to 72 hours. It may cause stomach cramping.

Osmotic Agents

Milk of Magnesia and polyethylene glycol 3350 (brand name Miralax) are examples of common osmotic agents used to promote a bowel movement (see figure 7.15

.

Figure 7.15 Miralax & Milk of Magnesia



Mechanism of Action Osmotic agents cause water to be retained with the stool, increasing the number of bowel movements and softening the stool so it is easier to pass.

Specific Administration Considerations Polyethylene glycol 3350 has a bottle top that can be used as a measuring cap to contain 17 grams of powder when filled to the indicated line. Fill to top of clear section in cap, which is marked to indicate the correct dose (17 g); stir and dissolve in any 4 to 8 ounces of beverage (cold, hot or room temperature), and then administer.

Patient Teaching & Education In addition to the administration considerations above, teach patients that polyethylene glycol usually produces a bowel movement in 1-3 days. It may cause loose, watery stools.

Lubricants

A mineral oil enema (brand name Fleet enema) is an example of a lubricant laxative (see Figure 7.16

"fleet_enema" by Logesh79 is licensed under CC BY-NC 2.0
).

Figure 7.16 Mineral oil enema

Mechanism of Action Mineral oil coats the stool to help seal in water.

Specific Administration Considerations Read drug label for children as some brands can be used in children aged 2 or older, whereas others are not intended for children.

Patient Teaching & Education A mineral oil enema generally produces a bowel movement in 2 to 15 minutes. It may cause stomach cramps, bloating, upset stomach, or diarrhea.

Stimulants

Bisacodyl is an example of a stimulant laxative.

Mechanism of Action Bisacodyl causes the intestines to contract, inducing the stool to move through the colon.

Specific Administration Considerations Oral dosage or rectal suppositories are available. See instructions for how to insert a rectal suppository. Instruct patient to retain suppository for about 15 to 20 minutes (see Figure 7.17
"Administering-med-rectally-2.png" by British Columbia Institute of Technology (BCIT) is licensed under CC BY 4.0
).

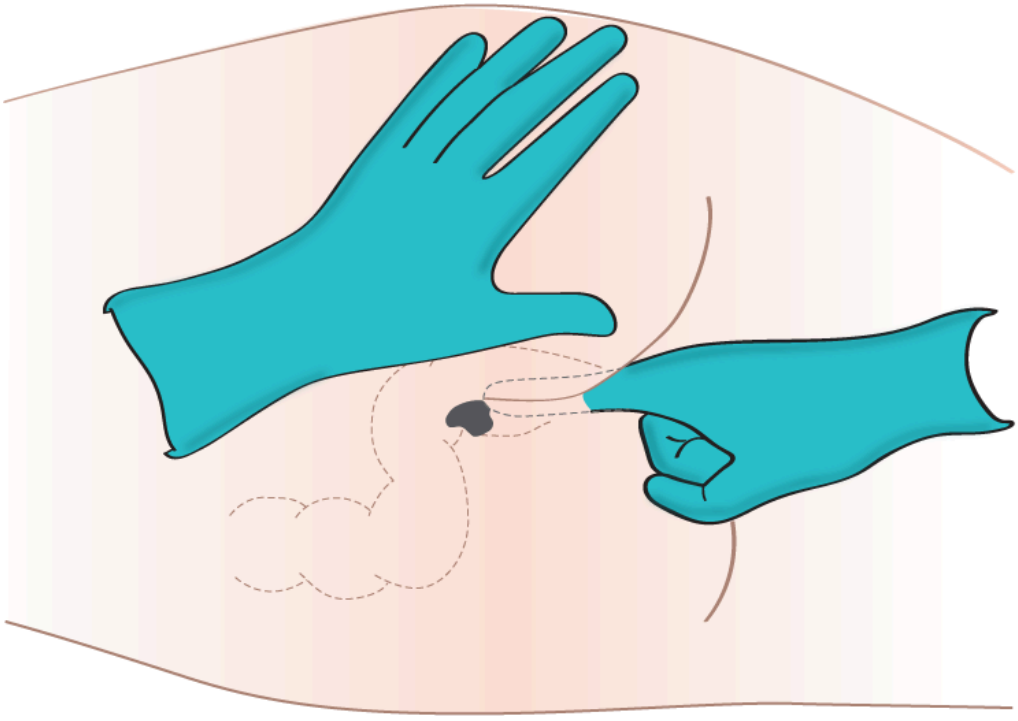


Figure 7.17 Administering a rectal suppository

Patient Teaching & Education A bowel movement is generally produced in 15 minutes. Bisacodyl may cause stomach cramps, dizziness, or rectal burning.

Now let's take a closer look at the medication grids comparing medications used to treat constipation. (See Table 7.4b2).

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Drugs.com [Internet]. *Metamucil*; © 2000-2019 [reviewed 20 November 2017; updated 1 October 2019; cited 27 October 2019]. https://www.drugs.com/mtm/metamucil.html

Medication grids are intended to assist students to learn key points about each medication. Because information about medication is constantly changing, nurses should always consult evidence-based resources to review current recommendations before administering specific medication. Basic information related to each class of medication is outlined below. Detailed information on a specific medication can be found for free at Daily Med. On the home page, enter the drug name in the search bar to read more about the medication. Prototype/generic medications listed in the grids below are also hyperlinked directly to a Daily Med page.

Table 7.4b2 Medication Grid Comparing Laxatives Used to Treat Constipation

Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/ Side Effects
psyllium (Metamucil)	Put one dose into an empty glass and mix with at least 8 ounces of water or other fluid. Taking this product without enough liquid	Improves regularity of	May cause

	may cause choking. Stir briskly and drink promptly. If mixture thickens, add more liquid and stir Usually produces a bowel movement within 12 to 72 hours Administer at least 2 hours before or 2 hours after other medications as it can affect absorption Start with 1 dose per day; may gradually increase to 3 doses per day as necessary	bowel movements	bloating and cramping
docusate	Usually produces bowel movement in 12 to 72 hours	Softens stool and improves regularity of bowel movements	May cause abdominal cramping
polyethylene glycol 3350 (Miralax)	Usually produces a bowel movement in 1-3 days The bottle top is a measuring cap marked to contain 17 grams of powder when filled to the indicated line For adults and children 17 years of age and older: ○ fill to top of clear section in cap, which is marked to indicate the correct dose (17 g) ○ stir and dissolve in any 4 to 8 ounces of beverage (cold, hot or room temperature) and then drink ○ use once a day ○ use no more than 7 days	Softens stool and improves regularity of bowel movements	May cause loose, watery stools
Mineral oil enema	Read drug label for children as some brands can be used in children aged 2 or older, whereas others are not intended for children Generally produces bowel movement in 2 to 15 minutes	Bowel movement within 15 minutes	Stomach cramps, bloating, upset stomach, or diarrhea
bisacodyl	Oral dosage or rectal suppositories are available To administer a rectal suppository: Position patient on left side with the right knee up towards the chest. In the presence of anal fissures or hemorrhoids, suppositories should be coated at the tip with petroleum jelly. Remove foil and insert suppository well into rectum touching the bowel wall. Instruct patient to retain	Bowel movement within one hour	Stomach cramps, dizziness, or rectal burning

suppository for about 15 to 20 minutes. A bowel movement is generally produced in 15 minutes to one hour. For children, read drug label for dosage

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=1200#h5p-19

Critical Thinking Activity 7.4b

Image of lightbulb in a circle

A patient who underwent hip surgery two days ago has not had a bowel movement since before admission. The patient is receiving oxycontin ER 10 mg every 12 hours and oxycodone 5 mg every 4 hours for pain. The patient describes abdominal discomfort and the nurse finds decreased bowel sounds in all quadrants. The nurse notifies the physician, follows the bowel protocol, and administers docusate sodium to the patient.

1. What are the potential causes of constipation that should be addressed for this patient?
2. What is the mechanism of action for docusate?
3. The patient asks how quickly the medication will work. What is the nurse's best response?
4. What other preventative measures for constipation should the nurse teach the patient?
5. If docusate is not effective within 24 hours, what other medications can the nurse anticipate to be ordered?

Note: Answers to the Critical Thinking activities can be found in the "Answer Key" sections at the end of the book.

7.5 Antiemetics

Open Resources for Nursing (Open RN)

Nausea and vomiting are common conditions. Nausea is the unpleasant sensation of having the urge to vomit, and vomiting(emesis) is the forceful expulsion of gastric contents.
Bashashati, M. & McCallum, R. (2014). Neurochemical mechanisms and pharmacologic strategies in managing nausea and vomiting related to cyclic vomiting syndrome and other gastrointestinal disorders. *European Journal of Pharmacology, 772*, p 79.
There are many potential causes of nausea and vomiting, such as:

- Morning sickness during pregnancy
- **Gastroenteritis** and other infections
- Migraines
- Motion sickness
- Food poisoning
- Side effects of medicines, including those for cancer chemotherapy
- GERD and ulcers
- Intestinal obstruction
- Poisoning or exposure to a toxic substance
- Diseases of other organs (cardiac, renal, or liver)

Nausea and vomiting are common and are usually not serious. However, the health care provider should be contacted immediately if the following conditions occur:

- Vomiting for longer than 24 hours
- Blood in the vomit (also called **hematemesis**)
- Severe abdominal pain
- Severe headache and stiff neck
- Signs of dehydration, such as dry mouth, infrequent urination, or dark urine

Treatment of nausea and vomiting should be tailored to the cause. There are several medications that work on different neuroreceptors that when used can treat nausea and vomiting. For severe cases of vomiting, intravenous fluids may also be needed to treat the accompanying dehydration.
MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2019 October 23]. *Nausea and vomiting;* [updated 2019 February 7; reviewed 2016 March 17; cited 2019 October 27]. https://medlineplus.gov/nauseaandvomiting.html.
,
Bashashati, M. & McCallum, R. (2014). Neurochemical mechanisms and pharmacologic strategies in managing nausea and vomiting related to cyclic vomiting syndrome and other gastrointestinal disorders. *European Journal of Pharmacology, 772*, p 79.

Pathophysiology

The vomiting center can be activated directly by irritants or indirectly following input from four principal areas: gastrointestinal tract, cerebral cortex and thalamus, vestibular region, and chemoreceptor trigger zone (CRTZ). See Figure 7.14 for an illustration of the pathophysiology of nausea and vomiting.
Becker D. E. (2010). Nausea, vomiting, and hiccups: a review of mechanisms and treatment. Anesthesia progress, 57(4), 150–157. doi:10.2344/0003-3006-57.4.150

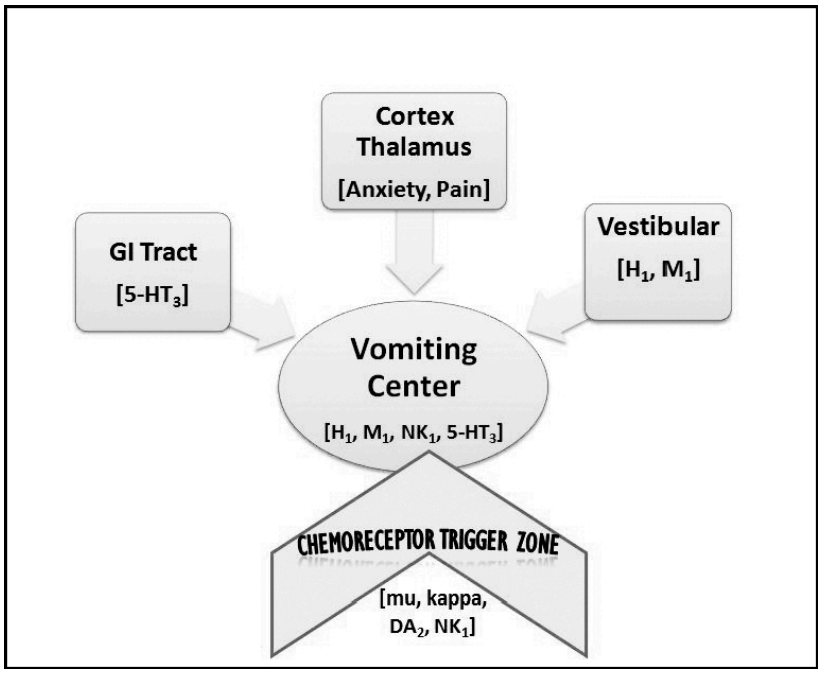

Figure 7.14 Pathophysiology of nausea and vomiting

An important part of the emesis circuit is the **chemoreceptor trigger zone (CTZ)**, located in the **area postrema** in the brain. The CTZ is not restricted by the blood–brain barrier, which allows it to respond directly to toxins in the bloodstream such as anesthesia and opioids. The CTZ also receives stimuli from several other locations in the body including the vestibular center; visceral organs such as the GI tract, kidneys, and liver; the thalamus; and the cerebral cortex.

The vestibular center and cerebral cortex can stimulate the vomiting center directly or indirectly through the CTZ. The **vestibular system** is located within the inner ear and gives a sense of balance and spatial orientation for the purpose of coordinating movement with balance. The feeling of nausea associated with motion sickness often arises from stimuli from the vestibular center. The gastrointestinal tract sends stimuli to the CTZ via cranial nerves IX and X related to obstruction, distension, inflammation, and infection. The cerebral cortex and other parts of the brain can also stimulate a sense of nausea related to odors, tastes, and images and send these stimuli to the CTZ. The CTZ forwards these signals to the vomiting center in the brain. Pain can also directly stimulate the vomiting center.

The **vomiting center** (VC) is located in the medulla in the brain. In response to these stimuli, the vomiting center initiates vomiting by inhibiting peristalsis and producing retro-peristaltic contractions beginning in the small bowel and ascending into the stomach. It also produces simultaneous contractions in the abdominal muscles and diaphragm that generate high pressures to propel the stomach contents upwards. Additionally, autonomic stimulation of the heart, airways, salivary glands, and skin cause other symptoms associated with vomiting such as salivation, palor, sweating, and tachycardia. Several neurotransmitters are involved in the nausea and vomiting process, and antiemetic medications are targeted to specific neuroreceptors.

Becker D. E. (2010). Nausea, vomiting, and hiccups: a review of mechanisms and treatment. *Anesthesia progress, 57*(4), 150–157. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3006663/

Table 7.5a compares the neurotransmitters involved in the nausea and vomiting process, classes of antiemetic medication targeting these neurotrasmitters, prototype antiemetic medications, and associated mechanisms of action.

Bashashati, M. and McCallum, R. (2014). Neurochemical mechanisms and pharmacologic strategies in managing nausea and vomiting related to cyclic vomiting syndrome and other gastrointestinal disorders. *European Journal of Pharmacology, 772*, p 79.

Each medication class is also discussed in more detail later in this section.

Table 7.5a Neurotransmitters and Associated Medications Used to Treat Nausea and Vomiting

Neurotransmitter	Medication Class	Antiemetic Drug	Mechanism of Action
Acetylcholine (M1)	Anticholinergics	scopolamine	Blocks ACh receptors in vestibular system
Histamine (H1)	Antihistamines	meclizine	Blocks H1 receptors and thus blocks ACh in vestibular system
Dopamine (DA2)	Dopamine antagonists	prochlorperazine	Blocks dopamine in CTZ and may block ACh
Dopamine and ACh (DA2 and M1)	Prokinetics	metoclopramide	Blocks dopamine in CTZ and stimulates ACh in GI tract
Serotonin (5HT)	Serotonin antagonists	ondansetron	Blocks serotonin in GI tract, CTZ, and VC
Substance P (NK1)	Neurokinin antagonists	aprepitant	Inhibits substance P neurokinin receptors
Cannabinoid (CB1)	Tetrahydrocannabinols (THC)	dronabinol or medical marijuana	Activated CB1 receptor leading to inhibitory effects on cerebral cortex

Nursing Considerations

Assessment

When administering antiemetics, identify factors contributing to the symptoms of nausea and vomiting so that treatment can correctly target the cause. Document the frequency and amount of emesis and effects on the patient's appetite and fluid intake. Assess for symptoms of dehydration, such as decreased blood pressure associated with tachycardia, decreased skin turgor, and decreased urine output or dark concentrated urine. If lab tests are ordered, monitor hemoglobin, hematocrit, and serum sodium levels for additional signs of dehydration.

Implementation

Advocate for the most effective route of administration if the patient is vomiting. Consider timing of administration of antiemetics in advance of meals when appetite is affected. Follow drug label administration information and monitor the patient closely for potential side effects associated with that category of medication. For example, when administering anticholinergics and antihistamines, monitor for anticholinergic side effects, especially in elderly patients.

Evaluation

Monitor for improvement of nausea and vomiting and notify the provider if expected improvement does not occur so that other treatment can be initiated. Continue to monitor for dehydration. Teach the patient nonpharmacological interventions for nausea such as:

- Drink enough fluids to avoid dehydration. If you are having trouble keeping liquids down, drink sips of clear liquids every few minutes.
- Eat bland foods; stay away from spicy, fatty, or salty foods.
- Eat smaller meals more often.
- Avoid strong smells because they can sometimes trigger nausea and vomiting.
- If you are pregnant and have morning sickness, eat crackers before you get out of bed in the morning.

MedlinePlus [Internet]. Bethesda (MD): National Library of Medicine (US); [updated 2019 October 23]. *Nausea and vomiting*; [updated 2019 February 7; reviewed 2016 March 17; cited 2019 October 27]. https://medlineplus.gov/nauseaandvomiting.html.

Antiemetic Medication Classes

Anticholinergics

Scopolamine is an example of an anticholinergic medication that is often used to treat motion sickness or nausea and vomiting associated with surgical recovery from anesthesia and/or opiate analgesia.

Mechanism of Action

Anticholinergics block ACh receptors in the vestibular center and within the brain to prevent nausea-inducing stimuli to the Chemoreceptor Trigger Zone (CTZ) and the Vomiting Center (VC). They also dry GI secretions and reduce smooth muscle spasms.

Specific Administration Considerations

The scopolamine transdermal patch (see Figure 7.15)

is designed for continuous release of scopolamine following application to an area of intact skin on the head, behind the ear. The system is formulated to deliver approximately 1 mg of scopolamine to the systemic circulation over 3 days. It is contraindicated in patients with glaucoma. It has been reported to exacerbate psychosis, induce seizures, and cause drowsiness, confusion, and sedation. Due to its anticholinergic properties, scopolamine can decrease gastrointestinal motility and cause urinary retention. Nurses should perform more frequent monitoring during treatment with Transderm Scōp and discontinue Transderm Scōp in patients who develop difficulty in urination. Transderm Scōp contains an aluminized membrane; skin burns have been reported at the application site in patients wearing an aluminized transdermal system during an MRI scan. Remove Transderm Scōp before undergoing an MRI.

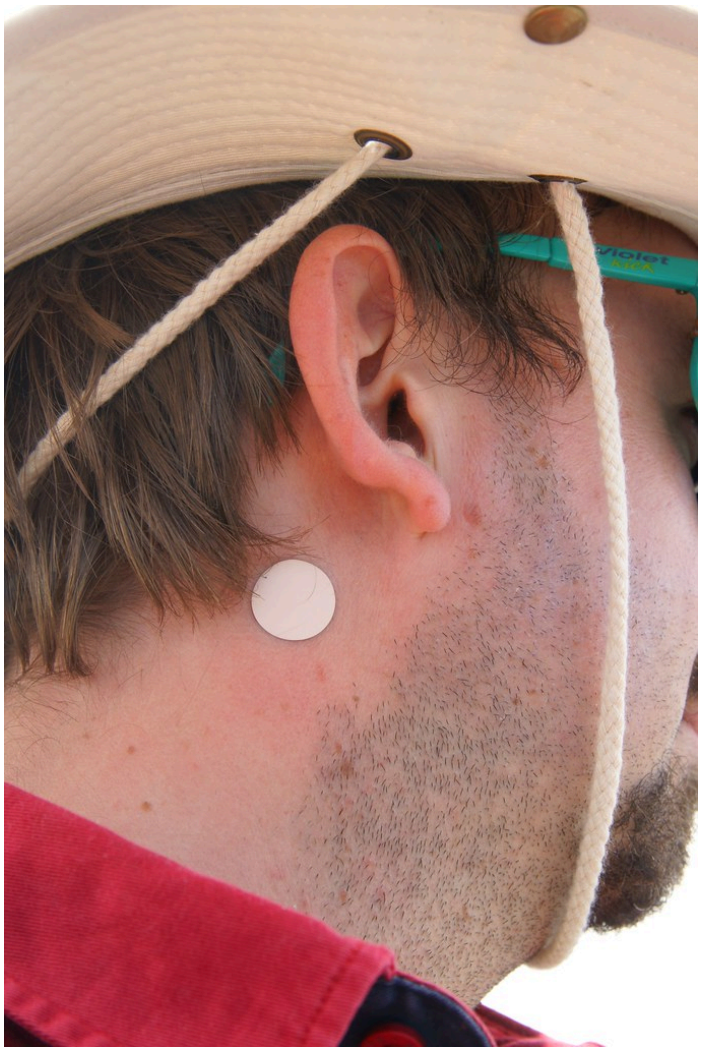

Figure 7.15 Scopolamine Transdermal Patch

Application instructions:

- Only wear one transdermal system at any time.
- Do not cut the transdermal system.
- Apply the transdermal system to the skin in the postauricular area (hairless area behind one ear).
- After the transdermal system is applied on the dry skin behind the ear, wash hands thoroughly with soap and water and dry hands.
- If the transdermal system becomes displaced, discard the transdermal system, and apply a new transdermal system on the hairless area behind the other ear.
- For surgeries other than cesarean section, apply one Transderm Scōp transdermal system the evening before scheduled surgery. Remove the transdermal system 24 hours following surgery.

Patient Teaching & Education

Transderm Scōp may impair the mental and/or physical abilities required for the performance of hazardous tasks such as driving a motor vehicle, operating machinery, or participating in underwater sports. Concomitant use of other drugs (e.g., alcohol, sedatives, hypnotics, opiates, and anxiolytics) that cause central nervous system (CNS) adverse reactions, or that have anticholinergic properties, may increase this impairment. Inform patients not to operate motor vehicles or other dangerous machinery or

participate in underwater sports until they are reasonably certain that Transderm Scōp does not affect them adversely. Scopolamine can cause temporary dilation of the pupils resulting in blurred vision if it comes in contact with the eyes. Advise patients to wash their hands thoroughly with soap and water and dry their hands immediately after handling the transdermal system. Upon removal, fold the used transdermal system in half with the sticky side together, and discard in household trash in a manner that prevents accidental contact or ingestion by children, pets, or others.

Antihistamines

Meclizine is an example of an antihistamine that is often used to treat motion sickness.

Mechanism of Action

Antihistamines block H1 receptors in the vestibular center and may also block acetylcholine (ACh).

Specific Administration Considerations

Antihistamines are contraindicated in patients with glaucoma or an enlarged prostate gland. Dosage should be started one hour before travel begins.

Patient Teaching & Education

- Do not exceed recommended dosage.
- Be advised that drowsiness may occur.
- Avoid alcohol, sedatives, and tranquilizers, which may increase drowsiness.
- Avoid alcoholic drinks.
- Be careful when driving a motor vehicle or operating machinery.

Dopamine Antagonists

Prochlorperazine is an example of a dopamine antagonist used to treat nausea and vomiting. It can also be used as an antipsychotic medication.

Mechanism of Action

Prochlorperazine blocks dopamine in the Chemoreceptor Trigger Zone (CTZ). It also calms the central nervous system and may also block acetylcholine.

Specific Administration Considerations

Prochlorperazine can be administered orally, intramuscularly, rectally or intravenously. It is contraindicated in children under age 2 or under 20 pounds. Severe side effects have occurred when used to treat psychosis.

Patient Teaching & Education

Patients should be instructed to take medications as prescribed. They should avoid alcohol and other

CNS depressants. Patients may experience increased photosensitivity and extreme temperatures should be avoided. Patients should be advised that urine may turn pinkish to reddish-brown.
uCentral from Unbound Medicine. https://www.unboundmedicine.com/ucentral

Prokinetics

Metoclopramide is an example of a prokinetic medication (see Figure 7.16).
"Metoclopramide" by John Campbell is licensed under CC0

Figure 7.16 Prokinetics

Mechanism of Action

Metoclopramide blocks dopamine and may also sensitize tissues to acetylcholine. It is used to promote peristalsis to empty the gastrointestinal tract and thus reduce nausea.

Specific Administration Considerations

Metoclopramide can be administered orally, intramuscularly, and intravenously. The onset of pharmacological action of metoclopramide is 1 to 3 minutes following an intravenous dose, 10 to 15 minutes following intramuscular administration, and 30 to 60 minutes following an oral dose. Pharmacological effects persist for 1 to 2 hours.

Metoclopramide should not be used whenever stimulation of gastrointestinal motility might be dangerous (e.g., in the presence of gastrointestinal hemorrhage, mechanical obstruction, or perforation). Metoclopramide is contraindicated in patients with pheochromocytoma because the drug may cause a hypertensive crisis. Metoclopramide should not be used in epileptics or patients receiving other drugs

that are likely to cause extrapyramidal reactions because the frequency and severity of seizures or extrapyramidal reactions may be increased. Rare reports of neuromalignant syndrome have occured.

Patient Teaching & Education

Teach patients to immediately inform the healthcare provider if they experience new feelings of depression or abnormal muscle movements they cannot control such as:

- lip smacking, chewing, or puckering of the mouth
- frowning or scowling
- sticking out the tongue
- blinking and moving the eyes
- shaking of the arms and legs

Serotonin Antagonists

Ondansetron is an example of a serotonin (5HT) antagonist often used to treat severe nausea and vomiting associated with chemotherapy, postoperative nausea and vomiting, and hyperemesis during pregnancy. (See Figure 7.17 for an image of odansetron blocking the 5-HT_3 receptor.

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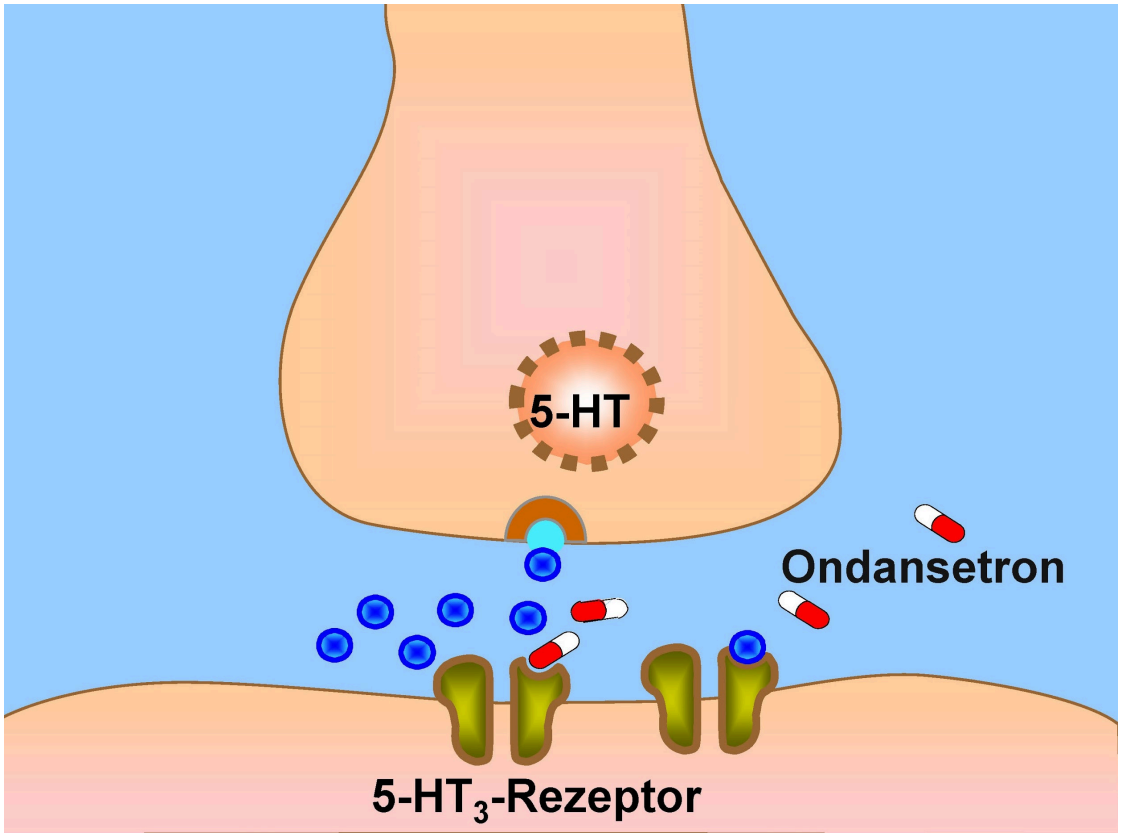

Figure 7.17 Ondansetron blocking the 5-HT_3 receptor

Mechanism of Action

Ondansetron blocks serotonin receptors in the GI tract, the chemoreceptor trigger zone (CTZ), and the vomiting center (VC). See Figures 7.18 and 7.19 for images of the injectable and oral formulations of ondansetron.

Figure 7.18 Ondansetron in injectable form

Figure 7.19 Ondansetron in tablet form

Specific Administration Considerations

Ondansetron is available as an orally disintegrating tablet and as an injectable for those patients too nauseated to tolerate oral medication. It is contraindicated with apomorphine. **Serotonin syndrome** can occur if administered concurrently with other serotonin antagonists or selective serotonin reuptake inhibitors. Ondansetron can cause headaches, drowsiness, constipation, fever, and diarrhea. A rare but serious adverse effect of ondansetron is QT prolongation that can cause an abnormal cardiac rhythm.

Patient Teaching & Education

Teach patients to immediately inform their healthcare provider if they experience a change in heart rate, lightheadedness, or feel faint or have any signs and symptoms of hypersensitivity reactions such as fever, chills, rash, or breathing problems.

Neurokinin Receptor Antagonists

Aprepitant is an example of a neurokinin antagonist used to prevent nausea and vomiting associated with chemotherapy and surgery.

Mechanism of Action

Aprepitant inhibits substance-P neurokinin receptors in the brainstem.

Nursing Considerations

Aprepitant is usually administered concurrently with dexamethasone (a corticosteroid) and ondansetron. It can be administered orally or intravenously. It has clinically significant CYP3A4 drug interactions with medications such as pimozide, diltiazem, and rifampin, and can decrease INR levels when taken concurrently with warfarin. It can also reduce the effectiveness of oral contraceptives.

Patient Teaching & Education

Teach patients taking warfarin that they will need to monitor their INR levels more closely, which may require adjustment of the warfarin dosage, while taking aprepitant. Teach patients using an oral contraceptive to use backup birth control.

Tetrahydrocannabinoids (THC)

Dronabinol or medical marijuana is an example of a **THC** medication used to treat nausea in patients with cancer or AIDS (see Figures 7.20 and 7.21).

Figure 7.20 Dronabinol, a THC medication

Figure 7.21 Medical Marijuana

Mechanism of Action

THC has inhibitory effects in the cerebral cortex causing an alteration in mood and the body's perception of its surroundings, which may relieve nausea and vomiting, as well as stimulate the appetite.

Specific Administration Considerations

THC will cause a dose-related "high" (easy laughing, elation, and heightened awareness). It is abusable and, thus, is a controlled substance and scheduled medication. THC should be used cautiously in elderly patients because they may be more sensitive to the neurological, psychoactive, and postural hypotensive effects of the drug. In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range.

Patient Teaching & Education

Teach patients to not drive, operate machinery, or engage in any hazardous activity when using THC. Keep out of reach of children and pets.

Herbal and Vitamin Supplements

Ginger has been used in traditional Indian and Chinese medicine as an antiemetic. Although its

mechanism of action is not completely understood, ginger is thought to antagonize the 5HT and cholinergic receptors and may have direct activity on the gastrointestinal tract. Although ginger can cause reflux and heartburn and may potentially cause bleeding because of its anticoagulant effects, dosages of up to 2 g per day in divided doses of 250 mg are considered safe even in pregnant women. Pyridoxine (vitamin B6) has also been recommended for treating nausea and vomiting in pregnancy. Typical dosages of pyridoxine 10 to 25 mg every eight hours cause minimal adverse effects.
Flake, Z., Linn, B., & Hornecker, J. (2015). Practical selection of antiemetics in the ambulatory setting. *American Family Physician, 91*(5): pp 293-296.

Antiemetics Medication Grid

Now let's take a closer look at the medication grid comparing medications used to treat nausea. See Table 7.5b.
This work is a derivative of Daily Med by U.S. National Library of Medicine in the public domain.

Medication grids are intended to assist students to learn key points about each medication. Because information about medication is constantly changing, nurses should always consult evidence-based resources to review current recommendations before administering specific medication. Basic information related to each class of medication is outlined below. Detailed information on a specific medication can be found for free at Daily Med. On the home page, enter the drug name in the search bar to read more about the medication. Prototype/generic medications listed in the grids below are also hyperlinked directly to a Daily Med page.

Table 7.5b Medication Grid Comparing Antiemetics

Class	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Anticholinergic	scopolamine	Apply patch to hairless skin behind ear for 3 days or apply the night before surgery and remove 24 hours later Do not cut patch After application, thoroughly wash and dry hands Remove before an MRI Contraindicated in patients with	Prevent or reduce nausea and vomiting associated with motion sickness or surgery	Monitor for anticholinergic effects such as decreased GI motility and urinary retention Discontinue if it exacerbates psychosis or causes seizures or cognitive impairment

		glaucoma		
Antihistamine	meclizine	Contraindicated in patients with glaucoma or an enlarged prostate gland Dosage should be started one hour before travel begins	Prevent or reduce nausea and vomiting associated with motion sickness	May cause drowsiness
Dopamine antagonist	prochlorperazine	Can be administered PO, IM, PR, or IV	To control nausea and vomiting associated with surgery	Drowsiness, dizziness, amenorrhea, blurred vision, skin reactions, and hypotension may occur
Prokinetic	metoclopramide	Can be administered PO, IM, and IV Onset of action is 1 to 3 minutes following an IV dose, 10 to 15 minutes following IM administration, and 30 to 60 minutes following an oral dose Pharmacological effects persist for 1 to 2 hours	To prevent or treat nausea and vomiting associated with surgery or chemotherapy	Restlessness, drowsiness, fatigue, depression, and suicide ideation Should be immediately discontinued if symptoms of tardive dyskinesia (abnormal muscle movements) or neuromalignant syndrome occur (hyperthermia, muscle rigidity, altered consciousness, irregular pulse or blood pressure, tachycardia, diaphoresis, and cardiac arrhythmias)
Serotonin antagonist	ondansetron	Can be administered as oral disintegrating tablet, PO, or IV	Prevention or treatment of severe nausea and vomiting associated with surgery, chemotherapy, or hyperemesis in pregnancy	Hypersensitivity reactions, including fever, chills, rash, or breathing problems Headache, drowsiness, constipation, fever, and diarrhea May cause QT prolongation Can cause serotonin syndrome if given concurrently with other serotonin antagonists or SSRIs
Neurokinin	aprepitant	Can be administered	Prevention of	Hypersensitivity reaction, such

receptor antagonist		PO or IV	nausea and vomiting associated with chemotherapy and surgery	as hives, rash. and itching; skin peeling or sores; or difficulty in breathing or swallowing If taking warfarin, increase monitoring of INR levels If taking oral contraceptives, use a backup method of birth control
THC	dronabinol or medical marijuana	Administered PO Most patients respond to 5 mg three or four times daily Dosage may be escalated during a chemotherapy cycle or at subsequent cycles, based on initial results	For treatment of nausea and vomiting associated with cancer chemotherapy when other treatment fails	Use cautiously in elderly patients because they may be more sensitive to the neurological, psychoactive, and postural hypotensive effects of the drug. In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range

Critical Thinking Activity 7.5
Image of lightbulb in a circle

A nurse is caring for a patient who underwent surgery earlier today and is experiencing nausea and vomiting. The original post-op orders included prochlorperazine, but the patient continues to experience vomiting despite receiving this medication. The nurse calls the provider and receives a new order for ondansetron orally dissolving tablets 8 mg three times daily as needed.

1. How will the nurse assess for symptoms of dehydration?
2. When administering the medication, the patient states, “This tastes terrible! Why can’t I have a normal pill to swallow?” What is the nurse’s best response?
3. What other measures should the nurse teach the patient to reduce feelings of nausea and avoid dehydration?

Note: Answers to the Critical Thinking activities can be found in the “Answer Key” sections at the end of the book.

7.6 Module Learning Activities

Open Resources for Nursing (Open RN)

Interactive Activity

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://wtcs.pressbooks.pub/pharmacology/?p=1444#h5p-42

VII: Glossary

Open Resources for Nursing (Open RN)

Adsorption: The adhesion of molecules to a surface. For example, bismuth salicylate coats the walls of the GI tract and binds the causative bacteria or toxin for elimination from the GI tract through the stool.

Antacids: Used to neutralize stomach acid and reduce the symptoms of heartburn.

Antidiarrheals: Relieve the symptoms of diarrhea, such as an increased frequency and urgency when passing stools, but do not eliminate the cause of it.

Antimotility medications: Medications that help to treat diarrhea by slowing peristalsis.

Area Postrema: A structure in the medulla oblongata in the brainstem that controls vomiting. Its location in the brain also allows it to play a vital role in the control of autonomic functions by the central nervous system.

Chemoreceptor Trigger Zone (CTZ): Area in the brain that responds directly to toxins in the bloodstream and also receives stimuli from several other locations in the body that stimulate the vomiting center.

Cytochrome P-450 enzymes: Enzymes produced from the cytochrome P450 genes involved in the formation (synthesis) and breakdown (metabolism) of various molecules, chemicals, and medications within cells.

Defecation: The digestive process where undigested materials are removed from the body as feces.

Diarrhea: The passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual).

Gastroenteritis: Infection of the intestines.

Gastroesophageal reflux disease (GERD): Caused by excessive hydrochloric acid that tends to back up, or reflux, into the lower esophagus.

Hematemesis: Blood in the vomit.

Hypercalcemia: Elevated levels of calcium in the bloodstream.

Intrinsic factor: Necessary for the absorption of vitamin B12 in the small intestine.

Osmotic agents: Cause water to be retained with the stool, increasing the number of bowel movements and softening the stool so it is easier to pass.

Parietal cells: Cells in the gastric glands that produce and secrete hydrochloric acid (HCl) and intrinsic factor.

Pepsin: A digestive enzyme.

Peptic ulcer disease (PUD): Occurs when gastric or duodenal ulcers are caused by the breakdown of GI mucosa by pepsin in combination with the caustic effects of hydrochloric acid.

Probiotics: Used for the prevention and treatment of diarrhea by restoring normal bacteria flora in the gastrointestinal tract.

Prokinetic: Medications used to promote peristalsis to empty the gastrointestinal tract and reduce nausea.

Proton pump inhibitors (PPIs): Bind to the hydrogen-potassium ATPase enzyme system of the parietal cell and inhibit the release of hydrogen ions into the stomach.

Rebound hyperacidity: A side effect of medication causing elevated levels of hydrochloric acid in the stomach after the medication is discontinued.

Serotonin Syndrome: Symptoms associated with serotonin syndrome may include the following: mental status changes (e.g., agitation, hallucinations, delirium, and coma), autonomic instability (e.g., tachycardia, labile blood pressure, dizziness, diaphoresis, flushing, hyperthermia), neuromuscular symptoms (e.g., tremor, rigidity, myoclonus, hyperreflexia, incoordination), seizures, with or without gastrointestinal symptoms (e.g., nausea, vomiting, diarrhea).

Stimulants: Laxatives that cause the intestines to contract, inducing stool to move through the colon.

Stool softeners: Laxatives that facilitate movement of water and fats into stool to make it soft and improve regularity of bowel movements.

Stress-related mucosal damage: A common condition in hospitalized patients that can lead to PUD.

Stress Ulcer Prophylaxis: Medication to prevent the formation of stress ulcers.

Surface epithelium cells: Cells found within the lining of the stomach that secrete mucus as a protective coating.

THC: Tetrahydrocannabinoids found in marijuana.

Vestibular system: An area located within the inner ear that gives a sense of balance and spatial

orientation for the purpose of coordinating movement with balance.

Vomiting Center (VC): An area in the brain that initiates vomiting by inhibiting peristalsis and producing retro-peristaltic contractions beginning in the small bowel and ascending into the stomach. It also produces simultaneous contractions in the abdominal muscles and diaphragm that generate high pressures to propel the stomach contents upwards.

VIII

Central Nervous System

8.1 Central Nervous System Introduction

Open Resources for Nursing (Open RN)

Learning Objectives

- Cite the classifications and actions of central nervous system drugs
- Cite the classifications and actions of drugs used to treat psychiatric disorders
- Give examples of when, how, and to whom central nervous system drugs may be administered
- Identify the side effects and special considerations associated with central nervous system drug therapy
- Identify considerations and implications of using central nervous system medications across the lifespan
- Apply evidence-based concepts when using the nursing process
- Identify indications, side effects, and potential drug interactions associated with the use of herbal supplements
- Identify and interpret related laboratory tests

The nervous system is a very complex organ system. Even though progress has continued at an amazing rate within the scientific disciplines of neuroscience, our understanding of the intricacies within this science are limited. The nervous system may be just too complex for us to completely understand, and you may notice evidence of this within some of the "Mechanisms of Action" statements later in this chapter where exact understanding is unknown. The complexity of the nervous system and understanding of the brain can make treating and preventing diseases that affect this system complicated.

8.2 Review of Basic Concepts of the Central Nervous System

Open Resources for Nursing (Open RN)

Before we can begin to understand how different medications influence the brain, we need to review the central nervous system. The nervous system can be divided into two major regions: the central and peripheral nervous systems. The **central nervous system (CNS)** is the brain and spinal cord, and the **peripheral nervous system (PNS)** is everything else. The brain is contained within the cranial cavity of the skull, and the spinal cord is contained within the vertebral cavity of the vertebral column. It is a bit of an oversimplification to say that the CNS is what is inside these two cavities and the peripheral nervous system is outside of them, but that is one way to start to think about it. In actuality, there are some elements of the peripheral nervous system that are within the cranial or vertebral cavities. The peripheral nervous system is so named because it is on the periphery—meaning beyond the brain and spinal cord. Depending on different aspects of the nervous system, the dividing line between central and peripheral is not necessarily universal. The peripheral nervous system is further divided into the autonomic nervous system and the somatic nervous system, which are further discussed in the "Autonomic Nervous System" chapter.

(See Figures 8.1

and 8.2

for illustrations of the central and peripheral nervous systems.)

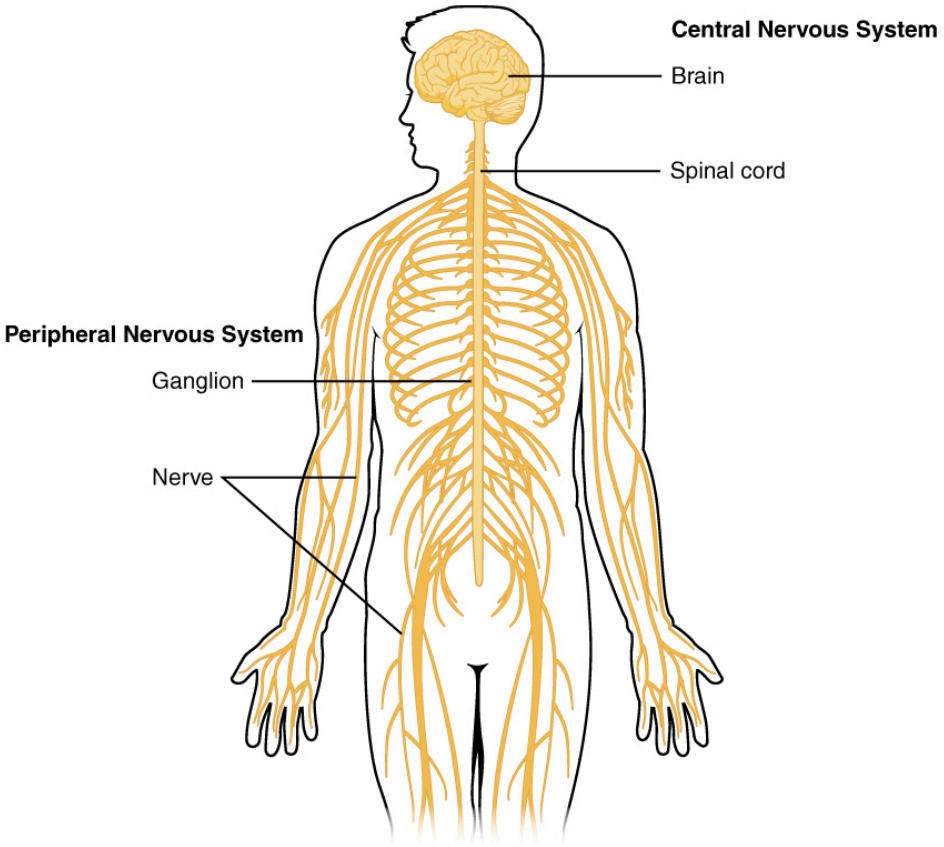

Figure 8.1 The Central and Peripheral Nervous System

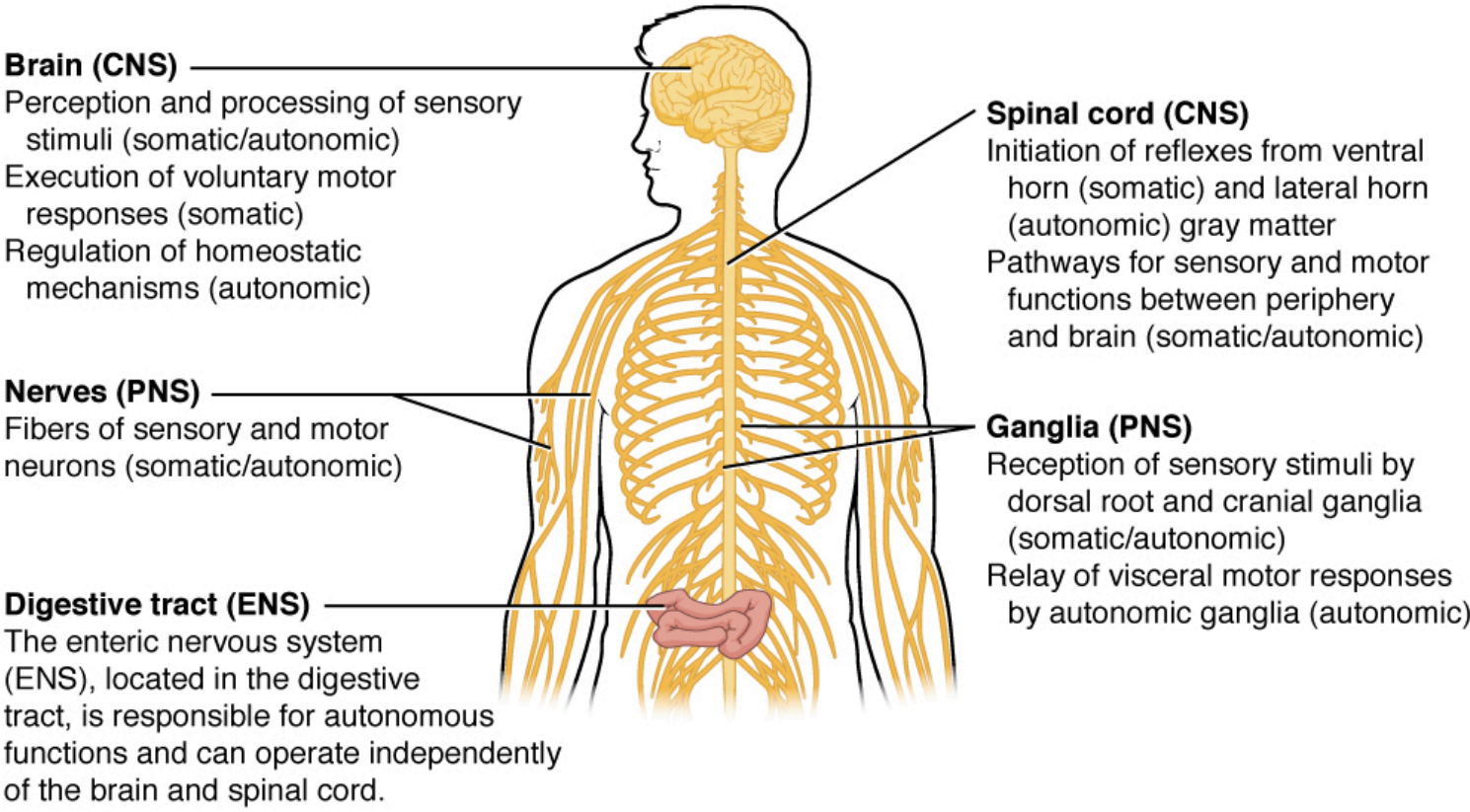

Figure 8.2 Somatic, Autonomic, and Enteric Structures of the Nervous System

Review more detailed information about the nervous system function using this OpenStax link:

Basic structure and function of the nervous system

Communication in the Nervous System

Your brain communicates with electrical impulses that signal a release of a **neurotransmitter**, which then binds to the targeted cell. Understanding this communication will help you put the pieces together when you are trying to understand the mechanism of action of medication that works by influencing neurotransmitters. See Figure 8.3 for an illustration of the major elements in **neuron** communication.

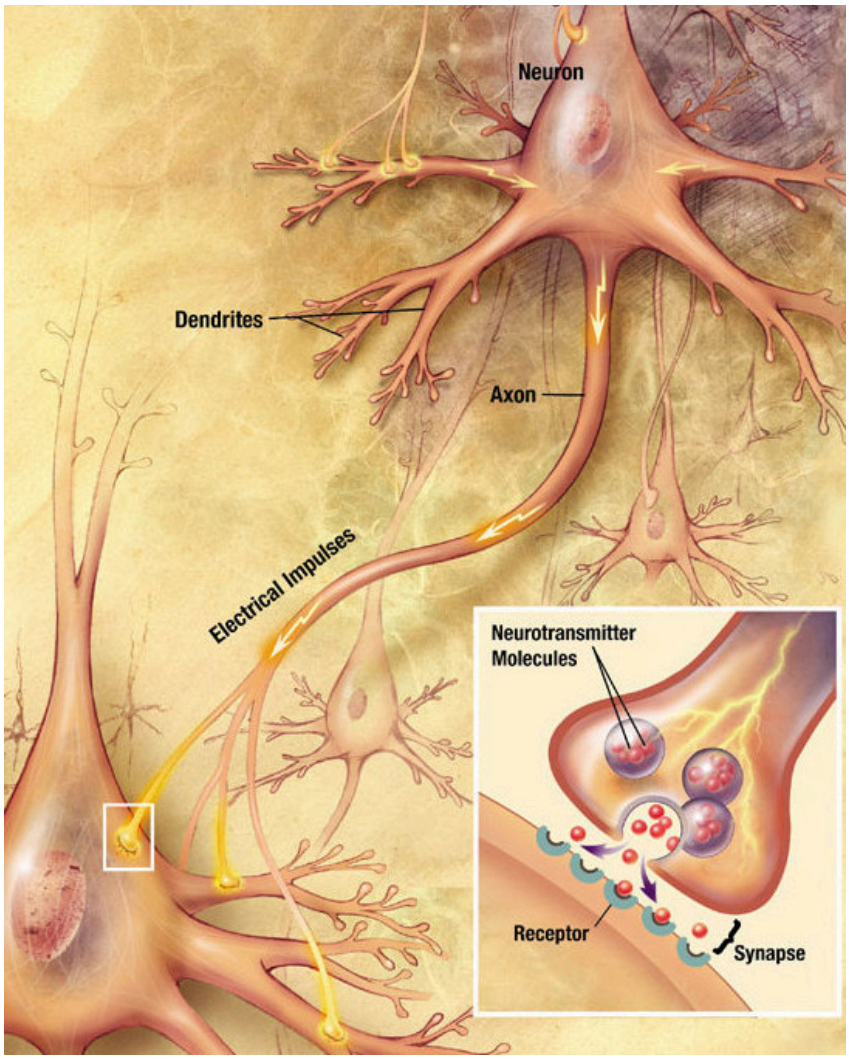

Figure 8.3 Major Elements in Neuron Communication

There are two types of connections between electrically active cells: chemical synapses and electrical synapses. In a **chemical synapse**, a chemical signal—namely, a neurotransmitter—is released from one cell and affects another cell. In comparison, in an **electrical synapse**, there is a direct connection between the two cells so that ions can pass directly from one cell to the next. In this unit we will be focusing on the communication of a neurotransmitter in a chemical synapse. Once in the synaptic cleft, the neurotransmitter diffuses the short distance to the postsynaptic membrane and can interact with neurotransmitter receptors. Receptors are specific for the neurotransmitter, and the two fit together like a key and lock. One neurotransmitter binds to its receptor and will not bind to receptors for other neurotransmitters, making the binding a specific chemical event.

(See Figure 8.4 for an illustration of a synapse.

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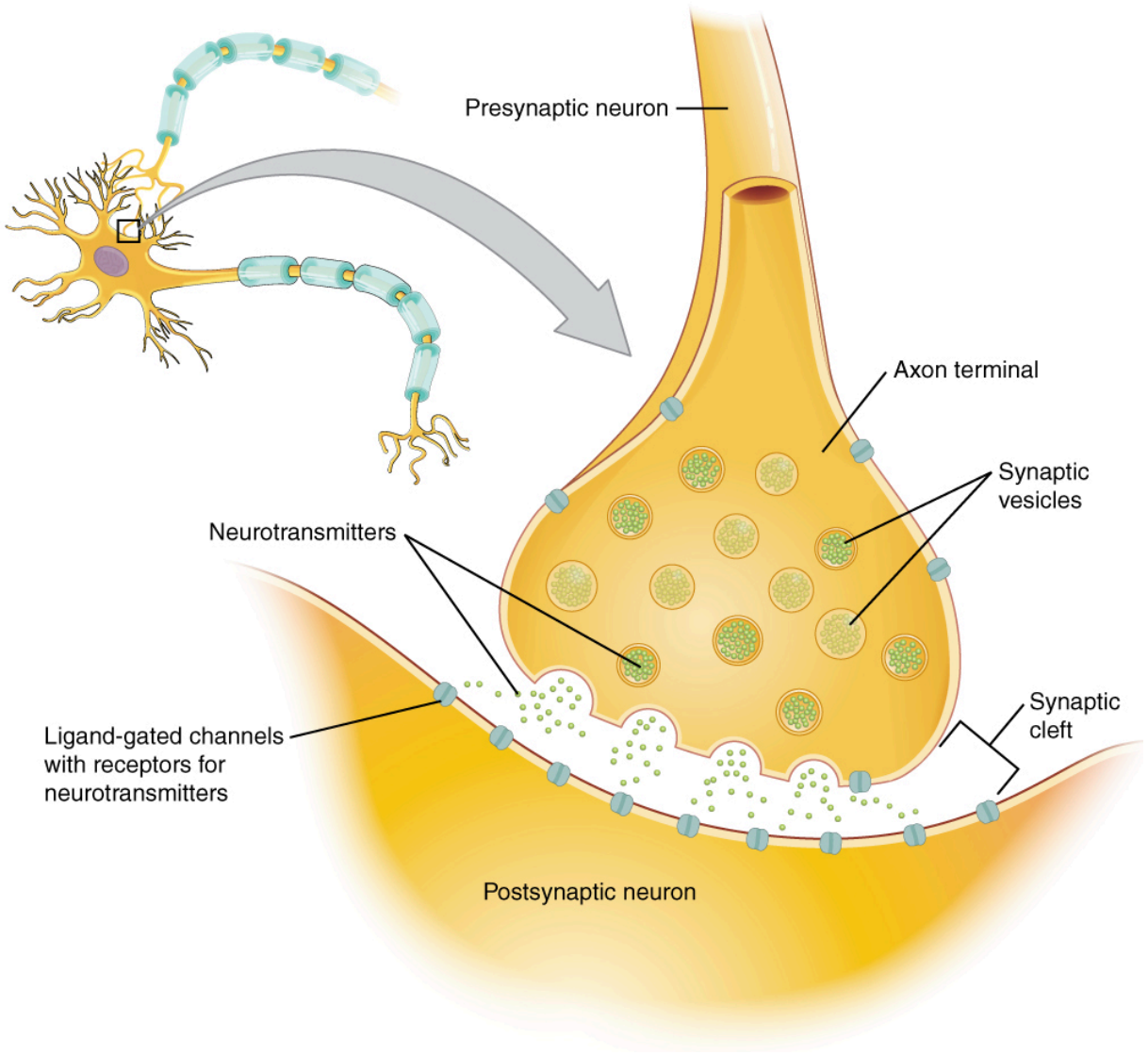

Figure 8.4 Major Elements in Neuron Communication

When the neurotransmitter binds to the receptor, the cell membrane of the target neuron changes its electrical state and a new graded potential begins. If that graded potential is strong enough to reach **threshold**, the second neuron generates an **action potential**. The target of this neuron is another neuron in the **thalamus** of the brain, the part of the CNS that acts as a relay for sensory information. The thalamus then sends the sensory information to the cerebral cortex, the outermost layer of gray matter in the brain, where conscious perception of that stimulus begins.

A supplementary video explaining neuron communication via action potentials is provided below.

Neuron communication via Action Potentials

One or more interactive elements has been excluded from this version of the text. You can view them

online here: https://wtcs.pressbooks.pub/pharmacology/?p=1811#oembed-1

Types of Neurotransmitters

Amino Acids

One group of neurotransmitters are amino acids. GABA (gamma-aminobutyric acid) is an example of an amino acid neurotransmitter. They each have their own receptors and do not interact with each other. Amino acid neurotransmitters are eliminated from the synapse by reuptake. A pump in the cell membrane of the presynaptic element, or sometimes a neighboring glial cell, will clear the amino acid from the synaptic cleft so that it can be recycled, repackaged in vesicles, and released again.

Biogenic Amine

Another class of neurotransmitter is the biogenic amine, a group of neurotransmitters that are enzymatically made from amino acids. For example, serotonin is made from tryptophan. It is the basis of the serotonergic system, which has its own specific receptors. Serotonin is transported back into the presynaptic cell for repackaging.

Other biogenic amines are made from tyrosine and include dopamine, norepinephrine, and epinephrine. Dopamine is part of its own system, the dopaminergic system, which has dopamine receptors. Norepinephrine and epinephrine belong to the adrenergic neurotransmitter system. The two molecules are very similar and bind to the same receptors, which are referred to as alpha- and beta-receptors. The biogenic amines have mixed effects. For example, dopamine receptors that are classified as D1 receptors are excitatory, whereas D2-type receptors are inhibitory.

The important thing to remember about neurotransmitters and signaling chemicals is that the effect is entirely dependent on the receptor.

Functions of Neurotransmitters

An alteration in CNS function is related to abnormal impulse transmission and can result in an imbalance of a neurotransmitter. A person with an imbalance of neurotransmitters may have signs and symptoms of a CNS disorder. The medications that are used to treat CNS disorders mimic or block the neurotransmitter based on the imbalance caused by the condition. Medications are used to either stimulate or depress the effect of the neurotransmitter. For example, CNS depressants alter the brain by decreasing excitability of neurotransmitters, blocking their receptor site, or increasing the inhibitory neurotransmitter. On the other hand, CNS stimulants increase brain activity by increasing excitability of neurotransmitters, decreasing the inhibitory neurotransmitters, or blocking their receptor sites.

Norepinephrine is often associated with the fight-or-flight response. Abnormal levels of this neurotransmitter are also associated with depression, decreased alertness and interest, along with possible palpitations, anxiety, and panic attacks. Dopamine is strongly linked to motor and cognition. This neurotransmitter influences movement and can be associated with ADHD, paranoia, and

schizophrenia. Serotonin is heavily involved in many bodily processes. Abnormal levels of serotonin can affect sleep, libido, mood, and temperature regulation. Alterations of this neurotransmitter have been linked to many mental health issues such as depression, bipolar disorder, anxiety, and body disorders. GABA (gamma-aminobutyric acid) can act as an inhibitory neurotransmitter. GABA assists with communication in the brain, and if this neurotransmitter is low, it has been linked to issues such as anxiety, seizures, mania, and impulse control. The neurotransmitter glutamate works as an excitatory neurotransmitter and works with GABA to control other functions of the brain.

8.3 Disorders of the CNS System

Open Resources for Nursing (Open RN)

Now that we have reviewed basic concepts of neurotransmitters and their function, let's review common CNS disorders.

Additional supplementary videos about mental disorders are available at:
Khan Academy

Anxiety

Anxiety disorders are a group of conditions marked by pathological or extreme anxiety or dread. People with anxiety experience disturbances of mood, behavior, and most systems in the body, making them unable to continue with everyday activities. Many feel anxious most of the time for no apparent reason.

Anxiety is different from fear. Fear is a person's response to an event or object. The psychiatric disorder of anxiety occurs when the intensity and duration of anxiety does not match the potential for harm or threat to the affected person. Anxiety can be expressed with physical symptoms or behaviorally.

Signs and Symptoms of Anxiety

- Aches
- Pains
- Stomach aches
- Headaches
- Heart racing or pounding
- Trembling
- Sweating
- Difficulty concentrating (see Figure 8.5)

- Increased agitation
- Crying

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Mayo Clinic Staff. (2018, May 4). *Anxiety disorders.* https://www.mayoclinic.org/diseases-conditions/anxiety/symptoms-causes/syc-20350961

Figure 8.5 Many patients with anxiety experience difficulty concentrating

Treatment can include non-pharmacological interventions as well as medications. Non-pharmacological interventions to decrease anxiety include relaxation techniques such as deep breathing, exercise, psychotherapy, support groups, or cognitive behavioral therapy. Anti-anxiety medications can also be used to help both verbal and nonverbal clients feel a much-needed sense of peace.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305)

Learn more about anxiety from the National Institute of Mental Health's website.

Depression

Depression is a frequent problem, affecting up to 5% of the population. To be diagnosed with depression, five of the following symptoms must be present during the same two-week period and represent a change from previous functioning. The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning. The symptoms of depression

cannot be due to effects of a substance or from bereavement.

Signs and Symptoms of Depression

- Depressed mood
- Diminished interest
- Weight loss when not dieting or weight gain
- Insomnia or hypersomnia
- Agitation
- Fatigue or loss of energy
- Feeling of worthlessness
- Inappropriate guilt
- Diminished ability to concentrate
- Recurrent thoughts of death, suicidal ideation, or suicide attempt

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  Mayo Clinic Staff. (2018, February 3). *Depression*. https://www.mayoclinic.org/diseases-conditions/depression/symptoms-causes/syc-20356007

Treatment of depression may include medication, psychotherapy, cognitive therapy, electroconvulsive therapy (ECT), and group therapy. Patients who are depressed may not report symptoms unless specifically asked, and they may be suicidal. Using assessment techniques to gather information about the history of each patient's depression, support system, specific triggering events, psychosocial assessment, and risk for harm to self or others is imperative. Each patient's response to medication is unpredictable, and often medications will need to be adjusted based on reported symptoms.

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Varcarolis, E. M. (2017). *Essentials of psychiatric mental health nursing: a communication approach to evidence-based care.* pp. 255-324. Elsevier.

Learn more about depression from the National Institute of Mental Health's website.

Bipolar

Bipolar affective disorder is marked by serious mood swings. Typically, patients experience extreme highs (called mania or hypomania) alternating with extreme lows (depression). See the "Depression" section for signs and symptoms of depression. People feel normal only in the periods between the highs and lows. For some people, the cycles occur so rapidly that they hardly ever feel a sense of control over their mood swings.

Signs and Symptoms of a Manic Episode

- Rapid speech
- Hyperactivity
- Reduced need for sleep

- Flight of ideas
- Grandiosity
- Poor judgement
- Aggression/hostility
- Risky sexual behavior
- Neglect basic self-care
- Decreased impulse control

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Mayo Clinic Staff. (2018, January 31)) *Bipolar disorder*. https://www.mayoclinic.org/diseases-conditions/bipolar-disorder/symptoms-causes/syc-20355955

Treatment for a patient diagnosed with bipolar may include medication, safety initiatives during acute mania, ECT, psychotherapy, and support groups. The severity of manic and depressive episodes varies for each patient. Assessing if a patient is a danger to others or themselves is the priority. People with bipolar may need assistance with impulse control during times when they are in a manic state.
Varcarolis, E. M. (2017). *Essentials of psychiatric mental health nursing: a communication approach to evidence-based care.* pp. 255-324. Elsevier.

Learn more about bipolar disorder from the National Institute of Mental Health's website.

Schizophrenia

Schizophrenia affects people from all walks of life and usually first appears between the ages of 15 and 30. Not everyone will experience the same symptoms, but many symptoms are common such as withdrawing, hearing voices, talking to oneself, seeing things that are not there, neglecting personal hygiene, and showing low energy.

Schizophrenia refers to a group of severe, disabling psychiatric disorders marked by withdrawal from reality, illogical thinking, delusions (fixed false beliefs that cannot be changed through reasoning), hallucinations (hearing, seeing, smelling, tasting, or feeling touched by things that are not there), and flat affect (lack of observable expressions of emotions, monotone voice, expressionless face, immobile body).

Signs and Symptoms of Schizophrenia

There are three types of symptoms related to schizophrenia: positive, negative, and cognitive.

Positive Symptoms

Note that in this context, the word *positive* is not the same as good. Rather, positive symptoms are psychotic and demonstrate how the individual has lost touch with reality. Positive symptoms include:

- Delusions

- Hallucinations
- Disorganized thinking and behavior

Delusions fall into several categories. Individuals with a persecutory delusion may believe they are being tormented, followed, tricked, or spied on. Individuals with a grandiose delusion may believe they have special powers. Individuals with a reference delusion may believe that passages in books, newspapers, television shows, song lyrics, or other environmental cues are directed toward them. In delusions of thought withdrawal or thought insertion, individuals believe others are reading their mind, their thoughts are being transmitted to others, or outside forces are imposing their thoughts or impulses on them.

Hallucinations may include hearing, seeing, smelling, tasting, or feeling as if they have been touched by things that are not there.

Negative Symptoms

Negative symptoms are those characteristics that should be there but are lacking. Negative symptoms include:

- Apathy (lack of interest in people, things, activities)
- Lack of motivation
- Blunted affect
- Poverty of speech (brief replies)
- Anhedonia (lack of interest in activities once enjoyed)
- Avoidance of relationships

Keep in mind that the inability to show emotion associated with a blunted affect does not reflect an inability to feel emotion. Similarly, it is helpful to understand that withdrawing from others is a coping mechanism for an individual with schizophrenia and not a rejection of those who initiate contact.

Cognitive

Cognitive symptoms are a change in thought pattern and include:

- Poor decision making
- Loss of memory
- Distracted
- Difficulty focusing

Treatment for a patient diagnosed with schizophrenia may include medications to control positive and/or negative signs and symptoms and nonpharmacological interventions such as limit setting, therapeutic communication, ECT, and psychotherapy. Key assessments for a patient with schizophrenia include examination for hallucinations and delusions, use of additional substances (alcohol or drugs), safety, their support system, and a medication review with a focus on compliance with their therapeutic

regimen.

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Varcarolis, E. M. (2017). *Essentials of psychiatric mental health nursing: a communication approach to evidence-based care.* pp. 255-324. Elsevier.

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Mayo Clinic Staff. (2020, January 7) *Schizophrenia.* https://www.mayoclinic.org/diseases-conditions/schizophrenia/diagnosis-treatment/drc-20354449

Learn more about schizophrenia from the National Institute of Mental Health's website.

Attention-Deficit / Hyperactivity Disorder

Attention-deficit/hyperactivity disorder (ADHD) is characterized by hyperactivity, lack of impulse control, and/or lack of attention that interferes with how a person functions. ADHD is often diagnosed during childhood, but signs and symptoms can last through adulthood.

Signs and Symptoms of ADHD

- Hyperactivity
- Inability to concentrate(see Figure 8.6)

- Difficulty with self-control
- Lack of emotional control

A child with ADHD may have difficulty sitting still and focusing at school or have emotional outbursts. These behaviors often impact their life. Medication, psychotherapy, behavior management, and family support all play a large part in helping an individual with ADHD. Additional resources for parents are also helpful.

Mayo Clinic Staff. (2019, June 25). *Attention-deficit/hyperactivity disorder (ADHD) in children.* https://www.mayoclinic.org/diseases-conditions/adhd/symptoms-causes/syc-20350889

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Figure 8.6 Patients with ADHD may have difficulty in focusing on details

Learn more about ADHD from the National Institute of Mental Health's website.

Seizures

The official definition of a seizure is "a transient occurrence of signs and/or symptoms due to an abnormal excessive or synchronous neuronal activity in the brain." This means that during a seizure, large numbers of brain cells are activated abnormally at the same time. It is like an electrical storm in the brain. They may alter consciousness and produce abnormal motor activity. There are different classifications of seizures based on severity of symptoms.
Epilepsy Foundation. (2016, December 22). *2017 Revised classification of seizures.* https://www.epilepsy.com/article/2016/12/2017-revised-classification-seizures

Signs and Symptoms of Seizures

Motor Symptoms

- Jerking (clonic)
- Muscles becoming limp or weak (atonic)
- Tense or rigid muscles (tonic)
- Brief muscle twitching (myoclonus)
- Epileptic spasms

Non-motor Symptoms

- Changes in sensation, emotions, thinking, or autonomic functions
- Lack of movement

Classification of Seizures

Seizures are classified in many ways, beginning with whether they are partial or generalized seizures.

Partial Seizures

Partial seizures have focal onset on one side of the brain. They are further classified into simple, complex, or secondarily generalized:

- Simple partial seizures are most common. They may also affect sensory and autonomic systems.
- Complex partial seizures include impairment of consciousness, with or without motor activity or other signs.
- Simple or complex partial seizures may become secondarily generalized, producing a tonic-clonic seizure.

Generalized Seizures

Generalized seizures have bilateral onset on both sides of the brain and are typified by petit mal seizures, which can be recognized by clinical characteristics as well as interictal EEG abnormalities.

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Mayo Clinic Staff. (2019, June 18). *Seizures*. https://www.mayoclinic.org/diseases-conditions/seizure/symptoms-causes/syc-20365711

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Epilepsy Foundation. (2016, December 22). *2017 Revised classification of seizures*. https://www.epilepsy.com/article/2016/12/2017-revised-classification-seizures

Status Epilepticus

Status epilepticus is a state of repeated or continuous seizures. It is often defined operationally as a single seizure lasting more than 20 minutes or repeated seizures without recovery of consciousness. Prolonged status epilepticus leads to irreversible brain injury and has a very high rate of mortality. The goal of therapy should be to achieve control of a seizure within 60 minutes or less. Pharmacological treatment of seizures is very successful in the majority of cases, but it requires accurate diagnosis and classification of seizures. Medication management of seizures may include CNS depressants, benzodiazepines or barbiturates, or anticonvulsants such as phenytoin.

Parkinson's Disease

Parkinson's disease is a progressive disease of the nervous system that impairs one's ability to move. The typical onset for Parkinson's disease is middle to later stages of life. This disease worsens over time and has no cure. The cause of this disease is unknown, but it is known that it is characterized by a loss of dopaminergic neurons.

Mayo Clinic Staff. (2018, June 30). *Parkinson's disease.* https://www.mayoclinic.org/diseases-conditions/parkinsons-disease/symptoms-causes/syc-20376055

Signs and Symptoms of Parkinson's Disease

- **Tremor** at rest
- **Bradykinesia**
- Muscle **rigidity**
- **Postural instability**
- **Gait disturbance**
- **Dystonia**
- **Ophthalmoplegia**
- Active mood disorders

See Figure 8.7 for a typical posture associated with Parksinon's disease.

Treatment for a patient with Parkinson's disease often includes medication to increase dopamine in the brain to slow the progression of the disease.

Figure 8.7. The typical stooping posture associated with Parksonson's disease.

Potential new treatment of proteins in Alzheimers and Parkinson's disease

The underlying cause of some neurodegenerative diseases, such as Alzheimer's and Parkinson's, appears to be related to proteins—specifically, to proteins behaving badly. One of the strongest theories of what causes Alzheimer's disease is based on the accumulation of beta-amyloid plaques, dense conglomerations of a protein that is not functioning correctly. Parkinson's disease is linked to an increase in a protein known as alpha-synuclein that is toxic to the cells of the substantia nigra nucleus in the midbrain.

For proteins to function correctly, they are dependent on their three-dimensional shape. The linear sequence of amino acids folds into a three-dimensional shape that is based on the interactions between and among those amino acids. When the folding is disturbed and proteins take on a different shape, they stop functioning correctly. But the disease is not necessarily the result of functional loss of these proteins; rather, these altered proteins start to accumulate and may become toxic. For example, in Alzheimer's the hallmark of the disease is the accumulation of these amyloid plaques in the cerebral cortex. The term coined to describe this sort of disease is "proteopathy" and it includes other diseases. Creutzfeld-Jacob disease, the human variant of the disease known as mad cow disease, also involves the

accumulation of amyloid plaques, similar to Alzheimer's. Diseases of other organ systems can fall into this group as well, such as cystic fibrosis or type 2 diabetes. Recognizing the relationship between these diseases has suggested new therapeutic possibilities. Interfering with the accumulation of the proteins, and possibly as early as their original production within the cell, may unlock new ways to alleviate these devastating diseases.

8.4 Nursing Process: CNS Medications

Open Resources for Nursing (Open RN)

Now that we have reviewed various CNS disorders and the anatomy and physiology underlying them, let's review the importance of the nursing process in guiding the nurse who administers CNS medication to treat these disorders.

Assessment

When thinking about administering CNS medication, there are many things to consider. Each medication is given for a specific purpose for your patient, and it is your job as a nurse to assess your patients and collect important data before safely administering medication. As a nurse, you will be not only performing the skill of administering medications, but also be expected to think critically about your patient and the safety of any medication at any particular time.

A nursing assessment completed prior to administering CNS medication will likely look different than an assessment for other types of medication because most of the associated assessments are done by collecting subjective data rather than objective data. For example, prior to administering a cardiac medication, a nurse will obtain objective data such as blood pressure and an apical heart rate. However, prior to administering CNS medication, a nurse will use therapeutic communication to ask questions to gather subjective data about how the patient is feeling. After reviewing the possible diseases connecting with the CNS system, you probably noticed that there is usually an associated imbalance of a neurotransmitter. As a nurse, you cannot directly measure a neurotransmitter to determine the effects of the medication, but you can ask questions to determine how your patient is feeling emotionally and perceiving the world, which are influenced by neurotransmitter levels. An example of a nurse using therapeutic communication to perform subjective assessment is asking a question such as, "Tell me more about how you are feeling today?" The nurse may also use general survey techniques such as simply observing the patient to assess for cues of behavior. Examples of data collected by a general survey could be assessing the patient's mood, hygiene, appearance, or movement.

Implementation of Interventions

With the administration of any medications, it is important to always perform the five rights (right patient, medication, dose, route, and time) and to check for allergies prior to administration. It is important to anticipate any common side effects and the expected outcome of the medication. When you administer CNS medication, it is key to perform assessments before administering medication because many patients may have changing behaviors and habits that influence the way they think and feel about taking their medication. Additionally, some medications require assessment of lab values before

administration. Many CNS medications may also have cumulative effects when used in conjunction with other medications, so careful assessment of the impact of the medications on one another is needed.

Evaluation

Finally, it is important to always evaluate the patient's response to a medication. Some CNS medications will take weeks to become therapeutic for the patient. It is key to teach the patient about when the medication is expected to produce an effect. Nurses should assess for mood, behavior, and movement improvement. If medications are effective, then patients should report fewer negative thoughts, worry, and symptomatic behaviors, as well as demonstrate fewer abnormal movements. Nurses also need to continually monitor for adverse effects, some of which can be life threatening and require prompt notification to the prescribing provider. Additionally, if symptoms are not improving or the patient's condition is worsening, the nurse should promptly notify the prescribing provider for further orders. For example, a symptom and/or adverse reaction of several CNS medications is increased thoughts of suicide. If a patient is experiencing thoughts of suicide, immediate assistance should be obtained to keep them safe. For more information about suicide, see the link to information about suicide prevention below.

Suicide Prevention

Now that we have reviewed CNS basics and how to use the nursing process related to CNS medications, we will take a closer look at specific classes of CNS medications. We will review classes and specific administration considerations, therapeutic effects, adverse/side effects, and teaching needed for each class of medications.

Medication grids are intended to assist students to learn key points about each medication. Because information about medication is constantly changing, nurses should always consult evidence-based resources to review current recommendations before administering specific medication. Basic information related to each class of medication is outlined below. Detailed information on a specific medication can be found for free at Daily Med. On the home page, enter the drug name in the search bar to read more about the medication.

Prototype/generic medications listed in the grids are also hyperlinked directly to a Daily Med page.

8.5 CNS Depressants

Open Resources for Nursing (Open RN)

Barbiturates and benzodiazepines are examples of CNS depressants.

Barbiturates

Phenobarbital is an example of a barbiturate primarily used as a sedative and to treat seizure disorders. In high doses it can be used to induce anesthesia, and overdosage can cause death. In the 1960s and 1970s, barbiturates were used to treat anxiety and insomnia, but are no longer used for these purposes due to their serious adverse effects. Barbiturates are a Schedule IV drug under the Federal Controlled Substances Act. However, the abuse of barbiturates continues to occur with street use as a "downer" to

counteract the effect of cocaine and methamphetamine.

Mechanism of Action

Barbiturates produce sedation and drowsiness by altering cerebellar function and depressing the actions of the brain and sensory cortex.

Indications for Use

Barbiturates are primarily used for sedation and seizures.

Nursing Considerations Across the Lifespan

Do not use for children less than 1 month of age. Barbiturates may harm the fetus during pregnancy. Avoid use in geriatic patients.

Adverse/Side Effects

Patients may experience CNS depression, suicidal thoughts or behaviors, GI disturbances, rashes, or some blood disorders that can be fatal. The concomitant use of alcohol or other CNS depressants may produce additive CNS depressant effects that can cause death. It can be habit forming.

Patient Teaching & Education

The patient should be advised to take the prescribed medication as directed. Patients who undergo prolonged therapy should not discontinue treatment abruptly as this may cause onset of seizure activity. These medications may cause drowsiness and should not be taken with alcohol or other CNS depressants. Female patients using oral contraceptives should also use non-hormonal based contraceptives during therapy.

Overdosage

The onset of symptoms following a toxic oral exposure to phenobarbital may not occur until several hours following ingestion. If overdose occurs, consult with a Certified Poison Control Center (1-800-222-1222) or go to https://www.poisonhelp.org/help for the latest recommendations.

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Drugs.com (2019, February 5). *Barbiturates*. https://www.drugs.com/drug-class/barbiturates.html

Now let's take a closer look at the medication grid for phenobarbital in Table 8.5a.

Medication grids are intended to assist students to learn key points about each medication class. Basic information related to a common generic medication in this class is outlined, including administration considerations, therapeutic effects, and side effects/adverse effects. Prototype/generic medication listed in the med grid is also hyperlinked directly to a free resource from the U.S. National Library of Medicine called Daily Med. Because information about medication is constantly changing, nurses should always consult evidence-based resources to review current recommendations before administering specific medication.

Table 8.5a Phenobarbital Medication Grid

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Barbiturates	phenobarbital	May be administered orally, IM, or IV High abuse potential Should not be combined with other CNS depressants When therapy is discontinued, the dose should be tapered and not stopped abruptly	Primarily used as an anticonvulsant Also used as a sedative and may also be used as a preanesthetic agent	CNS depression; overdosage can cause death May cause suicidal thoughts or behavior Respiratory depression GI: Nausea and vomiting

Benzodiazepines

Lorazepam, a benzodiazepine with antianxiety, sedative, and anticonvulsant effects, is available for oral, intramuscular, or intravenous routes of administration. Benzodiazepines are a controlled Schedule IV substance because they have a potential for abuse and may lead to dependence.

Mechanism of Action

Benzodiazepines bind to specific GABA receptors to potentiate effects of GABA.

Indications for Use

Benzodiazepines are used for sedation, antianxiety, and anticonvulsant effects. Lorazepam injection is indicated for the treatment of status epilepticus. It may also be used in adult patients for preanesthetic medication to produce sedation (sleepiness or drowsiness), relieve anxiety, and decrease the ability to recall events related to the day of surgery. Oral lorazepam is used to treat anxiety disorders.

Nursing Considerations Across the Lifespan

Benzodiazepines may cause fetal harm when administered to pregnant women. Children and the elderly are more likely to experience paradoxical reactions to benzodiazepines such as tremors, agitation, or visual hallucinations. Elderly or debilitated patients may be more susceptible to the sedative and respiratory depressive effects of lorazepam. Therefore, these patients should be monitored frequently and have their dosage adjusted carefully according to patient response; the initial dosage should not exceed 2 mg. Dosage for patients with severe hepatic insufficiency should be adjusted carefully according to patient response.

Adverse/Side Effects

A Black Box Warning states that concomitant use of benzodiazepines and opioids may result in profound sedation, respiratory depression, coma, and death.

The most important risk associated with the intravenous use of lorazepam injection is respiratory depression. Accordingly, airway patency must be assured and respiration monitored closely. Ventilatory support should be given as required. The additive central nervous system effects of other drugs, such as phenothiazines, narcotic analgesics, barbiturates, antidepressants, scopolamine, and monoamine-oxidase inhibitors should be considered when these other drugs are used concomitantly with, or during the period of recovery from, lorazepam injection. Sedation, drowsiness, respiratory depression (dose dependant), hypotension, and unsteadiness may occur with oral dosages as well. The use of benzodiazepines may lead to physical and psychological dependence. Abrupt termination of treatment may be accompanied by withdrawal symptoms. Benzodiazepines should be prescribed for short periods only (e.g., 2 to 4 weeks). Extension of the treatment period should not take place without reevaluation of the need for continued therapy.

Overdosage

Overdosage of benzodiazepines is usually manifested by varying degrees of central nervous system depression, ranging from drowsiness to coma. Treatment of overdosage is mainly supportive until the drug is eliminated from the body. Vital signs and fluid balance should be carefully monitored in conjunction with close observation of the patient. An adequate airway should be maintained and assisted respiration used as needed. The benzodiazepine antagonist flumazenil may be used in hospitalized patients in the management of benzodiazepine overdose. There is a risk of seizure in association with flumazenil treatment, particularly in long-term benzodiazepine users. If overdose occurs, consult with a Certified Poison Control Center (1-800-222-1222) or go to https://www.poisonhelp.org/help for the latest recommendations.

Patient Teaching & Education

Patients who receive lorazepam should be cautioned that driving a motor vehicle, operating machinery, or engaging in hazardous or other activities requiring attention and coordination should be delayed for 24 to 48 hours following administration or until the effects of the drug, such as drowsiness, have subsided. Patients should be advised that getting out of bed unassisted may result in falling and potential injury if undertaken within 8 hours of receiving lorazepam. Alcoholic beverages should not be consumed for at least 24 to 48 hours after receiving lorazepam injectable due to the additive effects on central nervous system depression seen with benzodiazepines in general. Elderly patients should be instructed that lorazepam injection may make them very sleepy for a period longer than 6 to 8 hours following surgery.

Now let's take a closer look at the medication grid for lorazepam in Table 8.5b.

Table 8.5b Lorazepam Medication Grid

Class/	Prototype/	Administration Considerations	Therapeutic Effects	Adverse/Side Effects

Subclass	Generic			
Benzodiazepines	lorazepam	Black Box Warning: Concomitant use of benzodiazepines and opioids may result in profound sedation, respiratory depression, coma, and death May cause fetal harm in pregnant women May cause paradoxical effect in children Use cautiously in elderly and with those with liver dysfunction	To relieve anxiety, reduce seizure activity, or as a preanesthetic	Oversedation and drowsiness Respiratory depression Unsteadiness and fall risk Overdosage can cause coma and death Flumazenil used for overdose

Critical Thinking Activity 8.5
Image of lightbulb in a circle

A patient who has been experiencing panic attacks is prescribed lorazepam. Upon further discussion with the patient, the nurse discovers that the patient is planning to go on a cruise with her husband next week and plans to use a scopolamine patch to control the nausea. The patient states, “I can’t wait to relax on the cruise ship and have a margarita as we leave port!”

What important patient education should the nurse provide to the patient about the new prescription for lorazepam?

Note: Answers to the Critical Thinking activities can be found in the “Answer Key” sections at the end of the book.

8.6 CNS Stimulants

Open Resources for Nursing (Open RN)

Methylphenidate is an example of a CNS stimulant that is often used to treat ADHD. CNS stimulants are Schedule II controlled substances and have a high potential for abuse and dependence.

Mechanism of Action

Methylphenidate stimulates the brain and acts similar to amphetamines. Methylphenidate is thought to block the reuptake of norepinephrine and dopamine into the presynaptic neuron.

Indications for Use

Methylphenidate is used for ADHD.

Nursing Considerations Across the Lifespan

Methylphenidate is typically prescribed to patients over the age of 6. It should be avoided in patients with known structural cardiac abnormalities, cardiomyopathy, serious heart rhythm arrhythmias, or coronary artery disease. Blood pressure and heart rate should be monitored in all patients.

CNS stimulants have been associated with weight loss and slowing of growth rate in pediatric patients. It increases the risk of peripheral vasculopathy, such as Raynaud's phenomenon, with signs and symptoms of fingers or toes feeling numb, cool, painful, and/or changing color from pale, to blue, to red.

Methylphenidate is contraindicated in patients using a monoamine oxidase inhibitor (MAOI), or use of an MAOI within the preceding 14 days. If paradoxical worsening of symptoms or other adverse reactions occur, the dosage should be reduced, or if necessary, discontinued.

Administer methylphenidate hydrochloride extended-release capsules orally once daily in the morning. Extended-release capsules should not be crushed, chewed, or divided. Monitor for signs of abuse and dependence while on therapy.

Adverse/Side Effects

Serious cardiovascular events have occurred with sudden death reported in association with CNS-stimulant treatment in pediatric patients with structural cardiac abnormalities or other serious heart problems. Sudden death, stroke, and myocardial infarction have also been reported in adults with CNS-stimulant treatment at recommended doses. Methylphenidate may cause increased blood pressure and increased heart rate. Use of stimulants may cause psychotic or manic symptoms in patients with no prior history and may cause priapism (painful or prolonged penile erections). The most common adverse reactions (greater than 5% incidence) were headache, insomnia, upper abdominal pain, decreased appetite, and anorexia. Alcohol should be avoided because it may cause a rapid release of the drug in extended-release formulations.

Overdose

If overdose occurs, consult with a Certified Poison Control Center (1-800-222-1222) or go to https://www.poisonhelp.org/help for the latest recommendations.

Patient Teaching & Education

There are several important topics to provide patients and/or parents of minor children.

Controlled Substance Status/High Potential for Abuse and Dependence: Advise patients that methylphenidate is a controlled substance, and it can be abused and lead to dependence. Instruct patients that they should not give methylphenidate to anyone else. Advise patients to store methylphenidate in a safe place, preferably locked, to prevent abuse. Advise patients to comply with laws and regulations on drug disposal. Advise patients to dispose of remaining, unused, or expired methylphenidate by a medicine take-back program if available.

Serious Cardiovascular Risks: Advise patients that there is a potential serious cardiovascular risk, including sudden death, myocardial infarction, stroke, and hypertension. Instruct patients to contact a healthcare provider immediately if they develop symptoms such as exertional chest pain or unexplained syncope.

Blood Pressure and Heart Rate Increases: Instruct patients that methylphenidate hydrochloride extended-release capsules can cause elevations of their blood pressure and pulse rate.

Psychiatric Risks: Advise patients that methylphenidate can cause psychotic or manic symptoms, even in patients without prior history of psychotic symptoms or mania.

Priapism: Advise patients of the possibility of painful or prolonged penile erections and to seek immediate medical attention if this occurs.

Circulation Problems in Fingers and Toes: Instruct patients beginning treatment with methylphenidate about the risk of peripheral vasculopathy and associated signs and symptoms: fingers or toes may feel numb, cool, painful, and/or may change color from pale, to blue, to red. Instruct patients to report to their physician any new numbness, pain, skin color change, or sensitivity to temperature in fingers or toes or any signs of unexplained wounds appearing on fingers or toes.

Suppression of Growth: Advise parents that methylphenidate may cause slowing of growth and weight loss.

Alcohol Effect: Advise patients to avoid alcohol while taking extended-release capsules.

Now let's take a closer look at the medication grid for methylphenidate in Table 8.6.

Table 8.6 Methylphenidate Medication Grid

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects

CNS Stimulant	methylphenidate	Black Box Warning: High abuse potential Patients should avoid alcohol Monitor BP and HR Monitor growth and weight in children Monitor for signs of abuse Contraindicated with MAOIs or use of an MAOI within the preceding 14 days	Increases mental focus and attention in patients with ADHD	Immediately report signs and symptoms of abuse, cardiac or peripheral vascular complications, and priapism Report mania or psychotic episodes Common side effects: headache, insomnia, upper abdominal pain, decreased appetite, and anorexia Gynecomastia

Critical Thinking Activity 8.6

A 12-year-old male child has been diagnosed with ADHD after his parents and teachers became concerned with his inability to concentrate and his poor impulse control in the classroom. The physician has prescribed methylphenidate (Ritalin).

What topics should the nurse reinforce while educating the child and his parents about this medication?

Note: Answers to the Critical Thinking activities can be found in the “Answer Key” sections at the end of the book.

8.7 Antidepressants

Open Resources for Nursing (Open RN)

Antidepressants are used to treat depression and other mental health disorders, as well as other medical conditions such as migraine headaches, chronic pain, and premenstrual syndrome. Antidepressants increase levels of neurotransmitters in the CNS, including serotonin (5-HT), dopamine, and norepinephrine. Treatment is based on the belief that alterations in the levels of these neurotransmitters are responsible for causing depression.
Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 246-272. Elsevier.

This module will discuss four classes of antidepressants: tricyclic antidepressants (TCAs), selective serotonin reuptake inhibitors (SSRIs), serotonin norepinephrine reuptake inhibitors (SNRIs), and monoamine oxidase inhibitors (MAOIs). TCAs and MAOIs are referred to as first-generation antidepressants because they were first marketed in the 1950s. SSRIs, SNRIs, and other miscellaneous medications such as bupropion are called second-generation antidepressants and are popular because of fewer side effects like sedation, hypotension, anticholinergic effects, or cardiotoxicity.
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Black Box Warnings are in place for all classes of antidepressants used with children, adolescents, and young adults for a higher risk of suicide. All patients receiving antidepressants should be monitored for signs of worsening depression or changing behavior, especially when the medication is started or dosages are changed.

Tricyclic Antidepressants

Tricyclic antidepressants (TCAs) were one of the original first-generation antidepressants. Due to the popularity of SSRIs and SNRIs, TCAs are now more commonly used to treat neuropathic pain and insomnia.

Mechanism of Action

Amitriptyline is an antidepressant with sedative effects. Its mechanism of action is not known. Amitriptyline inhibits the membrane pump mechanism responsible for uptake of norepinephrine and serotonin in adrenergic and serotonergic neurons. This interference with reuptake of norepinephrine and/or serotonin is believed to underlie the antidepressant activity of amitriptyline.

Indications for Use

TCAs are used to treat depression, neuropathic pain, and insomnia.

Nursing Considerations Across the Lifespan

TCAs are often administered at bedtime due to sedating effects and are contraindicated with MAOIs.

Geriatric patients are particularly sensitive to the anticholinergic side effects of tricyclic antidepressants. Peripheral anticholinergic effects include tachycardia, urinary retention, constipation, dry mouth, blurred

vision, and exacerbation of narrow-angle glaucoma. Central nervous system anticholinergic effects include cognitive impairment, psychomotor slowing, confusion, sedation, and delirium. Elderly patients taking amitriptyline may be at increased risk for falls. Elderly patients should be started on low doses of amitriptyline and observed closely.

After prolonged administration, abrupt cessation of treatment may produce nausea, headache, and malaise. The dose should be gradually tapered, but transient symptoms may still occur.

Adverse/Side Effects

Adverse effects of TCAs are a result of their blockade effects on various receptors, often resulting in anticholinergic adverse effects such as constipation, urinary retention, and drowsiness. Blockage of adrenergic and dopaminergic receptors can cause cardiac conduction disturbances and hypotension. Histaminergic blockage can cause sedation, and serotonergic blockade can alter the seizure threshold and cause sexual dysfunction.

Black Box Warnings are in place for all classes of antidepressants used with children, adolescents, and young adults for a higher risk of suicide. Patients receiving antidepressants should be monitored for signs of worsening depression or changing behavior, especially when the medication is started or dosages are changed.

Overdosage

Death may occur from overdosage with this class of drugs. Multiple drug ingestion (including alcohol) is common in deliberate tricyclic antidepressant overdose. If overdose occurs, consult with a Certified Poison Control Center (1-800-222-1222) or go to https://www.poisonhelp.org/help for the latest recommendations.

Patient Teaching & Education: Due to the increased risk of suicidality with antidepressants, patients and their family members or caregivers should be instructed to immediately report any sudden changes in mood, behaviors, thoughts, or feelings. Potential side effects discussed above should be reviewed.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

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Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 246-272. Elsevier.

Now let's take a closer look at the medication grid for amitriptyline in Table 8.7a.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

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Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 246-272. Elsevier.

Table 8.7a Amitryiptyline Medication Grid

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Tricyclic	amitriptyline	Black Box Warning: Increased risk of suicidality Taper dose when discontinuing; do not stop abruptly Monitor orthostatic blood pressures and consider fall risk precautions	Based on indication: decrease feelings of depression, chronic pain, or insomnia	Immediately report signs or symptoms of suicidality Anticholinergic effects Hypotension May lengthen QT interval; risk for arrhythmias Sedation Sexual dysfunction Altered seizure threshold

Selective Serotonin Reuptake Inhibitor (SSRI)

Selective Serotonin Reuptake Inhibitors (SSRIs) are a second-generation antidepressant and have fewer side effects than TCAs and MAOIs. Fluoxetine and citalopram are commonly used SSRIs.

Mechanism of Action

SSRIs inhibit the reuptake of serotonin.

Indications for Use

SSRIs are primarily used to treat depression, but are also used to treat obsessive compulsive disorder, bulimia, panic disorder, posttraumatic stress disorder, other forms of anxiety, premenstrual syndrome, and migraines.

Nursing Considerations Across the Lifespan

The onset of fluoxetine's antidepressant effect develops slowly for up to 12 weeks.

Use with caution in patients who are taking other CNS medications or who have liver dysfunction. This drug is contraindicated with MAOIs. Monitor for increased suicide ideation in all populations, as well as for the development of serotonin syndrome. Patients should avoid grapefruit juice due to its effect on the

CYP3A4 enzyme that affects the bioavailability of the medication.

Adverse/Side Effects

Black Box Warnings are in place for all classes of antidepressants used with children, adolescents, and young adults for a higher risk of suicide. Patients receiving antidepressants should be monitored for signs of worsening depression or changing behavior, especially when the medication is started or dosages are changed.

The development of a potentially life-threatening serotonin syndrome or neuroleptic malignant syndrome (NMS)-like reactions have been reported with SNRIs and SSRIs, particularly with concomitant use of serotonergic drugs, drugs that impair metabolism of serotonin (including MAOIs), or with antipsychotics or other dopamine antagonists. Symptoms of **serotonin syndrome** may include mental status changes (e.g., agitation, hallucinations, coma), autonomic instability (e.g., tachycardia, labile blood pressure, hyperthermia), neuromuscular aberrations (e.g., hyperreflexia, incoordination), and/or gastrointestinal symptoms (e.g., nausea, vomiting, diarrhea). Serotonin syndrome, in its most severe form, can resemble **neuroleptic malignant syndrome** (NMS), which includes hyperthermia, muscle rigidity, autonomic instability with possible rapid fluctuation of vital signs, and mental status changes. Patients should be monitored for the emergence of serotonin syndrome or NMS-like signs and symptoms.

Other side effects include rash; mania; seizures; decreased appetite and weight; increased bleeding associated with the concomitant use of fluoxetine and NSAIDs, aspirin, warfarin, or other drugs that affect coagulation; hyponatremia; anxiety; and insomnia.

Abrupt discontinuation may cause several adverse effects, so a gradual reduction in the dose rather than abrupt cessation is recommended whenever possible.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

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Lilley, L., Collins, S., & Snyder, J. (2014). *Pharmacology and the Nursing Process.* pp. 246-272. Elsevier.

Patient Teaching & Education

Patients should be careful to take medications as directed. Abrupt discontinuation may cause anxiety, insomnia, and increased nervousness. Additionally, orthostatic blood pressure changes are common during medication therapy. Patients may also be increasingly drowsy or exhibit some confusion. Use of SSRI medications with alcohol or other CNS depressant drugs should be avoided.

Patients, family, and caregivers should monitor patients carefully for suicidality. Other side effects include possible decreased libido, urinary retention, constipation, and increased photosensitivity.

Now let's take a closer look at the medication grid for fluoxetine and citalopram in Table 8.7b.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

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Lilley, L., Collins, S., & Snyder, J. (2020). *Pharmacology and the Nursing Process.* pp. 246-272. Elsevier.

Table 8.7b Fluoxetine and Citalopram Medication Grid

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
SSRI	fluoxetine citalopram	Black Box Warning: Monitor for increased risk of suicidality Do not stop abruptly; taper dose when discontinuing Contraindicated with MAOIs Use caution with liver dysfunction May take up to 12 weeks before achieve therapeutic effect	Based on indication: primarily decreases feelings of depression	Immediately report signs/symptoms of increased suicidality or serotonin syndrome Rash, mania, seizures, decreased appetite and weight, increased bleeding, hyponatremia, anxiety, and insomnia

Critical Thinking Activity 8.7

A 32-year-old female visits the nurse practitioner with concerns about “feeling tired all the time,” “having difficulty concentrating,” “problems sleeping,” and “just generally feeling down.” The nurse practitioner prescribed fluoxetine.

The patient tells the nurse, “One of my friends told me I have to be careful or I might get serotonin syndrome if I take medication.”

1.What places a patient at risk for serotonin syndrome, and what symptoms should the nurse teach the patient about this condition?

2. The nurse knows that anyone starting an antidepressant is at risk for suicidal thoughts. How should the nurse therapeutically discuss this potential adverse effect with the patient?

3. What potential common side effects should the nurse discuss with the patient?

The patient states, “I can’t wait to feel better again. How soon will this medication work?”

4. What is the nurse’s best response?

Note: Answers to the Critical Thinking activities can be found in the “Answer Key” sections at the end of the book.

Serotonin Norepinephrine Reuptake Inhibitor (SNRI)

Venlafaxine is an example of a Serotonin Norepinephrine Reuptake Inhibitor (SNRI).

Mechanism of Action

Venlafaxine inhibits the reuptake of serotonin and norepinephrine, with weak inhibition of dopamine reuptake.

Indications for Use

SNRIs are indicated for treatment of a major depressive disorder.

Nursing Considerations Across the Lifespan

SNRIs are contraindicated with MAOIs or within 14 days of use of an MAOI. Dosage adjustment is required for use in patients with renal and/or liver disease. Elderly patients are at greater risk for developing hyponatremia. Use with caution with other serotonin medications.

Adverse/Side Effects

Black Box Warnings are in place for all classes of antidepressants used with children, adolescents, and young adults for a higher risk of suicide. Patients receiving antidepressants should be monitored for signs of worsening depression or changing behavior, especially when the medication is started or dosages are changed.

SNRI medication may cause sustained increase in blood pressure. Other side effects include serotonin syndrome, insomnia, anxiety, decreased appetite, weight loss, mania, hyponatremia, increased bleeding (especially with the concomitant use of fluoxetine and NSAIDs, aspirin, warfarin, or other drugs that affect coagulation), elevated serum cholesterol, somnolence, and nausea.

Patient Teaching & Education

Patients should be careful to take medications as directed. The dose should be tapered prior to discontinuation. Patients may also be increasingly drowsy or dizzy. Use of SNRI medications with alcohol or other CNS depressant drugs should be avoided. Patients, family, and caregivers should monitor patients carefully for suicidality.

Now let's take a closer look at the Medication Grid for venlafaxine in Table 8.7c.

Table 8.7c Medication Grid for Venlafaxine

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/ Side Effects
SNRI	venlafaxine	Black Box Warning: Monitor for increased risk of suicidality Monitor BP Gradually reduce dose when discontinuing when possible Use with caution with patients with liver or renal disease	May take up to 8 weeks before therapeutic effect is recognized Decrease feelings of depression	Increased suicidality Serotonin syndrome Elevated BP Anxiety Insomnia Decreased appetite Weight loss Mania Hyponatremia Increased bleeding Elevated cholesterol Somnolence GI: Nausea and constipation

Monoamine Oxidase inhibitors (MAOI)

Monoamine oxidase inhibitors (MAOIs) are a first-generation antidepressant. Tranylcypromine is an example of a MAOI. A significant disadvantage to MAOIs is their potential to cause a hypertensive crisis when taken with stimulant medications or foods containing tyramine.

Mechanism of Action

The mechanism of action of tranylcypromine tablets as an antidepressant is not fully understood, but is presumed to be linked to potentiation of monoamine neurotransmitter activity in the central nervous system resulting from its irreversible inhibition of the enzyme monoamine oxidase (MAO).

MAO inactivates norepinephrine, dopamine, epinephrine, and serotonin. By inhibiting MAO, the levels of these transmitters rise.
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Indications for Use

Tranylcypromine is indicated for the treatment of major depressive disorder in adult patients who have not responded adequately to other antidepressants. The drug may also be used to treat Parkinson's disease.

Nursing Considerations Across the Lifespan

Serious interactions with several medications, as well as foods and beverages containing tyramine, have been reported; check drug labelling before administering. Safety has not been established with the pediatric population. The elderly population is at increased risk for postural hypotension and serious adverse effects. Abuse and dependence have been reported. Withdrawal effects can continue for several weeks after discontinuation.

Adverse/Side Effects

Black Box Warnings are in place for all classes of antidepressants used with children, adolescents, and young adults for a higher risk of suicide. Patients receiving antidepressants should be monitored for signs of worsening depression or changing behavior, especially when the medication is started or dosages are changed.

Use with caution due to the risks of hypertensive crisis, serotonin syndrome, and increased suicidality. **Hypertensive crisis** is defined by severe hypertension (blood pressure greater than 180/120 mm Hg) with evidence of organ dysfunction. Symptoms may include occipital headache (which may radiate frontally), palpitations, neck stiffness or soreness, nausea or vomiting, sweating, dilated pupils, photophobia, shortness of breath, or confusion. Either tachycardia or bradycardia may be present and may be associated with constricting chest pain. Seizures may also occur. Intracranial bleeding, sometimes fatal, has been reported in association with the increase in blood pressure. See more information about serotonin syndrome in the "SSRI" section.

Other potential side effects include mania, **orthostatic hypotension**, hepatotoxicity, seizures, hypoglycemia in diabetic patients, decreased appetite and weight loss, dizziness, headache, drowsiness,

and restlessness. Patients should be advised it may impair ability to operate machinery or drive. MAOIs should be discontinued if hepatotoxicity occurs.

Patient Teaching & Education

Patients should be careful to take medications as directed. They should avoid abrupt cessation of therapy to avoid withdrawal symptoms. Patients should avoid alcohol, other CNS depressants, and tyramine-containing products for two weeks after therapy is discontinued. Patients should be advised regarding the signs of hypertensive crisis and to immediately report headache, chest or throat tightness, and palpitations to the provider.

Now let's take a closer look at the medication grid for tranylcypromine in Table 8.7d.

Table 8.7d Medication Grid for Tranylcypromine

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
MAOI	tranylcypromine	Black Box Warning: Monitor for hypertensive crisis and increased suicide ideation Avoid foods containing tyramine Many drug interactions Monitor BP Do not stop abruptly; taper dose when discontinuing Discontinue if hepatotoxicity	Based on indication: decreased feelings of depression or decreased symptoms of Parkinson's disease	Increased suicidality Hypertensive crisis Serotonin syndrome Mania Orthostatic hypotension Hepatotoxicity Seizures Hypoglycemia in diabetic patients Decreased appetite and weight loss CNS: dizziness,

				headache, drowsiness, and restlessness May impair ability to operate machinery or drive

8.8 Antimania

Open Resources for Nursing (Open RN)

Mood stabilizers are used to treat bipolar affective disorder. Lithium was the first medication used to treat this disorder and is sometimes referred to as an anti-mania drug because it can help control the mania that occurs in bipolar disorder. Lithium must be closely monitored with a narrow therapeutic range.
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Lithium

Mechanism of Action

Lithium alters sodium transport in **nerve** and muscle cells and effects a shift toward intraneuronal metabolism of catecholamines, but the specific biochemical mechanism of lithium action in mania is unknown.

Indications for Use

Lithium is indicated in the treatment of manic episodes of bipolar disorder and as a maintenance treatment for individuals with a diagnosis of bipolar disorder.

Nursing Considerations Across the Lifespan

Lithium must be closely monitored with a narrow therapeutic serum range of 0.8 to 1.2 mEq/L. Serum sodium levels should also be monitored for potential hyponatremia.
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

The drug is contraindicated in renal or cardiovascular disease, severe dehydration or sodium depletion, and to patients receiving diuretics because the risk of lithium toxicity is very high in such patients.

Lithium can cause fetal harm in pregnant women. Safety has not been established for children under 12 and is not recommended.

When given to a patient experiencing a manic episode, lithium may produce a normalization of symptomatology within 1 to 3 weeks.

Adverse/Side Effects

Black Box Warning: Lithium toxicity is closely related to serum lithium levels and can occur at doses close to therapeutic levels at 1.5 mEq/L. Facilities for prompt and accurate serum lithium determinations should be available before initiating therapy. Lithium can cause abnormal electrocardiographic (ECG) findings and risk of sudden death. Patients should be advised to seek immediate emergency assistance if they experience fainting, lightheadedness, abnormal heart beats, or shortness of breath.

Signs of early lithium toxicity include diarrhea, vomiting, drowsiness, muscular weakness, and lack of coordination. At higher levels, giddiness, ataxia, blurred vision, tinnitus, and a large output of dilute urine may be seen. No specific antidote for lithium poisoning is known; treatment focuses on the elimination of the medication.

Fine hand tremor, polyuria, and mild thirst may also persist throughout treatment.

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Patient Teaching & Education

Patients should take medication as directed It is important to note the antimanic drugs may increase dizziness and drowsiness. Additionally, if individuals have low sodium levels, it may predispose the patient toxicity. Patients should also be advised that weight gain may occur.

Now let's take a closer look at the medication grid for lithium in Table 8.8.

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Table 8.8 Lithium Medication Grid

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
Antimanic	lithium	Black Box Warning: Monitor for signs of lithium toxicity Monitor serum lithium	When given during a manic episode, symptoms may resolve in 1-3 weeks	Lithium toxicity Hyponatremia Tremor

		and sodium levels Contraindicated in renal and cardiovascular disease and in dehydration	When given for maintenance therapy, it should reduce the frequency and intensity of manic episodes	Cardiac arrhythmia Polyuria Thirst

Critical Thinking Activity 8.8
Image of lightbulb in a circle

A 42-year-old male was recently diagnosed with bipolar disorder after his partner became concerned about his extreme highs and lows in moods. His high mood swings were often associated with grandiose ideas, gambling, risky sexual behavior, and shopping sprees that were causing the couple to go bankrupt. The physician prescribed lithium.

1. The patient states, “The doctor told me I am having manic episodes. What does that mean?” What is the nurse’s best response?

2. The nurse knows that there is a risk of lithium toxicity. What are the symptoms of lithium toxicity, and how will it be prevented?

3. The patient’s partner asks, “How quickly will the lithium work?” What is the nurse’s best response?

Note: Answers to the Critical Thinking activities can be found in the “Answer Key” sections at the end of the book.

8.9 Antipsychotics

Open Resources for Nursing (Open RN)

Antipsychotic drugs are used to treat drug-induced psychosis, schizophrenia, extreme mania, depression that is resistant to other therapy, and other CNS conditions. Antipsychotics are sometimes referred to as tranquilizers because they produce a state of tranquility. First-generation antipsychotics, also called

conventional antipsychotics, have similar mechanisms of action. An example of a conventional antipsychotic is haloperidol. Conventional antipsychotics have several potential adverse effects, and selection of a medication is based on the patient's ability to tolerate the adverse effects. Second-generation antipsychotics, also referred to as atypical antipsychotics, have fewer adverse effects. An example of an atypical antipsychotic is risperidone.

McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Both conventional and atypical antipsychotics have a Black Box Warning indicating that elderly patients with dementia-related psychosis treated with antipsychotic drugs are at an increased risk of death.

Mechanism of Action

All antipsychotics block dopamine receptors in the brain. However, the precise mechanism of action has not been clearly established. Conventional antipsychotics, such as haloperidol, block dopamine receptors in certain areas of the CNS, such as the limbic system and the basal ganglia. These areas are associated with emotions, cognitive function, and motor function, and blockage thus produces a tranquilizing effect in psychotic patients. However, several adverse effects are also caused by this dopamine blockade.

Second-generation, or atypical, antipsychotics block specific dopamine 2 receptors and specific serotonin 2 receptors, thus causing fewer adverse effects.

Indications for Use

Haloperidol is primarily indicated for schizophrenia and Tourette's disorder. Risperidone is primarily indicated for schizophrenia but is also used for acute manic episodes and for irritability caused by autism. Some atypical antipsychotics are also used as adjunct therapy for depression.

Nursing Considerations Across the Lifespan

Elderly patients with dementia-related psychosis treated with antipsychotic drugs should be closely monitored for signs and symptoms of cardiovascular events or infections such as pneumonia.

Haloperidol is contraindicated in patients with Parkinson's disease or dementia with lewy bodies.

Patients who are concurrently taking lithium and antipsychotics should be monitored closely for neurotoxicity (weakness, lethargy, fever, tremulousness, confusion, and extrapyramidal symptoms) and symptoms should be immediately reported.

Adverse/Side Effects

Elderly patients with dementia-related psychosis treated with antipsychotic drugs are at an increased risk of death due to cardiovascular or infection-related causes.

Conventional antipsychotic medications have several potential serious adverse effects such as **tardive dyskinesia**, neuroleptic malignant syndrome (NMS), and **extrapyramidal symptoms.** These adverse effects are due to the blockage of alpha-adrenergic, dopamine, endocrine, histamine, and muscarinic receptors. For additional details about these types of receptors, see the "Autonomic Nervous System" chapter. Figure 8.8 describes adverse effects associated with conventional antipsychotics. Patients should be warned to not consume alcohol and that their ability to operate machinery or drive may be

impaired.

Figure 8.8 Potential Adverse Effects of Antipsychotic Medication
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Adverse Effect	Definition
Tardive Dyskinesia	Involuntary contraction of the oral and facial muscles (such as tongue thrusting) and wavelike movements of the extremities.
Neuroleptic Malignant Syndrome (NMS)	Potentially life-threatening adverse effect that includes high fever, unstable blood pressure, and myoglobinemia.
Extrapyramidal Symptoms	Involuntary motor symptoms similar to those associated with Parkinson's disease. Includes symptoms such as **akathisia** (distressing motor restlessness) and **acute dystonia** (painful muscle spasms.) Often treated with anticholinergic medications such as benztropine and trihexyphenidyl.

Second-generation, or atypical, antipsychotics are less likely to cause adverse effects, but have a potential to do so. Atypical antipsychotics may also cause metabolic changes such as hyperglycemia, hyperlipidemia, and weight gain.

Patient Teaching & Education

Advise patient to take medication at directed. Medication doses should be evenly spaced throughout the day. This drug may require several weeks to obtain desired effects. Patients should be advised regarding the possibility of extrapyramidal symptoms and that abrupt withdrawal may cause dizziness, nausea and vomiting, uncontrolled movements of mouth, tongue, or jaw. Additionally, the patient should be careful to avoid alcohol or other CNS depressants while using the medication.

Now let's take a closer look at the medication grid for haloperidol and risperidone in Table 8.9.

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McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

Table 8.9 Haloperidol and Risperidone Medication Grid

Class/ Subclass	Prototype/ Generic	Administration Considerations	Therapeutic Effects	Adverse/Side Effects
1st generation (conventional) antipsychotic	haloperidol risperidone	Black Box Warning: Monitor elderly patients with dementia closely for	Decrease symptoms of psychosis, hallucinations,	Life-threatening cardiovascular events or infections

2nd generation (atypical) antipsychotic		symptoms of cardiovascular events or infection Advise patients to avoid alcohol, operate machinery, or drive	delusions, and delirium	Tardive dyskinesia Neuroleptic Malignant Syndrome Extrapyramidal symptoms Hypersensitivity reactions Falls related to sedation, motor instability, and postural hypotension

8.10 Anticonvulsants

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Medications used for seizures are called anticonvulsants or antiseizure drugs. Antiseizure drugs stabilize cell membranes and suppress the abnormal electric impulses in the cerebral cortex. These drugs prevent seizures but do not provide a cure. Antiseizure drugs are classified as CNS depressants. There are many types of medications used to treat seizures such as phenytoin, phenobarbital, benzodiazepines, carbamazepine, valproate, and levetiracetam.
McCuistion, L., Vuljoin-DiMaggio, K., Winton, M, & Yeager, J. (2018). *Pharmacology: A patient-centered nursing process approach.* pp. 227-305. Elsevier.

There are three main pharmacological effects of antiseizure medications. First, they increase the threshold of activity in the motor cortex, thus making it more difficult for a nerve to become excited. Second, they limit the spread of a seizure discharge from its origin by suppressing the transmission of impulses from one nerve to the next. Third, they decrease the speed of the nerve impulse conduction within a given neuron.

Some drugs work by enhancing the effects of the inhibitory neurotransmitter gamma-aminobutyric acid (GABA), which plays a role in regulating neuron excitability in the brain.
Lilley, L., Collins, S., & Snyder, J. (2020). *Pharmacology and the Nursing Process.* pp. 246-272. Elsevier.
Gabapentin, although structurally similar to GABA and classified as an anticonvulsant, is commonly used to control chronic neuropathic pain. Neuropathic pain is defined by the International Association for the Study of Pain as “pain caused by a lesion or disease of the somatosensory nervous system.”
Murnion B. P. (2018, June 1). Neuropathic pain: current definition and review of drug treatment. *Australian prescriber, 41*(3), 60–63. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6003018/
An example of neuropathic pain is tingling or burning in the lower extremities that often occurs in patients with diabetes.