Chapter 22
Lower Gastrointestinal Tract

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KEY TERMS AND DEFINITIONS

**Appendicitis**—inflammation of the vermiform appendix usually occurring because of an obstruction of the appendix.

**Colitis**—inflammation in the colon (another name for the large intestine). Different diseases may cause this inflammation, which can lead to significant disease, including cancer.

**Colonoscopy**—examination with a flexible, lighted, tubular instrument using fiber optics to permit visualization of the colon. Patients undergoing a colonoscopy are expected to use bowel preparations the day before the scope to ensure the entire colon has been thoroughly cleansed, and there are no feces remaining in the lower gastrointestinal tract. This aids in a clearer visual inspection of the colon.

**Duodenal ulcer**—chronic inflammation of the duodenal area of the gastrointestinal tract most commonly linked to the *Helicobacter pylori* bacteria or from nonsteroidal anti-inflammatory medications (ibuprofen, naproxen) or aspirin. Duodenal ulcers are the most common form of peptic ulcer.

**Gastroenteritis**—inflammation of the gastrointestinal tract, involving both the stomach and the small intestine, which results in acute diarrhea. The inflammation is caused most often by an infection from certain viruses or less often by bacteria, their toxins, parasites, or an adverse reaction to food contamination or medication.
Lower gastrointestinal tract—the portion of the digestive system that includes the cecum, appendix, large intestine, and anus. Water is actively absorbed in this portion of the system to help form the stool.

Prodrug—a medication that is given in an inactive form and is converted in the body to an active form. Prodrugs may be used to reduce side effects of the active medication or to permit administration via an alternate route.

LEARNING OBJECTIVES

After completing this chapter, you should be able to

1. Define the following:
   • Lower gastrointestinal tract.
   • Duodenal ulcer.
   • Appendicitis.
   • Gastroenteritis.
   • Colonoscopy.

2. Review the anatomy and normal physiology of the lower gastrointestinal tract.

3. Identify the causes, risk factors, and clinical presentation for diarrhea, constipation, hemorrhoids, inflammatory bowel disease, irritable bowel syndrome, flatulence, and parasitic infections.

4. Review the treatment goals for diarrhea, constipation, hemorrhoids, inflammatory bowel disease, irritable bowel syndrome, flatulence, and parasitic infections.

5. List the nonpharmacologic, pharmacologic, and alternative treatments for diarrhea, constipation, hemorrhoids, inflammatory bowel disease, irritable bowel syndrome, flatulence, and parasitic infections.

6. Discuss the therapeutic effects, drug properties, dosages, and routes of administration for each class of medications listed above, and list their most common side effects and drug interactions.

The lower gastrointestinal (GI) tract is the site of important functions of the body, including many of importance to the absorption and action of medications. Several diseases have an impact on this region of the body. This chapter provides a summary of the major disorders affecting the lower GI system and the medications that are used most frequently to treat them.

CASE STUDY

Paul Hernandez is a 55-year-old male who comes into the pharmacy every month to fill his prescriptions. This afternoon he seems unusually distant and pale in the face. He states, "You might want to stay away from me. I think I have a stomach virus." When asked about his illness, Mr. Hernandez replies, "I can't keep a thing down, no water or food. I've been having diarrhea since last night, and it has kept me up all night. I'm extremely tired and weak, and my mouth is dry as a bone." The pharmacist asks Mr. Hernandez a series of questions and finds out that Mr. Hernandez has a slight fever, severe abdominal cramping, and thought he saw blood in one of his bowel movements. He is not taking any antibiotics currently, just his usual blood pressure and high cholesterol medication. He has not traveled outside of the country in the last 6 months, but he states that he and Mrs. Hernandez ate at the local buffet yesterday for lunch.

ANATOMY AND PHYSIOLOGY OF THE LOWER GASTROINTESTINAL TRACT

The lower GI tract begins with the end of the small intestine, or small bowel, and ends with the anus (external GI tract opening—Figure 22-1).

The large intestine is the portion of the lower GI tract extending from the ileocecal junction to the anus. It consists of the cecum, colon, rectum, and anal canal (see Figure 22-1). Normally, 18 to 24 hours are required for material to pass through the large intestine. Attached to the cecum is a small tube called the vermiform appendix. If this tube becomes obstructed (blocked), secretions from the appendix cannot pass the obstruction and accumulate, causing enlargement,
pain, and inflammation. This condition is known as appendicitis. Bacteria in the area can cause infection of the appendix. Symptoms include sudden abdominal pain, particularly in the right lower portion of the abdomen; a slight fever; loss of appetite; constipation or diarrhea; nausea; and vomiting. If the appendix bursts, the infection can spread throughout the abdomen or even the whole body, with life-threatening results.

The colon, which is responsible for converting chyme to feces and containing feces until it is eliminated by defecation, consists of four parts: the ascending colon, transverse colon, descending colon, and sigmoid colon. The ascending colon extends superior to (above) the cecum and ends at the right colic flexure near the right inferior (lower) margin of the liver. The transverse colon extends from the right colic flexure to the left colic flexure, and the descending colon extends from the left colic flexure to the superior opening of the true pelvis where it becomes the sigmoid colon. Peristaltic waves are responsible for moving chyme along the ascending colon. About three or four times each day, large parts of the transverse and descending colon undergo several strong contractions, called mass movements. Mass movements are very common after meals, especially breakfast, because the presence of food in the stomach or duodenum initiates them. The sigmoid colon forms an S-shaped tube that extends into the pelvis and ends at the rectum. The rectum is a straight, muscular tube that begins at the termination of the sigmoid colon and ends at the anal canal. The last 2 to 3 cm of the digestive tract is the anal canal. It begins at the inferior (lower) end of the rectum and ends at the anus with the external sphincter.

Drugs administered orally pass through various parts of the GI tract and are absorbed. Any leftover drug residue exits the body through the anus. The total time it takes for a drug to move through the GI tract is from about 10 hours to 5 days. Some medications are administered in an inactive form, termed a prodrug, intended to reduce the incidence of side effects caused by taking a medication in its active form or to permit a drug to be administered via a route that would not be possible with its active version. The duodenum is the site where many prodrugs are hydrolyzed during absorption, being converted to their active forms. Drugs with a very low pH (acidic drugs) will dissolve best in the ileum, and drugs in an oral sustained-release dosage form will be more likely absorbed in the colon. Rectal suppository dosage forms have variable drug absorption. A portion of the drug dose may be absorbed via the lower hemorrhoidal veins, from which the drug enters directly into the systemic circulation (absorption within the body); other drugs may be metabolized (broken down) before systemic absorption, so will exert only a local effect.
DIARRHEA

Diarrhea is a symptom characterized by increased stool (feces) frequency, decreased consistency or liquidity (watery), and increased weight as compared to an individual’s normal bowel pattern. The normal frequency and consistency vary between individuals. More than three bowel movements per day is considered abnormal.

CASE?

What type of diarrhea is Mr. Hernandez experiencing? What might be the cause of his diarrhea?

Diarrhea can be acute, persistent, or chronic. Acute diarrhea is abrupt-onset diarrhea in a healthy individual most often related to an infectious agent, and lasts anywhere from 1 to 14 days. Persistent diarrhea is diarrhea lasting from 14 days to 4 weeks. Chronic diarrhea is a decrease in fecal consistency lasting more than 4 weeks. Persistent and chronic diarrhea illnesses are often secondary to other chronic medical conditions, which are outside the scope of this chapter.

Acute diarrhea can be caused by viruses, bacteria, protozoa, or from traveling to some countries, where poor sanitation and hygiene are prevalent. Ingestion of contaminated water or food can lead to infectious diarrhea. Noroviruses are the predominant cause of acute diarrhea, and most norovirus infections often occur after consuming contaminated water or food. Viruses in this group cause the “stomach flu,” or gastroenteritis. Typically these viruses are spread person to person by the fecal-oral route. They are self-limiting, usually lasting 1 to 3 days and affecting infants and children less than 5 years of age most often.

Patients may present with vomiting, nausea, headache, muscle ache, fever, or watery diarrhea. This type of viral diarrhea is often referred to as “the stomach bug.” The rotavirus accounts for about 12% of all acute diarrhea cases and up to 50% of infant viral diarrhea. Cases peak in the winter season and in children between 4 and 23 months of age. The rotavirus is also spread by the fecal-oral route and the effects typically last 5 to 8 days. Most of the cases exhibit watery diarrhea accompanied by vomiting. Nearly all children in both industrialized and developing countries have been infected with rotavirus by the time they are 3 to 5 years of age. Risk factors for the contraction of virus causing diarrhea (gastroenteritis) include daycare attendance, recent antibiotic use, having a compromised immune system (the body’s ability to fight infection is weak), or spending time in institutional settings, schools, and nursing homes. These infections can also occur in other group settings, such as banquet halls, cruise ships, dormitories, and campgrounds.

Bacterial diarrhea or bacterial gastroenteritis affects 15% to 20% of people in the United States annually and can be caused by numerous types of bacteria, including, most prominently, Escherichia coli, Salmonella, and Campylobacter. Typically, bacterial diarrhea is spread by eating contaminated food or water and improperly cooked or refrigerated poultry and dairy products. Bacterial diarrhea can present within 8 to 12 hours of eating contaminated food. Outbreaks of food-borne bacterial infections have been traced to poor sanitary conditions in meat-processing plants, grocery stores, and restaurants. Symptoms include nausea, abdominal cramping and bloating, occasional vomiting, and watery diarrhea. Depending on the bacteria causing the gastroenteritis, bloody diarrhea may result.

Another bacterial diarrhea is caused by Clostridiodides difficile. These bacteria, also known as C. diff, not only cause diarrhea but can also result in more serious intestinal conditions such as colitis. The prime risk factor for contracting C. diff infection includes prolonged use of antibiotics, with elderly patients having a greater risk. People can become infected if they touch items or surfaces that are contaminated with infected feces, then touch their mouths or mucous membranes. Healthcare workers can spread the bacteria to other patients or contaminate surfaces through hand contact. To prevent spread, healthcare workers must wash their hands with soap and water to eliminate the spores that cause the growth of C. diff; hand sanitizers will not eliminate the spores. Patients typically present with watery diarrhea (at least three bowel movements per day for 2 or more days), fever, loss of appetite, nausea, and abdominal pain/tenderness. C. diff can be hard to treat and requires prescription antibiotics (oral vancomycin or fidaxomicin). Other diarrheal diseases can be treated with over-the-counter (OTC) products.
Protozoal infections account for about 10% to 15% of diarrhea cases. These types of infections occur most frequently in travelers entering or returning from endemic areas—relatively secluded places with contaminated water supplies harboring protozoa (single-celled, nonbacterial organisms). Protozoal contamination is uncommon in developed countries, such as the United States, Canada, Australia, New Zealand, Japan, and countries in northern and western Europe. Cryptosporidium parvum and Cyclospora are the most common protozoal parasites among children, while Giardia lamblia is more common among traveling adults. Protozoal infections result in sudden-onset diarrhea 3 to 7 days after arrival in a foreign location and are generally accompanied by profuse watery or pale, greasy stool, nausea and vomiting, and occasional fecal evidence of inflammation (mucus). Preventative measures for travelers include awareness of parasites or bacteria known to the area and carrying small containers of hand-sanitizing solutions or gels when handwashing is not possible. Some oversights include brushing teeth with contaminated water, ingesting ice cubes, or eating cold salads or meats. Depending on the type of protozoan causing the diarrhea, symptoms may last up to 3 weeks but are self-limiting (will resolve on their own) and will end with adequate treatment unless the patient is severely immunocompromised. The most common protozoal parasites among children, while Giardia lamblia is more common among traveling adults. Protozoal infections result in sudden-onset diarrhea 3 to 7 days after arrival in a foreign location and are generally accompanied by profuse watery or pale, greasy stool, nausea and vomiting, and occasional fecal evidence of inflammation (mucus). Preventative measures for travelers include awareness of parasites or bacteria known to the area and carrying small containers of hand-sanitizing solutions or gels when handwashing is not possible. Some oversights include brushing teeth with contaminated water, ingesting ice cubes, or eating cold salads or meats. Depending on the type of protozoan causing the diarrhea, symptoms may last up to 3 weeks but are self-limiting (will resolve on their own) and will end with adequate treatment unless the patient is severely immunocompromised.

For children with body weight less than 10 kg, 60 to 120 mL of oral rehydration is needed for each diarrheal stool or vomiting episode. For patients who cannot be managed on oral rehydration therapy, intravenous (IV) rehydration (with solutions of sodium chloride, dextrose, and/or other electrolytes such as potassium or magnesium) may be necessary.

**Antidiarrheal Agents**

**Loperamide**

Among hundreds of OTC products promoted as antidiarrheal agents, only loperamide and bismuth subsalicylate have sufficient evidence of efficacy and safety to bear U.S. Food and Drug Administration (FDA)-approved labeling for this condition. Loperamide is available in OTC and prescription (Rx) strength as brand and generic. It is available in tablets, capsules, and a liquid formulation. Some brands are listed in Medication Table 22-1. Loperamide works by slowing intestinal motility (reducing small and large intestine movement), thereby reducing the daily fecal volume and diminishing the loss of fluid and electrolytes. Loperamide’s effect lasts for approximately 11 hours. Peak levels are reached in 2.5 hours with the liquid formulation and in 5 hours with the tablets and capsules. Improvement in diarrhea is usually seen within 48 hours. Most common side effects include increased blood glucose, abdominal pain, dry mouth, dizziness, and fatigue. Drug interactions have been noted with an antiretroviral medication (saquinavir), an antifungal medication (itraconazole), and a medication for high triglycerides (gemfibrozil). All of these drugs are known to increase the concentration of loperamide in the bloodstream.

**CASE?**

What signs and symptoms suggest dehydration in Mr. Hernandez? What is an appropriate treatment for his dehydration?

**Goals for treating patients with diarrhea are to (1) prevent dehydration or correct fluid and electrolyte imbalance, (2) relieve symptoms, (3) identify and treat the cause, and (4) prevent complications. Most acute cases of diarrhea can be treated with nonpharmacological therapy or OTC medications, as most cases of diarrhea are self-limiting. Replacement of fluid loss and electrolytes is the standard for efficacious and cost-effective management of acute diarrhea. Clear liquids at room temperature, such as broth, carbonated beverages (without caffeine), and rehydrating fluids such as Pedialyte or Gatorade, are good options for replacing fluid loss. Pedialyte and Gatorade contain a mix of water and electrolytes (sodium, chloride, glucose, potassium, and citrate), which are all needed to adequately hydrate a person and allow bodily processes to continue.**

**ALERT!**

Loperamide should not be used in diarrhea associated with antibiotic use, if there is blood present in the stool, or the diarrhea is caused by C. diff infection. If constipation occurs, loperamide should be discontinued.

**CASE?**

What OTC therapy might Mr. Hernandez try to treat his bacterial diarrhea?
is poorly absorbed in the GI tract. The sub salicylate in a dose of BSS is comparable to a 200-mg dose of aspirin with a similar effect in the body. An anti diarrheal effect should occur within 48 hours of use. The most common adverse events include a temporary and harmless darkening of the tongue and/or black stool, ringing in the ears (tinnitus), and fecal impaction.

**PRACTICE POINT**

BSS may decrease the effect of tetracyclines, an antibiotic used to treat bacterial infections.

**PRACTICE POINT**

The liquid formulation of BSS is a suspension, and, like all suspensions, should be shaken prior to each dose.

**CASE?**

What dose of bismuth subsalicylate would be appropriate for Mr. Hernandez?

**Bismuth Subsalicylate**

Bismuth subsalicylate (BSS) is effective in the treatment of acute diarrhea, including traveler’s diarrhea, by significantly reducing the number of diarrheal stools. It is also effective in treating upset stomach, indigestion, heartburn, and nausea. BSS is available as an OTC tablet or suspension with multiple brand names. BSS is also available as a combination product in prescriptions used to treat peptic ulcers. The exact mechanism is not known, but it seems to exert its anti diarrheal action by stimulating absorption of fluid and electrolytes across the intestinal wall (antisecretory action) and by reducing intestinal inflammation and hypermotility (excess intestinal movement) by the subsalicylate portion. In addition, the bismuth component may exert direct antimicrobial effects against bacterial and viral pathogens. Bismuth

**ALERT!**

Patients who are allergic to aspirin should not take BSS. As noted in Chapter 21, BSS is not intended for children, as it may cause a serious reaction (Reye's syndrome). Patients with gout, diabetes, bleeding ulcers, kidney insufficiency, or blood conditions (bleeding abnormalities) should take this medication with extreme caution.

**Diphenoxylate HCl/Atropine Sulfate**

Diphenoxylate HCl/atropine sulfate is better known as Lomotil®. It is a prescription anti diarrheal medication available as a Schedule V controlled drug. It is indicated as adjunct treatment (in addition to other therapies) of diarrhea.

Diphenoxylate is an opioid (opium derivative similar to those discussed in Chapter 5) that acts both locally, at the gut level, and centrally, in the central nervous system (CNS), to slow intestinal contractions and peristalsis, prolonging the gut transit time. This allows moisture to be drawn out of the intestines thereby stopping the formation of loose and liquid stools. Atropine is an anticholinergic combined with diphenoxylate to prevent abuse or overdose. Diphenoxylate begins working in 45 to 60 minutes, with effects lasting up to 3 to 4 hours. Improvement is usually observed within 48 hours.

Common side effects include abdominal discomfort, nausea and vomiting, dizziness, sedation, somnolence (sleepiness), euphoria, and malaise. Serious side effects include possible anaphylaxis in sensitive patients, pancreatitis, and toxic megacolon. Toxic megacolon refers to a rapid widening of the large intestine leading to bloating, abdominal pain, fever, and possibly shock if left untreated. Diphenoxylate is contraindicated for patients with myasthenia gravis or patients taking potassium chloride supplements.
Diphenoxylate should not be used in combination with monoamine oxidase inhibitors (MAOIs). The combination of the two can significantly raise a patient’s blood pressure. Because diphenoxylate is an opioid, combining it with barbiturates, tranquilizers, or alcohol can significantly increase the depressive effects of each medication. Use in women of childbearing potential is only indicated when, in the opinion of the prescriber, the potential benefits outweigh the potential risk to the fetus. Use in breastfeeding mothers should be cautioned as Lomotil can be found in breast milk. In addition, the atropine component can decrease the production of milk in the breastfeeding mother. Patients with bacterial diarrhea should be cautioned when using this medication, as it may prolong or aggravate the diarrhea further.

**ALERT!**
The use of Lomotil® is contraindicated in children younger than 2 years of age. If used in children, the liquid formulation is recommended when the child is less than 13 years of age. The maximum dose for adults and children is 20 mg/day. For children experiencing severe dehydration or electrolyte imbalance, Lomotil® should be withheld until the child is adequately hydrated because of the risk of intoxication from diphenoxylate when patients are severely dehydrated.

**PRACTICE POINT**
When measuring the liquid formulation for children, the plastic dropper provided should always be used to prevent accidental overdose.

**Opium**
Opium is an effective and fast-acting nonspecific antidiarrheal agent that exerts its action by both enhancing the tone and preventing contraction of the intestinal muscles, thus inhibiting the propulsive contractions of the GI tract. Its principal active ingredient is morphine and it is available as opium 10% tincture (10 mg morphine/mL). It is indicated for the treatment of diarrhea and used for unlabeled indications, which include the relief of pain, neonatal abstinence syndrome, and the management of short bowel syndrome. Common side effects include constipation, nausea, and vomiting; pruritus (itching) and urticaria (skin rash similar to hives) have also been observed related to the morphine in opium. Opium can be addictive, and a person can become tolerant of the medication and eventually require higher doses to achieve the same beneficial effect. Because morphine is a CNS depressant, other medications such as pain medications, anxiety medications, and antidepressant medications can worsen the depressant effects of opium.

Opium tincture may be used in children, but it is imperative that it is diluted appropriately. To administer to children, a 25-fold dilution must be used for a final concentration of 0.4 mg/mL of morphine. Opium should be used with caution in the elderly, in debilitated individuals, and in patients with liver or lung problems or bleeding disorders.

**ALERT!**
In diarrhea caused by poisoning, the toxin must be eliminated from the GI tract before opium can be given.

**PRACTICE POINT**
Opium tincture is a Drug Enforcement Administration (DEA) Schedule II controlled preparation, available to patients only by nonrefillable prescription.

**Complementary and Alternative Therapy:**
*Lactobacillus acidophilus*
Probiotics are dietary supplements of live microorganisms. According to the currently adopted definition by the World Health Organization, probiotics are “Live microorganisms, which when administered in adequate amounts, confer a health benefit on the host.” Probiotics include several *Lactobacillus* species and *Bifidobacterium lactis*, which both have strain-specific benefits in controlling some aspect of a person’s health. The most common species useful in the treatment or prevention of acute, uncomplicated diarrhea is *Lactobacillus acidophilus*. Lactobacilli are bacteria that normally live in the human small intestine and vagina. Probiotic formulations are available commercially in food products.
such as yogurt, nutrition bars, beverages, and many others that are becoming more popular. Lactobacillus acidophilus is also available as a capsule, tablet, granules for suspension, powder for suspension, and a concentrate solution. Some probiotics include other helpful bacteria to treat ailments in addition to diarrhea. Because Lactobacillus is naturally occurring bacteria in the lower GI tract, it is useful in the restoration and stabilization of the normal intestinal flora (harmless microorganisms that inhabit the intestinal tract and are essential for its normal functioning). Lactobacillus also interferes with the ability of pathogenic bacteria to adhere (attach) to intestinal mucosal cells and establish an infection. Patients who are sensitive to milk or have lactose intolerance should refrain from using Lactobacillus probiotics. Burping, intestinal gas (or flatulence), constipation, hiccups, and vomiting have been reported during treatment; however, it is unknown whether this symptom was due to Lactobacillus therapy or to concomitant antibiotic therapy. Lactobacillus is commonly used in both hospital and retail settings where patients are taking broad spectrum antibiotics as a way to restore the normal gut flora and prevent antibiotic-associated diarrhea.

Probiotics such as Lactobacillus acidophilus have been shown safe and effective for use in children. Product dosing will vary, but the typical daily dose for both adults and children is 3 to 4 times a day. Unless directed by a healthcare provider, use should be limited to 2 days of therapy.

**PRACTICE POINT**

The microorganisms in probiotic preparations are encapsulated for stability and are viable for a year from the shipping date. Lactobacillus granules must be stored in the refrigerator at 2°C to 8°C for optimum benefit.

**CASE STUDY**

Mr. Jones is a 58-year-old truck driver who recently lost his wife. He has come to the pharmacy to inquire about a remedy for the awful stomach cramping he has had in the past week. When asked if he has noticed any changes in his stool, he mentions that he "has not had a bowel movement for as long as he can remember." Mr. Jones tells the pharmacist that his diet consists of fast-food lunches and dinners with truck-stop snacks along the way. He doesn’t drink as much water as he once did, and now he relies on coffee and sodas to stay alert. He is tired all the time but attributes this to his recent 25-pound weight gain. Mr. Jones is taking two blood pressure medicines, amlodipine and lisinopril, and amitriptyline to help with his sad feelings and difficulty sleeping. He has picked up a value pack of ibuprofen and three boxes of Tums Extra Strength saying, "My knees are killing me from driving all the time and my stomach just can’t get right."

**CONSTIPATION**

The importance of regularity of defecation is often greatly overstated. Many people have the misleading notion that a daily bowel movement is critical for good health, but what is “normal” differs from person to person. Some will defecate once or twice daily, while other healthy adults may defecate only once every 2 days. A defecation rate of fewer than three per week is defined as constipation. Symptoms often include straining, lumpy or pellet-like hard stools, and a sensation of incomplete defecation or evacuation of stool. There are many causes of constipation, and most are poorly understood. Some causes include insufficient nutrition, impaired colon motility, psychiatric factors, or anatomical (structural) abnormalities. Structural abnormalities and to some degree psychiatric factors are beyond the scope of this chapter; however, some common psychiatric causes that could be recognized by pharmacy technicians include depression, sexual abuse, high levels of stress, and/or unusual attitudes toward food and bowel function. Insufficient nutrition can be a direct result of inadequate fiber or fluid intake. A diet low in calories, carbohydrates (e.g., Atkins diet), or fiber may lead to diet-related constipation. Some fiber-based foods (e.g., breakfast cereals, nutrition bars) could contribute to constipation because of the processed sugar they contain. Impaired colon motility can result from a slow transit time (GI tract moving slowly), irritable bowel syndrome (which will be discussed in detail later in the chapter), nerve damage (which stimulates gut motility), drugs, or other neurological causes (spinal cord injury, Parkinson disease, multiple sclerosis, etc.). Representative medications known to cause constipation can be found in Medication Table 22-2.
If no contraindications to fiber exist (anatomic abnormalities, some diseases), daily fiber intake should be increased and patients advised to drink approximately 2 L of fluid per day and increase aerobic exercise (walking, running, and swimming) to help stimulate GI motility. The American Dietetic Association recommends 14 g of dietary fiber per 1,000 kcal or 25 g for adult women and 38 g for adult men.\(^5\)

**CASE?**

What factors may be contributing to Mr. Jones's constipation?

Some patients are more likely to develop constipation than others. Infants and children, as well as adults over the age of 55 are more at risk. Functional fecal retention (slow GI movement) and fecal withholding (unwillingness to defecate) are two of the more common causes of pediatric constipation. The urge to defecate is a stimulus received from the brain. When this is ignored or suppressed, rectal muscles can lose tonicity and become less effective in eliminating stool. The leading contributors to constipation in adults are poor diet, lack of exercise, medication use, and poor bowel habits. Polypharmacy (use of multiple medications by a patient) and sedentary lifestyle are the primary factors leading to chronic constipation in older adults. Other populations at risk for constipation include pregnant women (especially in the last trimester), terminal care patients, those with limited mobility or sedentary lifestyles, and travelers.

**CASE?**

Does Mr. Jones require medical attention for his constipation?

Some patients who present with constipation complaints require medical attention. Those who report bloody stools, fever associated with constipation, sudden weight loss, or severe nausea and vomiting should be referred to a physician for follow-up and OTC medications should not be recommended. In managing constipation, the goal is to first relieve constipation and reestablish normal bowel function, then focus on establishing dietary and exercise habits that will prevent recurrences. If there are medications causing constipation, the medication may be stopped or changed, after the patient consults with their healthcare provider, to a product less likely to cause this side effect.

**CASE?**

What lifestyle changes might be recommended for Mr. Jones to treat his constipation?

Bulk-forming laxatives and stool softeners are good initial therapy in addition to increasing fiber and fluid in the diet. If no contraindications to fiber exist (anatomic abnormalities, some diseases), daily fiber intake should be increased and patients advised to drink approximately 2 L of fluid per day and increase aerobic exercise (walking, running, and swimming) to help stimulate GI motility. The American Dietetic Association recommends 14 g of dietary fiber per 1,000 kcal or 25 g for adult women and 38 g for adult men.\(^5\)

**CASE?**

What drug therapy might the pharmacist recommend for Mr. Jones?

**Bulk-Forming Agents**

Bulk-forming laxatives are derived from natural plant sources, synthetic cellulose derivatives, or analogs. The most common plant source is psyllium, branded as Metamucil\(^\text{®}\) and many generics. A synthetic cellulose derivative, methylcellulose, is often used and another agent is calcium polycarbophil, the calcium salt of a synthetic polyacrylic resin. (See Medication Table 22-1 for products and dosage forms.) Bulk-forming laxatives are often recommended as first line because they closely mimic the body's physiologic mechanism in promoting evacuation. They dissolve or swell in the intestinal fluid, forming emollient gels that facilitate passage of the intestinal contents and stimulate gut movement. The actions of these agents are localized in the gut and they do not undergo systemic absorption. This enables treatment while avoiding systemic drug interactions, but these agents should be taken at least 2 hours before or 2 hours after taking an oral prescription medicine to prevent a delay in absorption of some medications.

**ALERT!**

Psyllium can interfere with the absorption of some prescription medications, including antidiabetic agents, carbamazepine, and lithium. In combination with antidiabetic agents, an increased risk of hypoglycemia occurs because of the additive blood glucose-lowering effects. In combination with carbamazepine and lithium, the levels of both medications may be decreased, leading to a decrease in side effects.
Psyllium is approved for the relief of occasional constipation and for restoring regular bowel function. It is also useful when recommended by a physician for the treatment of constipation associated with GI disorders and in patients with irritable bowel syndrome, diverticular disease, and hemorrhoid treatment, which will be discussed later in the chapter. Psyllium also appears to be useful in the reduction of cholesterol levels as an adjunct to a dietary program. It is available in a granule, seed husk, whole seed, wafer, capsule, and powder for oral suspension. Psyllium products are indicated for children older than 6 years of age and adults.

Psyllium produces an effect in 12 to 72 hours. If constipation persists for longer than a week and psyllium has not produced an effect, patients should be advised to see a doctor. Psyllium should not be used for acute relief of constipation for longer than 7 days. If other adverse events such as chest pain, vomiting, or difficulty in swallowing or breathing occur after taking this product, patients should seek immediate medical attention. Two side effects that occur most often with bulk-forming laxatives are abdominal distention and flatulence.

Methylcellulose is approved for the same indications as psyllium, with a bowel movement expected within 12 to 72 hours. The side effects and drug interactions are the same as for psyllium. These products are available in a powder for oral suspension, tablets, and chewable tablets.

Polycarbophil laxatives produce a defecation response by increasing bulk volume and water content of the stool, which produces a bowel movement in 12 to 72 hours. Polycarbophils are approved for the same indications as psyllium. Additional uses, although not FDA approved, include bacterial vaginosis (bacterial infection of the vaginal tract), and diarrhea. Polycarbophil has been shown to lower the vaginal pH, which creates an unfavorable environment for bacterial growth. Polycarbophil is used in chronic watery diarrhea, due to its ability to absorb substantial amounts of water. The products are available as tablets that can be swallowed or chewed. Flatulence occurs less with calcium polycarbophil as compared to psyllium.

**ALERT!**

Prescription medications should be taken at least 1 hour before or 2 hours after polycarbophils (especially antibiotics containing any form of tetracycline).

**ALERT!**

Polycarbophil products contain approximately 150 mg of calcium per tablet. Patients susceptible to hypercalcemia (those who are elderly, have a malignancy, HIV/AIDS, or renal disease) should be cautioned.

**PRACTICE POINT**

Psyllium and other bulk-forming laxatives must be taken with at least 240 mL (8 ounces, a full glass) of water or other liquid either before or after meals. Without adequate fluid, the product can swell and block the throat or esophagus, which could lead to choking. Patients who have difficulty swallowing should not take these products.

**PRACTICE POINT**

Bulk-forming agents are the recommended constipation remedies for patients who are pregnant or postpartum, need additional fiber added to their diet, and diabetic patients. The powder, wafer, and granule dosage form of psyllium should be kept at room temperature away from moisture or humidity.

**Surfactants**

Surfactants, more commonly known as stool softeners, include docusate sodium (Colace®) and docusate calcium. Stool softeners are not considered laxatives. They work by actively drawing water into the stool, thus softening the stool and achieving ease in bowel movement. Their action takes place in the small and large intestines, with an onset of 24 to 72 hours. Most patients will achieve a bowel movement within 48 hours; however, for some patients it may take as long as 3 to 5 days. Surfactants should not be taken for more than 7 days. A 240-mg dose of docusate calcium...
and a 100-mg dose of docusate sodium contain the same quantity of dioctyl sulfosuccinic acid, the active ingredient. Occasionally docusate calcium is selected over docusate sodium by the physician based on its lack of sodium. This is a concern in patients who are sodium restricted (examples may include patients with hypertension or renal insufficiency). However, it should be noted that if no additional sodium is added during the manufacturing process, a 100-mg dose of docusate sodium contains only 10 mg of sodium.

Docusate sodium is available as a tablet, soft-gel capsule, syrup, rectal enema, and liquid formulation. It is approved for use in adults and children over the age of 2 years. The tablets and capsules are indicated for relief of occasional constipation (irregularity), while the syrup and liquid formulation are indicated for constipation due to hard stools, in cardiac and other conditions in which maximum ease of stool passage is desirable to avoid difficult or painful defecation, and when peristaltic stimulants (laxatives) are contraindicated. Docusate calcium is available as a soft gel capsule and as a regular capsule indicated for adults and children over the age of 12 years. It is approved for the treatment of occasional constipation and for the prevention of dry, hard stools. It is useful as a prophylactic agent to prevent straining during defecation in patients following anal or rectal surgery and in patients who have recently suffered with a heart attack. Docusate products are commonly used for preventing constipation. In terminally ill patients who are primarily confined to a bed or those taking scheduled doses of opiates for pain relief, docusate products are recommended as first line for prevention. Although docusate products appear to be safe for use in pregnancy since there is minimal absorption from the GI tract, there is not enough evidence to recommend their use in pregnant patients.

Dulcolax Stool Softener is a brand name for docusate sodium and Dulcolax is a brand name for bisacodyl, which is a stimulant laxative. Another product, Dulcolax Soft Chews, has still a different active ingredient. Similarly, Kaopectate Liqui-gels (stool softener docusate calcium) can be easily confused with Kaopectate Antidiarrheal (bismuth subsalicylate). Patients choosing OTC remedies may be confused by these similarities in product names.

Docusate should not be taken if constipation is accompanied by significant abdominal pain, nausea, vomiting, or sudden changes in bowel habits that persist for more than 2 weeks. Some uncommon reactions that have occurred with the use of docusate include development of a rash, bitter taste in the mouth, nausea, and diarrhea. Additional side effects from docusate calcium include perianal irritation, bloating, flatulence, and cramps.

**Alert!**

Docusate should not be taken along with mineral oil, as this may increase mineral oil absorption and result in systemic toxicity.

**Practice Point**

For administration purposes, the docusate syrup formulations should be mixed with 6 to 8 oz of milk or fruit juice prior to administration to improve taste.

**Hyperosmotic Laxatives**

Hyperosmotic laxatives can be classified as saline or non-saline. Nonsaline hyperosmotic agents include glycerin, polyethylene glycol (PEG) 3350 (MiraLax®), lactulose, and sorbitol. Bowel cleansing preparations, most often used for GI scopes or surgeries include PEG solutions such as Golytely® and Colyte™. This group of agents works by promoting local irritation and by drawing water into the feces, stimulating evacuation.

Glycerin is available as a suppository and rectal enema for the short-term treatment of constipation and to evacuate the colon prior to rectal and bowel examinations for adults and children older than 2 years of age. It usually produces a bowel movement within 15 minutes to 1 hour. Use of liquid glycerin as an enema is not recommended in adults and older children as this may cause considerable rectal irritation. The rectal suppositories must be retained for about 15 minutes for glycerin to have its full effect. They may cause rectal discomfort or a burning sensation. Contraindications for using the suppository include nausea, vomiting, recent abdominal surgery, fecal impaction, intestinal obstruction,
or undiagnosed abdominal pain. Some side effects include perianal (around the anus) irritation, sweating, excessive bowel activity, abdominal cramps, bloating, and flatulence. There are no appreciable drug interactions.

### PRACTICE POINT

_Glycerin suppositories should be stored in a cool place, away from any excessive heat._

Polyethylene glycol (PEG) 3350 (MiraLax®) consists of very large, poorly absorbable ethylene glycol molecules that act as osmotic agents, causing water to be retained with the stool, resulting in a softer stool and more frequent bowel movements. It appears to have no effect on active absorption or secretion of glucose or electrolytes; therefore, it does not contribute to a loss of much-needed nutrients. It is approved for the treatment of constipation and has been used for chronic constipation and preparation of the bowel for a colonoscopy. PEG 3350 is available as an OTC and prescription product. The dosage form available is an oral powder to be mixed in 8 oz of water, juice, soda, coffee, or tea prior to administration. A bowel movement is typically produced in 2 to 4 days, with dosing options available to adults and children 18 months of age and older. In contrast to other products useful in the treatment of constipation, PEG 3350 can be used for up to 14 days, which is 7 days longer than the recommendations for other products. Some common side effects include bloating, abdominal discomfort, cramping, and flatulence. For patients suffering with known or suspected bowel obstruction, this medication is contraindicated. There are no documented drug-drug interactions with PEG 3350.

### ALERT!

Patients who have renal disease should be cautioned to consult their prescriber before using PEG 3350 products. There are currently no sufficient data to confirm the safety of this laxative in pregnancy.

Sorbitol is available OTC for the treatment of constipation. It is available alone as a 70% oral solution and as a component of combination laxative products. (It is also available as a prescription but indicated for urinary bladder irrigation.) Sorbitol functions as an osmotic laxative but is not among the most commonly used agents. It has the tendency to cause hyperglycemia and electrolyte disturbances, so it is not considered first line as a laxative. GI upset such as abdominal pain, nausea, or vomiting has also been associated with sorbitol. However, in infants younger than 1 year of age, fluids, particularly juices containing sorbitol, such as prune, pear, and apple juices, are recommended as first-line treatment in constipation within the context of a healthy diet. An increased risk for colonic necrosis (local cell death) has been shown when sorbitol is used in conjunction with sodium polystyrene sulfonate (medication used for the reduction of potassium in the body).

Lactulose is a synthetic disaccharide used for the treatment of constipation in adults and infants and is available as an oral or rectal solution and as crystals for reconstitution. In patients with a history of chronic constipation, lactulose therapy increases the number of bowel movements per day and the number of days on which bowel movements occur. Lactulose is poorly absorbed from the GI tract, and no enzyme capable of hydrolysis of this synthetic disaccharide is present in human GI tissue. As a result, oral doses of lactulose reach the colon virtually unchanged. In the colon, lactulose is broken down primarily to lactic acid, and small amounts of formic and acetic acids by the action of colonic bacteria, which results in an increase in osmotic pressure and slight acidification of the colonic contents. This in turn causes an increase in stool water content and softens the stool. Since transit time through the colon may be slow, 24 to 48 hours may be required to produce the desired bowel movement. Side effects that can occur with lactulose include gaseous distention with flatulence or belching and abdominal discomfort such as cramping. Excessive dosage can lead to diarrhea with potential complications such as loss of fluids, hypokalemia (low potassium levels), and hypernatremia.

### ALERT!

When lactulose crystals are dissolved in water, the resulting solution may be colorless to a slightly pale yellow. Under recommended storage conditions, a normal darkening of color characteristic of sugar solutions may occur and does not affect therapeutic action. Prolonged exposure to temperatures greater than 30°C (86°F) or to direct light, however, may cause extreme darkening and clouding to the point where the products should not be used.
mixed as directed, the final volume is 4 L (about 1 gallon). Typical dosing is 240 mL (1 cup) every 10 minutes until all 4 L are consumed or until the rectal effluent is clear. Bowel cleansing preparations are contraindicated in patients with GI obstruction, gastric retention, bowel perforation, or other serious inflammatory bowel condition. Safety and efficacy have not been determined in children; therefore, bowel cleansing preparations are only recommended for adults. The first bowel movement should occur within 1 hour of beginning the preparation. The most common side effects include nausea, abdominal fullness, and bloating.

**ALERT!**

Oral medications given within 1 hour of the start of drinking the material may be flushed from the body before adequate absorption so required doses should be administered at least 2 hours before starting the bowel cleansing preparation. The patient should fast 3 to 4 hours prior to ingestion of the solution. No foods, except clear liquids, are permitted after the solution is started.

**PRACTICE POINT**

A 10-g packet of lactulose crystals should be dissolved in half a glass of water before administration. Lactulose syrup can be mixed with fruit juice, water, or milk to increase palatability. Lactulose solution should be kept at room temperature, but not frozen (it becomes too thick to pour). Lactulose should be dispensed in a tightly closed, light-resistant container with a child-resistant closure.

In terminally ill patients, prevention of constipation is extremely important. Glycerin suppositories or docusate sodium are recommended; lactulose is an alternative to docusate, although it can lead to bloating and possible postural hypotension (due to fluid shift to the bowel).

Bowel cleansing preparations such as Golytely are considered hyperosmotic laxatives, but they are only used for procedural or surgery situations that require a complete emptying of bowel contents. These hyperosmotic laxatives (bowel cleansing preparations) all contain a combination of polyethylene glycol (PEG) 3350, sodium bicarbonate, potassium chloride, and sodium chloride. The ingredients are important to supply the body with needed electrolytes to prevent dehydration related to bowel evacuation. Bowel cleansing preparations are supplied as a powder to be mixed with water; sometimes flavor packs are included. Once
Saline Laxatives

Saline laxatives are a group of hyperosmotic laxatives, which include magnesium citrate, magnesium hydroxide, and the sodium phosphates. Products in this group encourage bowel movements by drawing water into the bowel from surrounding body tissues. This provides a soft stool mass and increased bowel action. Most commonly, these products are used for bowel cleansing prior to surgery, similar to the PEG/electrolyte preparations discussed earlier. Their onset of action is between 30 minutes and 3 hours for oral doses and 2 to 5 minutes for rectal doses. Typically, the rectal formulations are safe for use in adults and children over the age of 2, and the oral formulations should not be used in children younger than 5 years of age. Saline laxatives also can interact with many medications, such as oral anticoagulants (warfarin or aspirin), medications that affect the heart rhythm (digoxin), and some antinausea medications (chlorpromazine).

Magnesium citrate is available as oral solution 1.75 g/30 mL. The typical dose is 150 to 300 mL once, which can be repeated if needed. The citrate form is more easily digested and better absorbed than other forms of magnesium. It is best taken on an empty stomach. In addition to renal insufficiency, patients with heart block or on a low sodium (salt) diet should not use magnesium citrate. Some important side effects include diarrhea, dizziness, abdominal pain, nausea, and vomiting. Severe dehydration can result if the patient is not consuming enough fluids while taking this medication.

Magnesium hydroxide (Phillips’ Milk of Magnesia) is used for the treatment of constipation and as an antacid. It is available as a chewable tablet, oral liquid suspension, and an oral concentrate suspension. It can be given to adults and children older than 2 years of age. Magnesium hydroxide should not be used when abdominal pain, nausea, or vomiting are present, and it should not be taken for longer than 1 week. Multiple drug interactions exist with the use of magnesium hydroxide. Some drugs to use with caution include amphetamines (attention deficit hyperactivity disorder [ADHD] medications) or quinidine, as it can cause a decrease in their absorption. The effects of anticholinergics, iron preparations, folic acid, penicillin antibiotics, digoxin, some antifungals, and phenytoin could all be reduced and these medications should be spaced from doses of magnesium hydroxide, preferably with magnesium hydroxide given 2 to 4 hours after the prescription medication. Use of magnesium hydroxide with fluoroquinolone antibiotics such as levofloxacin and ciprofloxacin (even spaced 2 to 4 hours apart) can cause crystals in the urine and eventually lead to toxicity of the kidney.

**ALERT!**

Magnesium-containing laxatives should not be used long term or for repeated correction of constipation. Up to 20% of an orally administered dose may be absorbed, leading to toxicity in patients with compromised renal function. Magnesium toxicity can lead to severe cardiovascular changes such as decreased blood pressure and slow heart rate, especially in newborns or older adults.
Sodium phosphate preparations are indicated for cleansing of the colon as a preparation for colonoscopy in adults 18 years of age or older. They work by inducing diarrhea, which effectively cleanses the entire colon. Each administration has an effect for approximately 1 to 3 hours. The primary mode of action is thought to be through the osmotic effect of sodium, causing large amounts of water to be drawn into the colon, promoting evacuation. The more common side effects include abdominal bloating and pain, nausea, and vomiting. Patients should be advised to hydrate adequately before, during, and after taking sodium phosphate preparations.

**ALERT!**

Medication guides are required when sodium phosphate bowel preps are dispensed.

**PRACTICE POINT**

Sodium phosphate bowel cleansing kits have complex directions, which must be followed precisely. It is a good idea to have patients review the instructions before leaving the pharmacy to be sure they understand how these are to be taken.

**Mineral Oil (Lubricant Agent)**

Mineral oil is used in many different products for its laxative effects and as an emulsifier for oral and topical preparations. This section focuses on mineral oil as an emollient laxative. Mineral oil is indicated in adults for the relief of constipation when straining must be avoided, such as before and after surgery for hemorrhoids or other painful anorectal disorders (conditions affecting the anus and rectum) and in patients with hypertension, coronary occlusion, and hernia. It acts only as a nonirritating intestinal lubricant. Mineral oil can also be administered rectally for bowel cleansing. In children 2 years of age and older, it is indicated primarily for chronic constipation.

Mineral oil works by slowing down colonic absorption of fecal water and therefore softening the stool. It coats fecal material to prevent or reduce colonic absorption of fecal water and lubricate hard stools, easing their passage without irritating the mucosa. If given orally, mineral oil will exert its effect within 6 to 8 hours; if given rectally, the effect occurs in 5 to 15 minutes. The nonemulsified plain mineral oil given orally and mineral oil given rectally have minimal absorption; however, the emulsified mineral has 30% to 60% absorption. Mineral oil use can decrease the absorption of fat-soluble vitamins (vitamins A, D, E, and K) from the GI tract. Mineral oil can also cause anal pruritus (itching), diarrhea, nausea and vomiting, bloating, flatulence, and abdominal cramps. Mineral oil should not be given if docusate products are also being used; docusate can increase the absorption of mineral oil, thereby increasing its systemic effect. Mineral oil should not be used by patients with appendicitis (inflammation of the appendix), history of a colostomy (removal of the colon) or ileostomy (removal of the ileum), diverticulitis, or fecal impaction. It should not be given to bedridden patients or patients with difficulty swallowing. It should not be used in pregnant patients.

**ALERT!**

Oral mineral oil is only indicated for adults and children older than 6 years of age. Only the rectal administration of mineral oil is recommended in children 2 to 6 years of age.

**PRACTICE POINT**

Mineral oil should not be taken with meals; it should be administered on an empty stomach. The bottle of mineral oil should be kept tightly closed and protected from sunlight.

Castor oil is indicated for the preparation of the small and large bowel for procedures and for isolated bouts of constipation. It is approved for use in adults and children over the age of 2 years; however, it can be used in infants with much smaller dosing. The exact mechanism of action for castor oil is unknown. It is believed that within the small intestine, pancreatic enzymes break castor oil down to glycerol and ricinoleic acid. Ricinoleic acid reduces the net absorption of fluid and electrolytes and stimulates intestinal peristalsis. A bowel movement occurs within 2 to 6 hours. If constipation is accompanied by abdominal pain, intestinal obstruction, nausea and vomiting, and symptoms of appendicitis, castor oil should not be used. Prolonged use of castor
oil may result in loss of electrolytes, fluid, and nutrients in addition to habituation (habit forming) and laxative abuse. Nausea, vomiting, diarrhea, cramps, and abdominal pain have been reported with castor oil.

**ALERT!**
The use of castor oil should be avoided in pregnancy and lactating mothers. It has the ability to possibly induce labor and can be excreted in breast milk. It should also be avoided in the elderly as long-term therapy except if being used for constipation associated with opiate analgesic use.

**PRACTICE POINT**
A full glass (8 oz) of water should be ingested 1 hour after taking castor oil. This is necessary to flush the colon thoroughly and prevent cramping.

**CASE?**
If Mr. Jones decided to try Senokot for the treatment of his constipation, when should he expect a bowel movement, and what is the appropriate dose for him to take?

**Stimulant Laxatives**

**Anthraquinone Laxatives**
Anthrakinone laxatives include aloe, cascara sagrada, casanthranol, senna, aloin, danthon, rhubarb, and frangula. The two drugs here discussed are cascara sagrada and senna (includes the sennosides), which are the most commonly used. Cascara is available as a dietary supplement as a tablet, capsule, fluid extract (liquid), and a tea for use in adults and children over the age of 2 years. It is an all-natural laxative designed for the relief of occasional constipation. The plant-derived compounds present in cascara are laxative prodrugs, which pass unabsorbed through the GI tract until they reach the colon. There they exert their action by increasing motility and affecting secretion and absorption. A bowel movement typically occurs in 6 to 8 hours. Abdominal pain, excessive bowel activity, diarrhea, nausea, and perianal irritation are the primary adverse effects with anthraquinone laxatives. Symptoms of appendicitis, bowel obstruction, and fecal impaction are contraindications for the use of this medication. This medication should not be used for more than 1 week.

**ALERT!**
Patients taking cascara for more than 1 to 2 weeks may experience a decrease in serum potassium level. A reduction in potassium could predispose patients to heart irregularities and affect concomitant medications. The risk of digoxin toxicity is much greater if serum potassium decreases.

**PRACTICE POINT**
Discoloration of acidic urine to yellow-brown or black may occur. Pink-red, red-violet, or red-brown discoloration of alkaline urine may occur with cascara.

Sennosides (senna) can be found alone or in combination with other products in OTC formulations. Some common dosage forms include tablets, chocolate tablets (Ex-Lax®), granules, oral liquid, oral drops, and even a tea. They are approved for the relief of occasional constipation in adults and children over the age of 2 years. All sena products should be taken with a full glass of water or juice. All anthraquinones are passed unchanged to the colon where they are converted to their active product (very similar to cascara). Senna is converted to its active anthraquinones known as sennosides, which are then metabolized to an active byproduct. They appear to act by preventing water and electrolyte absorption from the large intestine, resulting in increased intestinal volume and pressure that stimulates colonic motility. Defecation is typically seen within 6 to 12 hours, but effects may not occur for 24 hours. Some absolute contraindications to using this medication include acute inflammatory conditions such as Crohn’s disease (CD) and appendicitis (which will be discussed later).
bowel obstruction, severe nausea and vomiting, or undiagnosed abdominal pain.

**ALERT!**

Pregnant patients and lactating mothers should not use cascara products. Although not recommended for pregnant patients, senna products can be used in lactating mothers. Sennosides are not excreted in breast milk.

Two important side effects that can occur as a result of using senna products include a condition called melanosisis colic. Melanosisis colic is a harmless darkened pigmentation of the colonic mucosa resulting from chronic use of anthraquinone derivatives. Once the medication is stopped, melanosisis colic will improve in 4 to 12 months. The same urine discoloration that is caused from cascara preparations can also occur with senna. Acidic urine will change from yellow to brown or black, while alkaline urine will change to a pink-red, red-violet, or red-brown color. Other more common side effects while taking this medication may include diarrhea, nausea, vomiting, perianal irritation, fainting, bloating, flatulence, and cramps. There are no drug interactions known with sennosides.

**ALERT!**

While some senna products are labeled for use in children 2 to 6 years of age, others are not recommended for children under 12 years. If there is any doubt, the pediatrician should be consulted.

**Bisacodyl**

Bisacodyl is one of the more commonly used stimulants. Bisacodyl products are available OTC as enteric-coated tablets, tablets, and rectal suppositories. They are also available in some bowel preparation kits. Bisacodyl is indicated for the relief of occasional constipation and irregularity in adults and children over the age of 12 years. Bisacodyl works in the large intestine, where it stimulates the bowel muscles to contract, and thereby push the bowel’s contents along. It produces strong but brief peristaltic movements. It also helps ease elimination by accumulating water to soften the bowel’s contents. The effect is both to help soften the stool and make it pass through more quickly. Rectal suppositories will stimulate a bowel movement in 15 minutes to 1 hour. Defecation is usually seen in 6 to 12 hours with the tablets. Absolute contraindications to using this medication include appendicitis, intestinal obstruction, and gastroenteritis. Patients should be cautioned about taking bisacodyl products if they are experiencing severe abdominal pain, nausea, vomiting, rectal bleeding or failure to have bowel movements after administration, inflammatory bowel disease (CD or appendicitis), or ulcerated hemorrhoid. The more common side effects include abdominal cramping, which may be worse in severely constipated patients. The use of bisacodyl products beyond 7 days is not recommended.

**ALERT!**

Multiple laxatives have the same brand name followed by a qualifier (such as Stool Softener) although they may have completely different active ingredients. Additionally, some products are combined to include a stimulant laxative and a stool softener. It is important to be proficient with reading drug labels on OTC products and becoming familiar with the active ingredients in those products to assist consumers in making appropriate choices and avoiding contraindications.

**PRACTICE POINT**

Bisacodyl products should not be taken within 1 hour of any antacids or other stomach medications that may increase the pH of the stomach. It has the possibility of preventing bisacodyl from working effectively.

**PRACTICE POINT**

Bisacodyl products have been shown to be safe in pregnancy and lactating mothers.
irritating substances such as caffeine or spicy foods. Patients should avoid sitting on the toilet for longer than 10 minutes to reduce straining and decrease pressure on the hemorrhoidal vessels. OTC nonsteroidal anti-inflammatory drugs (ibuprofen, naproxen) and aspirin should be avoided; both may cause excessive bleeding. Pharmacological OTC and prescription treatments are available to treat hemorrhoids. They consist of a range of psyllium or methylcellulose products to increase fiber, corticosteroids, which act as antipruritic and anti-inflammatory agents, analgesics, anesthetics, and vasoconstrictors. Antipruritic agents are used to relieve or prevent itching. In addition to previously discussed oral products, including stool softeners and psyllium, the most prescribed medications for hemorrhoids are topical preparations such as hydrocortisone, pramoxine, phenylephrine, and lidocaine.

Hydrocortisone Preparations

Hydrocortisone products for hemorrhoids may contain hydrocortisone alone (as hydrocortisone acetate) or include pramoxine or lidocaine. All three are available as rectal creams. Additionally, hydrocortisone/lidocaine is available as a rectal gel and as a topical pad; hydrocortisone/pramoxine is available as a rectal foam aerosol and rectal lotion; and hydrocortisone acetate is available as a rectal suppository and rectal foam aerosol. Topical hydrocortisone works by constricting the blood vessels, reducing itching and inflammation. Hydrocortisone is the only OTC corticosteroid and is available at a maximum concentration of 1%. The prescription hydrocortisone products can be found in concentrations as high as 2.5%. The rectal foam aerosol is available at a concentration of 10%. Lidocaine and pramoxine are both local anesthetics, which work by inhibiting the conduction of nerve impulses from sensory nerves, thereby causing a loss of sensation and reducing itching, burning, and pain in 30 to 60 seconds. Absorption is variable as with all rectal products, and sometimes the relief will not occur for much longer. Typically, intact skin will not respond as well as damaged or abraded skin, but hydrocortisone products should not be used on weeping or exudative (fluid that leaks out of blood vessels into nearby tissues) lesions. The dosing for these products ranges from one to three times a day for 1 to 2 weeks depending on symptom severity. Some of the more common side effects include stinging, tenderness, sloughing (skin peeling), and redness. Patients with traumatized or extremely irritated skin should consult a physician before using the product. Mixing other rectal medications along
with any of the hydrocortisone preparations is not recommended. There are no appreciable drug interactions with the use of topical hydrocortisone preparations. If the hemorrhoids worsen, or if symptoms persist unaltered for greater than 7 days or clear up and occur again within only a few days, patients should discontinue use of these product(s) and consult a doctor.

**INFLAMMATORY BOWEL DISEASE**

**CASE STUDY**

Kelsey Fratner is a 24-year-old Caucasian woman who comes into the pharmacy regularly. She asks to speak to the pharmacist and mentions that she has been having an "upset stomach" and frequent diarrhea for more than 2 months. She has been using loperamide daily and does not feel it has been working; she wants to know what other OTC products she might consider. She reports that she has had frequent mouth ulcers over the last couple of months, but they generally heal and are not that painful. She also states that she has had blood mixed in with her diarrhea.

Inflammatory bowel disease (IBD) occurs in more than 1 million patients in the United States. Just like joints in the body may become swollen and painful (arthritis), the intestines can become inflamed and swollen. Also, like arthritis, there is more than one cause for IBD. The two most common causes of IBD are Crohn’s disease (CD) and ulcerative colitis (UC).

CD is an autoimmune disorder, meaning the body’s defenses against bacterial and viral infections have turned against the body and have started to attack body tissues (other autoimmune diseases discussed in this book include type 1 diabetes in Chapter 10 and rheumatoid arthritis in Chapter 13). CD may appear at almost any age but is most often diagnosed when patients are in their 30s or over the age of 50 years. This condition may affect the entire length of the GI tract. Although the majority of patients have symptoms in their colon, fewer than one out of five patients have the disease restricted to that portion of the GI tract. Affected locations appear like a road made of cobblestones where there are areas of ulcers surrounded by areas of thickness from where other ulcers have healed and left scar tissue behind. Among the patches of cobblestone areas, there may be portions of the GI tract where no disease is present. This type of disease is called discontinuous as it only has an effect on portions of the GI tract at one time. CD can also be continuous in which the entirety of the GI tract is affected. Patients with CD have

**Phenylephrine Preparations**

Phenylephrine products for hemorrhoids are branded as Preparation H and may contain hydrocortisone, aloe vera, or lidocaine for additional relief. OTC phenylephrine products are available as a suppository or an ointment with a maximum concentration of 0.25%. Phenylephrine is an alpha-adrenergic agonist, which produces local vasoconstriction that helps reduce hemorrhoids. These products are usually dosed four times a day and since they are topical preparations, systemic absorption is minimal, which reduces side effects. Phenylephrine products can be used in adults and children 12 years of age or older. If symptoms do not improve within 7 days or rectal bleeding occurs, a physician should be consulted.

Although systemic side effects are rare, patients with cardiovascular disease, especially ischemic heart disease, should use caution with extensive use of these topical preparations. There is limited information about the use of topical phenylephrine in pregnancy, but systemic (IV) phenylephrine does cross the placenta. Currently, it is recommended to avoid topical preparations of phenylephrine for pregnant and lactating patients.
a wide range of GI symptoms, including frequent diarrhea (sometimes more than 10 times a day), with some bleeding when defecating (passing feces), diffuse (widespread) abdominal pain, and ulcers of the mouth that may spread down the esophagus. Symptoms that may occur outside of the GI tract include skin ulcers and joint pain. Both types of symptoms are relieved by the same medications; however, currently there are no medications or therapies that cure CD. Due to the autoimmune nature of the disease, patients may have symptoms relapse and remit (come and go).

Another form of IBD is UC. The majority of patients with UC are diagnosed with the disease earlier in life than patients with CD and are female. People who have family members that have UC are at a higher risk of being diagnosed with UC than the general population. The cause of UC is less well defined than that of CD, and while there is evidence that it is related to genetics, there could also be nongenetic contributing factors. Though the cause of the inflammation may be different, the end result of both diseases is similar. Patients with UC frequently present with diarrhea accompanied by blood and mucus. Patients may also complain of diffuse abdominal pain.

UC is similar to CD in that the patient will develop ulcers in parts of their GI tract. However, unlike CD, the ulcers only appear in the colon and usually in the rectum. The ulcers in UC are continuous through the affected areas of the colon, which is different than what is seen in CD. There are pharmacologic treatments for UC, but these only reduce the symptoms of the disease and do not address its underlying causes. The only curative procedure is to remove the patient’s colon; however, this is generally done only in patients with significant disease that does not respond to other treatments. The treatments for IBD depend on which of the major types of the disease the patient has. However, many of the treatments are the same in duration and dose, with the end goal of forcing the disease into remission.

**CASE?**

Which type of IBD correlates with the symptoms that Kelsey is having?

**Anti-inflammatory Medications**

Anti-inflammatory agents have a direct impact on the symptoms of IBD; however, they do not impact the root causes of the disease. Since there is an inflammation reaction occurring that leads to swelling and ulcerations, these agents help reduce the reaction and allow the tissue to heal.

Generally, when anti-inflammatory agents are discussed, the most common agents like ibuprofen, naproxen, and celecoxib are mentioned. However, these are not generally used in the treatment of IBD due to an increased risk in ulcer formation with these particular agents. Sulfasalazine, mesalamine, balsalazide, and olsalazine are used for the treatment of both CD and UC. Though similar in action, these agents do have different dosage regimens and side effects.

**Sulfasalazine (Azulfidine®)**

Sulfasalazine is an older anti-inflammatory agent. It is unique in that it contains a sulfonamide moiety (part of its chemical structure contains a sulfur molecule in the same configuration as sulfa antibiotics) that can lead to patients developing allergies to the medication. Additionally though, this sulfamoyl acts like an antibiotic that may help in treating the ulcers that develop from IBD. Sulfasalazine is activated by the bacteria in the gut to its active form, mesalamine, an anti-inflammatory and sulfapyridine. Sulfasalazine is usually started at a dose of 1 to 2 g divided in two doses daily and gradually increased to as much as 4 g divided into two doses for UC and up to 6 g daily for CD. It is expected that the full potential of the medication will not be achieved until at least 4 weeks of therapy. Even though the medication is working, the body may still need additional time to heal the inflamed areas.

Sulfasalazine has side effects that impact the skin and GI system. One of the most common side effects is a rash that may develop after the start of the drug or after a dose increase. If the rash is significant, the patient can be started on a desensitization protocol (which allows the body to slowly adjust to the medication, thus not causing a rash). In rare cases, sulfasalazine has been linked to Stevens-Johnson syndrome (a very serious and deadly skin rash).
Indigestion, loss of appetite, nausea, and vomiting have all been associated with sulfasalazine in up to one out of three patients taking the medication. If the patient has significant adverse effects to the medication, one of the other anti-inflammatory agents should be used.

**Mesalazine (Asacol® and Others)**

Mesalazine is one of the active metabolites of sulfasalazine. The benefit of mesalazine over sulfasalazine is that there is no sulfonamide produced by mesalazine, thus fewer patients are hypersensitive (allergic) to the medication. Mesalazine, also known as 5-ASA (it looks like aspirin to the body), works by inhibiting the inflammation in the GI tract by blocking prostaglandin (a chemical in the body that can cause inflammation) synthesis.

Mesalazine also will take a few days to a few weeks to work before the patient starts seeing a benefit from the medication. It is dosed as two 400-mg tablets twice daily for mild to moderate, active UC and two 800-mg tablets twice daily for more significant active disease. Once the patient has responded to therapy with the agent, the dose is usually a total of 1,600 mg daily. For patients with CD, the dose is higher. The target dose for CD is two 400-mg tablets 3 times a day. This dose was found to be as effective as a 4-g daily dose in clinical trials.

Mesalazine can lead to several side effects. The most common side effects include diarrhea (which is already caused by IBD so it may worsen initially), flatulence, nausea, and upper abdominal pain (which may be related to IBD). In addition to these GI side effects, mesalazine has been linked to headache and can cause nasopharyngitis (sore throat).

**PRACTICE POINT**

Some prescriptions written for mesalazine will have its abbreviation of 5-ASA on them in place of mesalazine.

**PRACTICE POINT**

Mesalazine has multiple different formulations (ie, immediate release, extended release, delayed release, etc.). These formulations are not interchangeable and correlate to where the medication will be released in the GI tract.

**Balsalazide**

Balsalazide is a prodrug for mesalazine. The benefit is that it is not active in the upper part of the GI tract but is metabolized to its active form once it reaches the lower GI tract where it can have an effect. As mesalazine, it works in the lower GI tract by reducing prostaglandin synthesis, thereby reducing inflammation. Balsalazide is used in the treatment of active UC and in patients whose UC is in remission. For active disease, the patient should take 2.25 g (three 750-mg tablets) three times daily for 6 weeks to induce remission. After this high-dose start, the dose is reduced to 1.5 g twice daily or 3 g twice daily. The patient should expect to see an effect from the medication within 10 to 14 days of starting the higher dose.

Balsalazide has fewer side effects, especially GI and skin related, than either mesalamine or sulfasalazine. This is most likely because it does not start to work until it is in the lower intestines. It can cause rash (very infrequently) and some GI tract issues, such as abdominal pain, diarrhea, nausea, and vomiting (occurring about one-half as much as the other agents). There is still concern that the patient must be screened to see if they have an allergy to aspirin as mesalazine is very similar to aspirin and other salicylates.

**Olsalazine**

Olsalazine is another prodrug for mesalazine. It is actually two mesalamine molecules attached together that are then separated in the lower GI tract. Once separated from each other, the two molecules have the same mechanism of action as mesalamine. The usual dose for olsalazine is 1 g/day in two divided doses. Like balsalazide, olsalazine has fewer side effects than sulfasalazine most likely because it is not activated until it reaches the lower GI tract. The primary side effect of therapy with olsalazine is diarrhea. Again, the disease also causes diarrhea so it is difficult to determine if it is the disease causing the diarrhea or olsalazine. Some patients will require a dose reduction to tolerate therapy with olsalazine.

**PRACTICE POINT**

Though they have fewer side effects, both olsalazine and balsalazide cost more than mesalazine or sulfasalazine. Thus, if a patient has difficulty paying for medication, the pharmacist might recommend one of the older medications to the physician.
**Corticosteroids**

Corticosteroids have been covered elsewhere (Chapter 9), thus a full review of them will not be done here. However, corticosteroids play an important role in the management of IBD when the nonsteroidal medications have failed. Corticosteroids reduce inflammation by preventing the arachidonic acid pathway, which will reduce several key inflammatory agents such as prostaglandins and chemokines (chemicals in the body that help cause inflammation). Corticosteroids are also immunosuppressants.

Oral steroid therapy with either prednisone or methylprednisolone is not indicated for the long-term management of IBD. Due to the significant side effects associated with long-term steroid use, such as weight gain, osteoporosis (bone loss over time), and hyperglycemia (high blood sugar), the limited effectiveness in chronic use discourages their use. However, corticosteroids are very effective for the short-term treatment of an acute episode of IBD.

**Immunomodulators**

Due to the immunogenic (related to the body’s own immune system) causes of CD and the possible link to UC, medications that can have an impact on the immune system and thus reduce its targeting of the body’s tissues may be prescribed. The following medications are primarily used to treat only IBD that is diagnosed as CD; however, some prescribers may use the agents for UC, though effectiveness is very limited.

**Azathioprine and Mercaptopurine**

Azathioprine is rapidly metabolized inside the body to 6-mercaptopurine so these will be considered together. 6-Mercaptopurine is thought to suppress the immune system by inhibiting the body’s synthesis of new proteins, including antibodies, which contribute to inflammation. With fewer antibodies circulating in the bloodstream, inflammation should diminish. These agents have been used primarily in host versus graft disease (which happens after organs are transplanted) and other autoimmune disorders but have been studied in both CD and UC. Azathioprine and mercaptopurine are dosed based on the weight of the patient. (See Medication Table 22-1.) Patients should not expect to see any positive effects until 3 months after starting the medication.

Because of their mechanism of action, these drugs can have significant effects not only on the immune system but also on other body functions. Thrombocytopenia (low platelet counts) and leukopenia (low levels of white blood cells) have been noted with patients taking these agents. Nausea, vomiting, and diarrhea may occur within the first few months of therapy. Studies recommend giving the drugs in smaller doses throughout the day to minimize the threat of these side effects. Finally, pancreatitis (inflammation of the pancreas, which can be deadly) has occurred in about 6% of patients taking azathioprine in some clinical trials and patients should be alert to changes in their abdominal pain (location or intensity).

**Monoclonal Antibodies**

Because IBD, like rheumatoid arthritis, is an autoimmune disorder, the monoclonal antibodies (infliximab, adalimumab, and certolizumab) discussed in Chapter 13 are also useful in the treatment of IBD. Infliximab, ustekinumab, adalimumab, and vedolizumab are used to treat both CD and UC, whereas certolizumab (alternative therapy option) is used for CD only.

**PRACTICE POINT**

The immunomodulators are now considered first-line therapy, with the biologics or biologics plus thiopurine agents (azathioprine and mercaptopurine) carrying a more substantial recommendation than the thiopurine agents alone.

**PRACTICE POINT**

The dosing of monoclonal antibodies changes over the therapy period. Initially (usually the first week), patients receive higher doses than in subsequent periods. While standard doses of adalimumab, certolizumab, ustekinumab, and vedolizumab are prescribed for most patients, infliximab dosing is based on patient weight.
In severe cases of IBD, patients may be taking several different classes of medications, some of which may be administered by infusion at a clinic or physician’s office. It is important that these be recorded in the pharmacy patient record.

**CASE?**

If Kelsey is started on immunomodulators, what general precautions should she observe?

**IRRITABLE BOWEL SYNDROME**

Irritable bowel syndrome (IBS) is a collection of symptoms that, when found together, are considered IBS (IBS should not be confused with IBD described above). The hallmark of IBS is chronic or recurrent abdominal pain or discomfort that occurs along with a change in bowel habits. Patients may have symptoms that include unusual frequency of bowel movements (either less than three per week or more than three per day), abnormal stool consistency (hard and lumpy or soft and watery), straining during defecation, urgency of defecation, a feeling of not completely defecating after finishing, passing mucus, or bloating. Additionally, these patients may either present as constipated, having diarrhea with frequent bowel movements, or a mix of the two. These symptoms are all GI related; however, IBS patients also report other pain disorders and generalized issues throughout their bodies. Patients who are diagnosed with IBS are also likely to have GERD (gastroesophageal reflux disease), fibromyalgia, and chronic fatigue syndrome.

A clear cause for the disease is not known, but there are theories that it is related to stress and an overactive pain response. During stressful situations in life, the body changes hormone levels to prepare the body for whatever is going to happen. Some scientists believe that these changes cause patients with IBS to start developing symptoms as their GI systems are being affected by the change of hormone levels. The involvement of overactive pain receptors, known as hyperalgesia, relates IBS to fibromyalgia and pain disorders. Scientists think that the overactive pain response best explains IBS symptoms because IBS patients are more responsive to both internal and external stimuli, demonstrating a
of alosetron has been approved for females only as it was not found to be effective in men. Significant side effects related to the use of alosetron, including toxic megacolon (rapid expansion of the diameter of the colon that can lead to death), obstruction, and ischemic colitis were reported. Other than these GI-related side effects, the medication is well tolerated.

**PRACTICE POINT**

The Prescribing Program for Lotronex (PPL) requires a physician to undergo training to monitor the medication and its effects. The FDA requires a medication guide each time the drug is dispensed. Additional Information on the program may be found at http://www.lotronexppl.com/.

**Tegaserod (Zelnorm)**

Tegaserod is a serotonin receptor agonist, which appears to accelerate the motility of the GI tract. It is also thought to have some effect on 5-HT1. Tegaserod increases the secretion of intestinal fluids and increases the peristaltic reflex, lower threshold for pain. Additionally, when stressed, a natural response is to be more sensitive to stimuli; thus, both theories may be tied together.

Because there is no known cause for IBS, therapies for it deal mostly with treatment of anxiety or depression. The first-line treatment for IBS, though, is diet. A diet that is high in fiber is recommended to regulate patients. Additionally, patients are asked to identify food triggers that can worsen the disease. If patients are unable to reduce or control their symptoms through diet, pharmacologic agents are then recommended. For these patients a determination, if possible, of whether they have constipation- or diarrhea-dominant IBS must occur. If the patient has constipation more frequently, laxatives and other agents to increase the number of bowel movements are recommended. The opposite is true for patients with diarrhea. The recommended therapies are the medications for constipation and diarrhea covered earlier in this chapter. Additionally, some patients begin therapy and see benefit from selective serotonin reuptake inhibitors (SSRIs) or tricyclic antidepressants (TCAs); these are used at the same doses used to treat depression. These agents are covered in Chapter 7. There are three other classes of medication that have shown to be effective in relieving the symptoms of IBS: serotonergic agents, antispasmodics, and guanylate cyclase activators.

**Serotonergic Agents**

There are two agents in this class of drugs: tegaserod and alosetron. Both agents affect serotonin receptors; however, one is an agonist and one is a receptor antagonist. They are used to treat different types of the disease, one for constipation dominant and the other for diarrhea dominant. They both are in restricted access programs due to side effects.

**Alosetron (Lotronex)**

Alosetron is a serotonin (5-HT3) receptor antagonist that helps slow down the gut and reduce the frequency of diarrhea. It is very selective and potent at the receptor site; thus, unlike other serotonin antagonists, there is not much concern of it having effects at other receptor sites. By blocking the actions of 5-HT3 in the GI tract, it decreases gut motility. Alosetron originally was approved only for IBS with diarrhea; however, it was used for treating patients with diarrhea only, which led to the occurrence of significant (and deadly) side effects. These side effects lead to the removal of the product from the U.S. market, but public demand resulted in the product being re-released but as part of a limited access program. The dosing for alosetron starts at the lowest possible dose and is increased later to minimize side effects. The use of alosetron has been approved for females only as it was not found to be effective in men. Significant side effects related to the use of alosetron, including toxic megacolon (rapid expansion of the diameter of the colon that can lead to death), obstruction, and ischemic colitis were reported. Other than these GI-related side effects, the medication is well tolerated.

**PRACTICE POINT**

The safety and efficacy of tegaserod have not been established in males. This agent is contraindicated for women 65 and over.

**ALERT!**

Cardiovascular risk factors that must be considered before tegaserod is prescribed and used include active smoking, high blood pressure or history of being treated with medicines that lower blood pressure, high cholesterol or medicine to lower blood cholesterol levels, history of diabetes, age 55 years or over, or obesity. A medication guide must accompany every tegaserod prescription dispensed.
which will help expel the contents of the intestines. Tegaserod is used for short periods of time only for constipation-dominant IBS in adult women under 65 years of age who do not have a history of ischemic cardiovascular disease and who have no more than one risk factor for cardiovascular disease. Patients taking tegaserod have complained of GI side effects such as flatulence, abdominal pain, and headaches. Most significantly, however, tegaserod has been linked to an increased risk of major cardiovascular events (stroke and heart attack).

**Antispasmodics**

*Dicyclomine and Hyoscyamine*

Dicyclomine and hyoscyamine are the most commonly used antispasmodics for the management of symptoms associated with IBS. These agents work by relaxing intestinal smooth muscles, which reduces GI motility. Each medication may be dosed multiple times a day, but is not intended for long-term use. Hyoscyamine is available in multiple dosage forms, including immediate- and extended-release tablets, intramuscular injection, intravenous, or subcutaneous injection. Dicyclomine is available only as an oral capsule or solution. Please refer to the medication table at the end of the chapter for dosing specifics, as there are many. Common side effects of these agents include drowsiness or blurred vision, diarrhea, increased sensitivity to hot environments, and dry mouth.

Dicyclomine is approved for use in adults and children older than 2 years of age. If an antispasmodic is needed for a child, hyoscyamine is the better agent to use, especially with infants and children younger than 2 years of age. Both dicyclomine and hyoscyamine cross the placenta, therefore use in pregnant women is not recommended due to the potential fetal adverse effects. These agents are also present in breast milk and can suppress lactation, so they are not recommended for use in breast feeding mothers.

**Guanylate Cyclase Activators**

*Linaclotide and Plecanatide*

Linaclotide (Linzess) and plecanatide (Trulance) are agonists of guanylate cyclase-C on the luminal surface of the intestinal epithelium. This causes a chain reaction that ultimately increases the secretion of chloride and bicarbonate into the intestines, which increases intestinal fluid concentrations and GI transit time. Linaclotide and plecanatide are only used for chronic idiopathic constipation and IBS syndrome with constipation in adult patients, and are recommended as first-line agents.

<table>
<thead>
<tr>
<th>PRACTICE POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Linaclotide is a capsule, which can be taken whole, or its contents sprinkled into applesauce or mixed with 30 mL of room-temperature water for sipping or tube feeding. Plecanatide is a tablet that can be swallowed whole or crushed and administered with applesauce or water. When opened or crushed for mixing, the medications should be administered immediately.</em></td>
</tr>
</tbody>
</table>

These medications are well tolerated, with the most common side effect being diarrhea within the first month of use. This usually subsides the longer the patient is on the medication, but if it does not decrease after the first month of use, then a physician should be consulted.

**ALERT!**

The use of linaclotide and plecanatide should be avoided in children younger than 6 years of age and is contraindicated for those under 2 years. In younger patients, these medications can cause severe dehydration leading to death.

**FLATULENCE**

Flatulence, or gassiness, occurs when there is an accumulation of gas in the intestines. Frequently patients will also complain of pain or bloating that goes along with flatulence. There are several causes of flatulence. A common cause that is correctable with behavior changes is aerophagia (swallowing air). People who frequently chew gum, drink carbonated drinks, or smoke are more prone to swallowing air, which can end up in the intestines and lead to flatulence. Other causes of flatulence are mechanical obstructions (such as cancers or adhesions of the inner part of the intestine to itself); poor absorption of certain nutrients that are then metabolized by bacteria to gaseous products; movement disorders of the bowels where slowdown of the gut may occur, leading to...
dark stools after usage as the charcoal passes from their systems. In patients where there are concerns about GI bleeding this may be an issue as it will be hard to distinguish the dark stool of melena (blood in the feces) from that caused by charcoal. Care must also be advised when giving charcoal to patients with swallowing difficulties as aspiration of the medication into the lungs is possible and is harmful.

**ALERT!**
Charcoal interacts with numerous drugs because it binds medications as well as gas, thus the doses of charcoal and medications must be separated by at least 2 hours.

**Alpha-Galactosidase-A**

Alpha-galactosidase-A is considered to be a dietary supplement and is widely used to reduce the incidence of intestinal gas caused by eating beans. Beans contain a complex carbohydrate that is metabolized by gas-producing bacteria in the lower GI tract. Alpha-galactosidase-A is an enzyme that converts the complex carbohydrates into glucose and other simple carbohydrates, which can be absorbed by the body and made unavailable to the bacteria, thus reducing gas production.

**ALERT!**
Beano should be put only on cool foods. If placed on hot foods, the enzyme will be deactivated.

**Charcoal, Activated**
Charcoal is one of nature’s great purifiers. It actively binds a host of chemicals to it, and prevents those molecules from reentering the system around it. This is the mechanism of action for charcoal in intestinal gas, as it binds the gas and then enables the patient to expel the bound gas through defecation. In addition to its uses for intestinal gas, it is also used in acute poisonings with several different agents. Charcoal is available as an OTC product and can be used for adults to treat intestinal gas. The normal dose for adults is 520 mg given after meals or when the patient first feels discomfort from gas or bloating. The patient should not consume more than 4 g charcoal/day.

Side effects from charcoal ingestion are generally mild and cosmetic. All patients taking charcoal will notice black,
This section will focus on helminths (worms) that live in the intestines. Common worms that live inside the human intestines include *Ascaris lumbricoides*, *trichuris trichiura* (whipworm), *Enterobius vermicularis* (pinworm), *Taenia solium* and *Taenia sanguinata* (tapeworm), and *Necator americanus* and *Ancylosoma duodenale* (hookworm). The various worms, though different, have similar life cycles where the adult worm lives and feeds in the intestines of a human. Once the worm matures, eggs are laid in the intestines that are then excreted with the feces. The eggs then need to mature outside of the body, and at some point, they may be ingested by a human again. This is considered to be a fecal-oral route of transmission. The human does not need to eat feces to be exposed, because when feces dry out, it is common for the eggs to disperse in the wind or be carried away by water or other animals. Once the eggs are inside the human body, they hatch and the cycle begins again.

Most patients with worm infections do not notice them. However, certain populations, especially children, may have lifelong complications from worm infections early in life, as the worms compete for the same nutrients that the child needs for growth and development. So even though a child is eating normally, there may be signs of malnutrition, growth retardation, and failure to thrive syndrome related to a worm infection.

Treatments that help eliminate worms from the body usually work in one of two ways. They either attack the adult worm, or they inhibit the ability of the eggs to form and grow, terminating the life cycle. These mechanisms support the pulse therapy (short “bursts” of medications) that is common with antiparasite treatment. There are several treatments available for each of the types of parasites. One of the choices, metronidazole is covered in Chapter 27.

**Mebendazole**

Mebendazole is an antiparasite (worm) agent that is taken by mouth and can impede the growth of and eventually kill several different types of intestinal parasites. Mebendazole interferes with the parasite’s cellular transport of glucose, eventually starving it of needed energy. This causes the parasite’s death. It is believed that mebendazole also has an effect on the eggs of the parasite and the larvae of the parasites that are living in tissues and not in the intestinal lumen.

The dosage of mebendazole depends on the species of the parasite (see Medication Table 22-1) and is not dependent on the age of the patient, though the medication is not recommended for patients younger than 2 years of age. Each of the dosing regimens may be repeated in 3 weeks if complete resolution of the infection has not occurred. The medication is not effective for hydatid disease, and thus should not be used to treat this infection. Side effects of mebendazole are generally mild due to the short-term nature of the therapy. However, the most common are skin rash, headache, or diarrhea/constipation. Rarely has the medication been believed to cause hepatitis.

**Albendazole**

Albendazole is similar to mebendazole as it is effective against different types of worms and works at multiple stages of the life cycle of the worm, primarily by blocking glucose transport inside of the worm. This leads to an energy starvation of the worm, eventually paralyzing it, and allowing the patient to pass it with the stool. Albendazole is also effective in certain species of worms in the larval and egg phases.

Dosing for albendazole also depends on the worm infection the patient has. This cycle is repeated three times to ensure that all of the larvae are destroyed. Doses are adjusted for patients who weigh less than 60 kg (132 pounds). Since the medication targets processes that are different in the worm and are not shared with humans, the side effects of this medication are generally mild. However, headache, nausea and vomiting, and abdominal pain are common side effects of the medication. Additionally, although rare, Stevens-Johnson syndrome and agranulocytosis have occurred with the medication, and hepatotoxicity and acute renal failure have occurred in patients taking the medication.

**SUMMARY**

The lower gastrointestinal (GI) tract is a complex system of different organs that are affected by several different diseases. As shown in this chapter, the diseases that affect the lower GI system cause significant issues in patients who have them. However, there are treatments that are safe and effective in the management of these diseases. The knowledgeable pharmacy technician, in collaboration with a pharmacist, can have a significant impact on the lives of these patients.

**REFERENCES**


REVIEW QUESTIONS

1. What are the goals of treatment for diarrhea and which drug classes are available without a prescription?

2. What are some of the common causes of constipation?

3. What are the major differences between the treatments of Crohn’s disease and ulcerative colitis?

4. Explain the differences between the different anti-inflammatory agents used to treat IBD.

5. Discuss why the two serotonergic agents used to treat irritable bowel syndrome have been pulled off of the market. Consider both effectiveness and safety.
### MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medications for the Treatment of Diarrhea</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loperamide (loperamide)</td>
<td>Imodium A-D, Diamode</td>
<td>OTC</td>
<td>Tablets and capsules: 2 mg</td>
<td>4 mg once, 2 mg after each unformed stool (max 16 mg)</td>
<td>8–12 years (&lt;30 kg): 2 mg 3 times/day (max 6 mg) 5–8 years (20–30 kg): 2 mg 2 times/day (max 4 mg) 2–5 years (13–20 kg): 1 mg 3 times/day (max 3 mg)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid: 1 mg/5 mL, 1 mg/7.5 mL</td>
<td>4 mg once, 2 mg after each unformed stool (max 16 mg)</td>
<td>Not intended for children &lt;6 years of age</td>
</tr>
<tr>
<td>Bismuth subsalicylate (Bismuth) (subsalicylate)</td>
<td>Bismatrol, Pepto-Bismol</td>
<td>OTC</td>
<td>Tablet, chewable tablet: 262 mg</td>
<td>2 tablets, repeat every 30 min to 1 hr (max 16 tablets)</td>
<td>9–11 years: 1 tablet 6–8 years: tablet 3–5 years: tablet; not intended for children &lt;3 years of age (max 8 doses)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid, children’s: 87 mg/5 mL, 130 mg/15 mL, 262 mg/15 mL</td>
<td>30 mL of 262 mg/15 mL or 15 mL of 524 mg/15 mL, repeat every 30 min to 1 hr (max 16 tablets)</td>
<td>9–11 years: 15 mL 6–8 years: 10 mL 3–5 years: 5 mL of 87 mg/5 mL; not intended for children &lt;3 years of age (max 8 doses)</td>
</tr>
<tr>
<td>Diphenoxylate/atropine sulfate (diphenoxylate) (atropine)</td>
<td>Lomotil Rx (Schedule V controlled substance)</td>
<td>Rx</td>
<td>Tablet: 2.5 mg/0.025 mg Liquid: 2.5 mg/0.025 mg/5 mL; liquid should be used in children &lt;13 years of age</td>
<td>5 mg 4 times/day PRN</td>
<td>9–12 years (23–55 kg): 1.5–3 mL 4 times/day 6–8 years (17–32 kg): 2.5–5 mL 4 times/day 5 years (16–23 kg): 2.5–4.5 mL 4 times/day 4 years (14–20 kg): 2–4 mL 4 times/day 3 years (12–16 kg): 2–3 mL 4 times/day 2 years (11–14 kg): 1.5–3 mL 4 times/day; not intended for children &lt;2 years</td>
</tr>
<tr>
<td>Opium (Opium)</td>
<td>Rx (Schedule II)</td>
<td>Tincture: 10%</td>
<td>0.6 mL 4 times/day</td>
<td>If used for children, must be diluted 25-fold</td>
<td></td>
</tr>
</tbody>
</table>

*Continued next page*
### MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract® (Continued)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name, others</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulk-forming Agents</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psyllium (SILi yum)</td>
<td>Metamucil, Konsyl, others</td>
<td>OTC</td>
<td>Capsules: 0.52 g</td>
<td>2–6 capsules with 8 oz liquid 3 times/day PRN</td>
<td>Not intended for children &lt;12 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Powder: 3.4–3.5 g</td>
<td>1 rounded tsp with 8 oz liquid 1–3 times/day PRN</td>
<td>6–12 years: ½ rounded tsp with 8 oz liquid 1–3 times/day PRN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Granules: 4.03 g</td>
<td>1–2 rounded tsp with 8 oz liquid 1–2 times/day PRN</td>
<td>7–11 years: 1 rounded tsp with 8 oz liquid 1–2 times/day PRN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wafers: 3.4 g</td>
<td>2 wafers with 8 oz liquid 3 times/day PRN</td>
<td>6–12 years: 1 wafer with 8 oz liquid 3 times/day PRN</td>
</tr>
<tr>
<td>Methylcellulose (meth ill SELi yoo lose)</td>
<td>Citrucel, Maltsupex</td>
<td>OTC</td>
<td>Tablets: 500 mg</td>
<td>2 tablets with 8 oz liquid PRN (max 12)</td>
<td>6–12 years: 1 tablet with 8 oz liquid PRN (max 6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Powder: 2 g</td>
<td>11.5 g with 8 oz liquid 3 times/day PRN</td>
<td>6–12 years: 5.75 g with 8 oz liquid daily</td>
</tr>
<tr>
<td>Polycarbophil (pol i KAR boe fili)</td>
<td>Equalactin, Fiber-Lax, Fiber</td>
<td>OTC</td>
<td>Tablets, chewable tablets: 500 mg</td>
<td>2 tablets with 8 oz liquid 1–4 times/day PRN</td>
<td>6–12 years: 1 tablet with 8 oz liquid 1–3 times/day PRN</td>
</tr>
<tr>
<td><strong>Surfactants</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Docusate sodium (DOK yoo sate) (SOE dee um)</td>
<td>Colace, Dulcolax Stool Softener, and many others</td>
<td>OTC</td>
<td>Tablets: 100 mg</td>
<td>100–300 mg daily</td>
<td>6–12 years: 100 mg daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Capsules: 50–250 mg</td>
<td>100–300 mg daily</td>
<td>6–12 years: 50–150 mg daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Syrup: 4 mg/mL (available as 20 mg/5 mL and 60 mg/15 mL)</td>
<td>60–180 mg daily</td>
<td>6–12 years: 40–120 mg daily 3–6 years: 20–60 mg daily &lt;3 years: 10–40 mg daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Syrup: 3.33 mg/mL (available as 50 mg/15 mL and 100 mg/30 mL)</td>
<td>50–100 mg daily</td>
<td>6–12 years: 50 mg daily 3–5 years: 33 mg daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid: 10 mg/mL</td>
<td>50–200 mg daily</td>
<td>6–12 years: 40–120 mg daily 3–6 years: 20–60 mg daily</td>
</tr>
</tbody>
</table>

*Continued next page*
## MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract

(Continued)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hyperosmotic Laxatives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glycerin (GLIserin)</td>
<td>Fleet Glycerin Suppositories, Pedia-Lax, others available</td>
<td>OTC</td>
<td>Suppository</td>
<td>1 suppository daily</td>
<td>Do not use in children &lt;2 years of age</td>
</tr>
<tr>
<td></td>
<td>Fleet Liquid Glycerin</td>
<td></td>
<td>Rectal liquid</td>
<td>Not indicated for adults</td>
<td>2–6 years: 1 unit as directed by physician</td>
</tr>
<tr>
<td>Polylene glycol (PEG) 3350 (pol ee ETH i leen) (GLYE col)</td>
<td>Gavilax, MiraLAX, others</td>
<td>OTC</td>
<td>Powder for oral solution: 17 g packets 225 g, 510 g, and 527 g bottle</td>
<td>17 g (approx. 1 heaping tbsp) in 8 oz of water daily</td>
<td>18 months to 11 years: 0.25–1.42 g/kg/day; in children &gt;20 kg, use adult dose</td>
</tr>
<tr>
<td>Polylene glycol/electrolyte solutions: (PEG ES) polylene glycol (PEG) 3350, sodium bicarbonate, potassium chloride, and sodium chloride (pol ee ETH i leen) (GLYE col)</td>
<td>Golytely, Nulytely, Gavilyte, MoviPrep</td>
<td>Rx</td>
<td>Packets, disposable jugs</td>
<td>4 L of oral solution prior to GI exam; patients should drink 240 mL every 10 min until 4 L are consumed or until the rectal effluent is clear</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Sorbitol (SOR bi tal)</td>
<td></td>
<td>Rx</td>
<td>70% solution</td>
<td>2–3 tbsp PO daily as a single dose (1 part 70% solution: 2.3 parts water) 120 mL rectally daily</td>
<td>2–12 years: 30–60 mL (1 part 70% solution: 2.3 parts water) rectally daily</td>
</tr>
<tr>
<td>Lactulose (LAK tyoo lose)</td>
<td>Constulose, Enulose, Generlac, Kristalose</td>
<td>Rx</td>
<td>Oral solution: 10 g/15 mL</td>
<td>15–45 mL 3–4 times/day (max 40 g or 60 mL)</td>
<td>Children: 40–90 mL/day in divided doses Infants: 2.5–10 mL/day in divided doses</td>
</tr>
</tbody>
</table>

Continued next page
### MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract (Continued)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hyperosmotic Saline Laxatives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium citrate</td>
<td>Citroma</td>
<td>OTC</td>
<td>Oral solution: 1.75 g/30 mL</td>
<td>150–300 mL once</td>
<td>6–12 years: 0.5 mL/kg (max 200 mL every 4–6 hr for bowel procedure)</td>
</tr>
<tr>
<td>(mag NEE zhum)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium hydroxide</td>
<td>Milk of Magnesia</td>
<td>OTC</td>
<td>Chewable tablet: 311 mg</td>
<td>6–8 tablets before bedtime with 8 oz of water</td>
<td>6–11 years: 3–4 tablets at bedtime with 8 oz of water 2–6 years: 1–2 tablets at bedtime with 8 oz of water</td>
</tr>
<tr>
<td>(mag NEE zhum)</td>
<td></td>
<td></td>
<td>Liquid suspension: 400 mg/5 mL</td>
<td>30–60 mL daily in 2 divided doses</td>
<td>6–12 years: 15–30 mL daily in 2 divided doses 2–6 years: 5–15 mL daily in 2 divided doses &lt;2 years: 0.5 mL/kg in 2 divided doses 4 times/day PRN</td>
</tr>
<tr>
<td>(hye DROX ide)</td>
<td></td>
<td></td>
<td>Liquid suspension: 800 mg/5 mL</td>
<td>15–30 mL daily in 2 divided doses</td>
<td>6–12 years: 7.5–15 mL daily in 2 divided doses 2–6 years: 2.5–7.5 mL daily in 2 divided doses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Liquid suspension: 1,200 mg/5 mL</td>
<td>10–20 mL daily in 2 divided doses</td>
<td>Not recommended in children &lt;12 years</td>
</tr>
<tr>
<td>Sodium phosphate</td>
<td>OsmoPrep®</td>
<td>Rx</td>
<td>Oral tablet</td>
<td>As directed (32–40 tablets starting the evening prior to the procedure)</td>
<td>Not recommended in children &lt;18 years</td>
</tr>
<tr>
<td>(SOE dee um)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(FOS fate)</td>
<td></td>
<td></td>
<td>Rx</td>
<td>Oral liquid 45 mL the evening prior to the procedure</td>
<td>Not recommended in children &lt;18 years</td>
</tr>
<tr>
<td><strong>Mineral Oil</strong></td>
<td>Fleet Oil</td>
<td>OTC</td>
<td>Rectal enema (118 mL)</td>
<td>1 bottle daily</td>
<td>2–12 years: ½ bottle daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GoodSense Mineral Oil</td>
<td>OTC</td>
<td>Oral solution</td>
<td>15–45 mL daily</td>
<td>6–12 years: 5–15 mL daily</td>
</tr>
<tr>
<td><strong>Castor oil</strong></td>
<td>GoodSense Castor Oil</td>
<td>OTC</td>
<td>Oral liquid</td>
<td>15–60 mL daily</td>
<td>2–12 years: 5–15 mL daily</td>
</tr>
</tbody>
</table>

*Continued next page*
**MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract**

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stimulant Laxatives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senna (SEN a)</td>
<td>Ex-Lax, Senokot, Perdiem Overnight Relief, others</td>
<td>OTC</td>
<td>Tablets: 8.6–25 mg sennosides</td>
<td>2 tablets 1–2 times/day with water</td>
<td>6–12 years: 1 tablet 1–2 times/day with water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC</td>
<td>Granules: 15 mg/5 mL</td>
<td>1 tsp daily (max 2 tsp 2 times/day)</td>
<td>6–12 years: ½ tsp (max 1 tsp 2 times/day) 2–6 years: ¼ tsp (max ½ tsp 2 times/day)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC</td>
<td>Granules: 20 mg/5 mL</td>
<td>As a tea: ¼–½ cup daily</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC</td>
<td>Oral syrup: 8.8 mg/5 mL</td>
<td>2–3 tsp daily (max 3 tsp 2 times/day)</td>
<td>6–12 years: 1–1½ tsp daily (max 1½ tsp 2 times/day) 2–6 years: ½–¾ tsp daily (max ¾ tsp 2 times/day)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC</td>
<td>Oral concentrate (Fletcher’s Castoria)</td>
<td>Not intended for adults</td>
<td>6–15 years: 10–15 mL daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC</td>
<td>Oral drops: 8.8 mg/mL</td>
<td>Not intended for adults</td>
<td>2–5 years: 5–10 mL daily 6–12 years: 1–1.5 mL daily (max 1.5 mL 2 times/day) 2–6 years: 0.5–0.75 mL daily (max 0.75 mL 2 times/day)</td>
</tr>
<tr>
<td>Bisacodyl (bis AK oh dil)</td>
<td>Dulcolax, Ex-Lax Ultra, others</td>
<td>OTC</td>
<td>Tablets, enteric-coated: 5 mg</td>
<td>1–3 tablets daily</td>
<td>6–12 years: 1 tablet daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OTC</td>
<td>Rectal suppository: 10 mg</td>
<td>1 suppository daily</td>
<td>½ suppository daily</td>
</tr>
<tr>
<td><strong>Medications for Hemorrhoids</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocortisone (hye droe KOR ti sone)</td>
<td>Preparation H, others</td>
<td>OTC</td>
<td>Cream/suppository</td>
<td>Cream: apply sparingly up to twice daily  Suppository: insert 1 suppository rectally 2 times/day</td>
<td>None</td>
</tr>
<tr>
<td>Phenylephrine (fen il EF rin)</td>
<td>Preparation H</td>
<td>OTC</td>
<td>Gel/ointment/ suppository</td>
<td>Gel/ointment: apply up to 4 times daily  Suppository: insert 1 suppository rectally 2 times/day</td>
<td>None</td>
</tr>
</tbody>
</table>
### Medication Table 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract (Continued)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sulfasalazine</strong></td>
<td>Azulfidine</td>
<td>Rx</td>
<td>Tablets: 500 mg Enteral-coated tablets: 500 mg</td>
<td>Starting dose: 1–2 g in 2 divided doses Maintenance dose: 3–4 g in 2 divided doses</td>
<td>Starting dose: 40–60 mg/kg/day divided into 4 or fewer doses/day Maintenance dose: 30 mg/kg/day divided into 4 or fewer doses/day; do not exceed 2 g</td>
</tr>
<tr>
<td><strong>Mesalamine</strong></td>
<td>Apriso, Asacol, Canasa, Lialda, Pentasa, Rowasa</td>
<td>Rx</td>
<td>Rectal enema: 4 g/60 mL Extended-release tablets: 0.375 g, 800 mg Extended-release capsule: 250 mg, 500 mg Enteral-coated tablets: 400 mg Rectal suppository 1 g</td>
<td>Enema: 4 g once daily HS; Rectal suppository: 1 g daily Oral: 800–1.6 g TID or 2.4–4.8 g daily, depending on patient status and dosage form</td>
<td>Oral, 5 years and up: dose based on weight; not indicated for children &lt;5 Rectal: not labeled for pediatric use.</td>
</tr>
<tr>
<td><strong>Balsalazide</strong></td>
<td>Colazal</td>
<td>Rx</td>
<td>Capsule: 750 mg</td>
<td>Initial dose: 2,250 mg 3 times/day Maintenance dose: 1,500 mg 2 times/day</td>
<td>5 years and above: 2,250 mg 3 times/day initially; no maintenance dose for pediatrics</td>
</tr>
<tr>
<td><strong>Olsalazine</strong></td>
<td>Dipentum</td>
<td>Rx</td>
<td>Capsule: 250 mg</td>
<td>1.5 g in 2 or 3 doses daily</td>
<td>Dosing not established</td>
</tr>
<tr>
<td><strong>Immunomodulators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adalimumab</td>
<td>Humira</td>
<td>Rx</td>
<td>SUBQ solution: 20 mg/0.4 mL, 40 mg/0.8 mL</td>
<td>160 mg the first week, 80 mg the second week, then 40 mg every other week</td>
<td>No recommend dose for IBD</td>
</tr>
<tr>
<td>Azathioprine</td>
<td>Azasan, Imuran</td>
<td>Rx</td>
<td>Tablet: 50 mg, 75 mg, 100 mg</td>
<td>1.4–2.5 mg/kg/day; however, clear dose is unknown</td>
<td>Dosing not established</td>
</tr>
<tr>
<td>Certolizumab pegol</td>
<td>Cimzia</td>
<td>Rx</td>
<td>SUBQ solution: 200 mg/mL</td>
<td>400 mg every other week over 6 weeks, then 400 mg every 4 weeks</td>
<td>Dosing not established</td>
</tr>
</tbody>
</table>
MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract8 (Continued)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infliximab</td>
<td>Remicade</td>
<td>Rx</td>
<td>IV powder for solution:</td>
<td>5 mg/kg every 2 weeks × 3 doses, then 5 mg/kg every 8 weeks</td>
<td>For children 6 years and older: 5 mg/kg every 2 weeks × 3 doses, then 5 mg/kg every 8 weeks; no dose established for children younger than 6 years</td>
</tr>
<tr>
<td>(in FLIX i mab)</td>
<td></td>
<td></td>
<td>100 mg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercaptopurine (6-MP)</td>
<td>Purixan</td>
<td>Rx</td>
<td>Oral tablet</td>
<td>1.5–2.5 mg/kg daily</td>
<td>1–1.5 mg/kg/day</td>
</tr>
<tr>
<td>(mer kap toe PURE een)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natalizumab</td>
<td>Tysabri</td>
<td>Rx (limited access program)</td>
<td>IV solution: 20 mg/mL</td>
<td>300 mg every month IV</td>
<td>Dosing not established</td>
</tr>
<tr>
<td>(na ta LIZ you mab)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Irritable Bowel Syndrome**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alosetron (al OH se tron)</td>
<td>Lotronex</td>
<td>Rx</td>
<td>Tablet: 0.5 mg, 1 mg</td>
<td>Females only: 0.5 mg 2 times/day × 4 weeks, then 1 mg 2 times/day</td>
<td>Not recommended</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tegaserod (te GAS a rod)</td>
<td>Zelnorm</td>
<td>Rx</td>
<td>Tablet: 6 mg</td>
<td>Females &lt;55 years only: 6 mg 2 times/day up to 12 weeks</td>
<td>Not recommended</td>
</tr>
</tbody>
</table>

**Flatulence**

<table>
<thead>
<tr>
<th>Alpha-galactosidase-A (AL fa gal lak TOE si days)</th>
<th>Beano, Gas-X</th>
<th>OTC</th>
<th>Tablets and suspension</th>
<th>Use after meals containing beans</th>
<th>Use after meals containing beans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charcoal, activated available</td>
<td>Various brands</td>
<td>OTC</td>
<td>Capsules: 250 mg, 260 mg</td>
<td>520 mg after meals or with discomfort; NTE 4,160 mg</td>
<td>Not recommended in children</td>
</tr>
<tr>
<td>Simethicone (sye METH i kone)</td>
<td>Mylicon, Gas-X, Phazyme, others</td>
<td>OTC</td>
<td>Chewable tablets: 80 mg, 125 mg Capsule: 125 mg, 166 mg, 180 mg Suspension: 20 mg/0.3 mL, 40 mg/0.6 mL</td>
<td>40–360 mg PO 4 times/day and nightly; NTE 500 mg</td>
<td>&lt;2 years: 20 mg 4 times/day and nightly; NTE 240 mg 2–12 years: 40 mg 4 times/day and nightly; NTE 240 mg</td>
</tr>
</tbody>
</table>
MEDICATION TABLE 22-1. Representative Medications for Disorders of the Lower Gastrointestinal Tract® (Continued)

<table>
<thead>
<tr>
<th>Generic Name</th>
<th>Brand Name</th>
<th>Rx/OTC</th>
<th>Dosage Forms</th>
<th>Adult Dosages</th>
<th>Pediatric Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albendazole</td>
<td>Generics</td>
<td>Rx</td>
<td>Tablet: 200 mg</td>
<td>Angiostomiasis, necatoriasis, ascariasis: 400 mg × 1 dose</td>
<td>Angiostomiasis, necatoriasis, ascariasis: 400 mg × 1 dose</td>
</tr>
<tr>
<td>(al BEN da zole)</td>
<td></td>
<td></td>
<td></td>
<td>Echinococcosis, patients &gt;60 kg: 400 mg 2 times/day × 28 days, then 14 days off × 3 cycles</td>
<td>Echinococcosis, patients &gt;60 kg: 400 mg 2 times/day × 28 days, then 14 days off × 3 cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Echinococcosis, patients &lt;60 kg: 15 mg/kg/day in 2 doses; NTE 800 mg</td>
<td>Echinococcosis, patients &lt;60 kg: 15 mg/kg/day in 2 doses; NTE 800 mg</td>
</tr>
<tr>
<td></td>
<td>Emverm</td>
<td>Rx</td>
<td>Chewable tablets: 100 mg</td>
<td>Angiostomiasis, necatoriasis, ascariasis, trichuriasis: 100 mg 2 times/day × 3 days</td>
<td></td>
</tr>
<tr>
<td>(me BEN da zole)</td>
<td></td>
<td></td>
<td></td>
<td>Enteroheiosis: 100 mg × 1 dose</td>
<td>For patients &gt;2 years, the adult dose is used; no dose is recommended for patients &lt;2 years</td>
</tr>
</tbody>
</table>

GI = gastrointestinal; IBD = inflammatory bowel disease; IV = intravenous; NTE = not to exceed; OTC = over the counter; PO = by mouth; PRN = as needed; Rx = prescribed; SUBQ = subcutaneous.
**MEDICATION TABLE 22-2. Medication Classes That Cause Constipation (Examples of Drugs within Those Classes—Not All Inclusive)**

<table>
<thead>
<tr>
<th>Opioids</th>
<th>(morphine, naloxone, codeine, hydrocodone, oxycodone, propoxyphene/APAP, tramadol, fentanyl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticholinergics</td>
<td>(diphenhydramine or other antihistamines, atropine agents, neuroleptics, antiparkinsonian drugs, overactive bladder medications such as tolterodine, trospium, and tiotropium)</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>(monoamine oxidase (MAO) inhibitors: selegiline, amitriptyline)</td>
</tr>
<tr>
<td>Antipsychotics</td>
<td>(aripiprazole, clozapine, quetiapine, haloperidol)</td>
</tr>
<tr>
<td>Antacids</td>
<td>(aluminum, calcium carbonate)</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>(calcium channel blockers, diuretics, clonidine, hydralazine)</td>
</tr>
<tr>
<td></td>
<td>Calcium-channel blockers (diltiazem, verapamil, amlodipine, nicardipine)</td>
</tr>
<tr>
<td></td>
<td>Diuretics (furosemide, hydrochlorothiazide)</td>
</tr>
<tr>
<td>Ganglionic blockers</td>
<td>(mecamylamine)</td>
</tr>
<tr>
<td>Iron supplements</td>
<td>(slow Fe, iron sulfate)</td>
</tr>
<tr>
<td>Nonsteroidal anti-inflammatory drugs</td>
<td>(naproxen, ibuprofen, meloxicam)</td>
</tr>
<tr>
<td>Resins</td>
<td>(cholestyramine, polystyrene)</td>
</tr>
</tbody>
</table>