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Choosing the Right Antibiotic in Ambulatory Care

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ABSTRACT

The goal of this article is to be a quick guide for the nurse practitioner practicing in an ambulatory setting for making the right antibiotic choice for the right infection. With the use of a system-based approach, this article defines the most common infections seen in ambulatory care and their most common causative organisms and gives antibiotic options with respect to efficacy, common side effects, and cost. We provide recommendations for length of therapy and follow-up, as well.

Keywords: Bronchitis, candidiasis, cellulitis, cephalosporins, diarrhea, *Haemophilus*, macrolides, *Moraxella*, otitis media, penicillins, pharyngitis, pneumococcus, pneumonia, quinolones, sinusitis, *Staphylococcus*, *Streptococcus*

According to the Centers for Disease Control and Prevention's report "National Hospital Ambulatory Care Survey: 2004 Outpatient Department Summary,"¹ the number of patients seen by a mid-level provider, nurse practitioner, midwife, or physician assistant rose by 93% from 5.9% in 1993-1994 to 11.4% in 2003-2004. Furthermore, the treatment of infectious problems, especially respiratory ailments, in an ambulatory setting ranked third highest. Making the right decision on antibiotic usage likely falls to a nurse practitioner in the ambulatory care setting.¹

With the use of a system-based approach, this article defines the *most* common infections seen in ambulatory care and their most common causative organisms and gives antibiotic options with respect to efficacy, common side effects, and cost. We provide recommendations for length of therapy and follow-up, as well.

INTEGUMENTARY INFECTIONS

The integument system—the skin, the largest body organ system, and our most key natural defense system—comprises the dermis and the epidermis. The epidermis is

approximately 20- to 1400- μ m thick. The dermis, lying deeper to the epidermis, houses sweat glands, nerves, blood vessels, and lymphatics.

Diagnoses of skin infections, rashes, or both are made by history and examination, and at times a skin biopsy is needed. The medical history and the history of the injury will help in choosing what organisms might be involved or to what extent one or both of these structures are involved. Nurse practitioners can diagnose and manage most of these skin infections; however, in the case of necrotizing fasciitis this is a surgical emergency and requires immediate referral and hospitalization. The following clinical entities most commonly seen in outpatient care are described: cellulitis, impetigo, folliculitis, furuncles and carbuncles, necrotizing fasciitis, paronychia, onychomycoses, lice, scabies, and Lyme disease.

Cellulitis

Definition. An acute inflammatory *spreading* response of the skin characterized by superficial swelling, pain, erythema, and warmth that often extends in the subcutaneous tissues.²

Diagnosis. Rapidly spreading cellulitis, evidence of systemic response, or association with asplenia, neutropenia, cardiac or renal failure, cirrhosis, preexisting edema, or immunodeficiencies are indications for admission and treatment with an intravenous antibiotic (cefazolin or vancomycin for patients allergic to penicillin). In a diabetic host, a clinician should consider broader coverage to include gram-negative and anaerobe coverage that includes an intravenous (carbapenem, meropenem, or imipenem-cilastatin) and a penicillinase-penicillin such as ampicillin-sulbactam.

Differential diagnosis.

- Contact dermatitis: intense pruritus and a history of an exposure help to differentiate this usually erythematous rash that can spread from the point of exposure.
- Erysipelas: superficial, red, and tender, “St. Anthony’s fire” rash with well-demarcated edges caused mostly by group A β -hemolytic streptococci.
- Panniculitis: defined as an inflammation of the adipose layer of the skin and can be septate or lobular and includes such entities as erythema nodosum (multiple, scattered erythematous lesions that are painful), erythematous nodules of idiopathic or

varied cause such as infection, drug reaction, sarcoidosis, ulcerative colitis.

- Sweet’s syndrome or acute febrile dermatosis.
- Insect bites or stings: the history, pruritus, and lack of response to antimicrobials may help to distinguish this from cellulitis.
- Kerions of the scalp because of tinea capitis can appear erythematous, indurated, and painful but is caused by a fungus instead of bacteria so will not respond to antibiotics, and cultures from drainage will be negative for bacteria but may be positive on the wet mount.
- Folliculitis: see discussion below.
- Superficial thrombophlebitis and deep vein thrombosis (DVT): a tender cord and a history of venous catheter will help with the differential for superficial thrombophlebitis. Engorgement of superficial veins in the extremity of a DVT and a history of risk factors toward a DVT and a lower-extremity ultrasound scan will help to differentiate this from cellulitis.²

Cause. Usually trauma related. Most common sites are legs and digits; rarely seen are the face, hands, torso, neck, and buttocks.³

Common bacterial organisms. Gram-positive organisms: *Streptococcus pyogenes*, *Staphylococcus aureus*. If saltwater or brackish water injuries lead to cellulitis, consider *Vibrio vulnificus*.

Treatment. Heat and elevation of an extremity; support hose for patients with chronic edema, analgesics (acetaminophen or ibuprofen), and antibiotics.

Antibiotics. Duration is *typically* 10 to 14 days.

- β -Lactamase-resistant penicillin. Augmentin: adult, 875 mg orally every 12 hours; pediatric, 30 to 40 mg/kg divided every 12 hours.
- First-generation cephalosporin. Keflex: adult, 250 mg every 6 hours or 500 mg every 12 hours; pediatric, 25 to 50 mg/kg per day in divided doses every 6 hours.
- Azithromycin (Zithromax): adult, 500 mg day 1 and 250 mg days 2 to 5, may increase to 10 days depending on host and extent of disease; pediatric, 10 mg/kg day 1, followed by 5 mg/kg days 2 to 5.
- Fluoroquinolones. Levofloxacin: adult, 500 mg orally every day; pediatric use is not approved for those aged younger than 18 years.

Treatment for *Vibrio*. Doxycycline 100 mg twice daily for 10 days or ceftazidime 2000 mg every 8 hours for 5 days.

Follow-up. Follow-up is immediate for change in rash or pain; otherwise, it is in 3 to 5 days to ensure adequacy of treatment.

Animal or human bites

Causative organism. Animal bites are usually caused by *Pasteurella multocida*, *S aureus*, and *Bacteroides tectus*. Human bites are often polymicrobial, including *Streptococci viridans*, *S aureus*, *Eikenella corrodens*, and *Bacteroides*.

Treatment. Cleanse the wounds with copious amounts of sterile saline and debride as necessary and depends on the nature and extent of the injury. If the wound is limited and the patient is otherwise healthy, outpatient antibiotic therapy is appropriate.⁴

Antibiotics for animal bites.

- Augmentin: adult, 875 mg orally every 12 hours for 10 days; pediatric, 30 to 40 mg/kg divided every 12 hours for 10 days.
- Bactrim: adult, 1 double strength (DS) (160 mg/800 mg) twice a day for 10 days; pediatric, 5 to 8 mg/kg per day as trimethoprim (TMP) every 12 hours for 10 days.
- Allergy to penicillin. Ciprofloxacin: adult, 500 mg orally twice a day for 7 to 10 days; pediatric, 20 to 30 mg/kg per day orally divided every 12 hours (max, 1.5 g/day) for 7 to 10 days.
- Clindamycin: adult, 150 to 450 mg orally every 6 hours for 10 to 14 days; pediatric, 8 to 20 mg/kg per day orally divided every 6 to 8 hours for 10 to 14 days.

Antibiotics for human bites. A human bite that occurred through a closed fist injury is quite serious and requires intravenous antibiotics.⁴ For less complicated injuries treatment can include the following:

- Augmentin: adult, 875 mg orally every 12 hours for 10 days; pediatric, 30 to 40 mg/kg divided every 12 hours for 10 days.
- Bactrim: adult, 1 DS (160 mg/800 mg) twice a day for 10 days; pediatric, 5 to 8 mg/kg per day as TMP every 12 hrs for 10 days.
- Allergy to penicillin. Ciprofloxacin: adult, 500 mg orally twice a day for 7 to 10 days; pediatric: 20 to 30 mg/kg per day orally divided every 12 hours (max, 1.5 g/day) for 7 to 10 days.

- Clindamycin: adult, 150 to 450 mg orally every 6 hours for 10 to 14 days; pediatric, 8 to 20 mg/kg per day orally divided every 6 to 8 hours for 10 to 14 days.
- Intravenous ampicillin-sulbactam or ceftoxitin.

Impetigo

Definition. A primarily pediatric entity, this superficial infection of the corneal layer of the dermis presents as a unilocular, vesicular rash that often erupts, leaving a serous drainage that is golden yellow and crusting. Occurs mostly on the face or cheek and chin and is usually associated with trauma but can be a secondary infection from a herpetic lesion or angular cheilitis. It can be bullous or nonbullous and is highly infectious, often in families and institutional childcare settings.

Differential diagnosis.

- Varicella: crusts of varicella are darker and harder.
- Herpes simplex: fluid is more turbid and lacks the golden yellow hue.
- Acute palmar pustulosis: palms and soles are more commonly affected and are sterile and self-limited associated with pharyngitis.

Causative organisms. *S aureus*, gram-positive organism commonly found in the environment.

Treatment. Hand washing, topical Bactroban, and systemic antibiotics.

- Azithromycin: adult, 500 mg day 1 and 250 mg days 2 to 5; pediatric, 10 mg/kg day 1, followed by 5 mg/kg days 2 to 5.
- β -Lactamase—resistant penicillin. Augmentin: adult, 875 mg orally every 12 hours; pediatric, 30 to 40 mg/kg divided every 12 hours.
- First-generation cephalosporin. Keflex: adult, 250 mg every 6 hours or 500 mg every 12 hours; pediatric, 25 to 50 mg/kg per day in divided doses every 6 hours.

Follow-up. Follow-up is immediate for a change in the rash or for new or changing systemic symptoms; otherwise, it is as needed.

Folliculitis

Definition. Folliculitis is a localized infection of the hair shafts after injury, inflammation, or irritation. It occurs in skin-bearing areas and is often self-limited but may become extensive and lead to a visit for evalu-

ation. Diagnosis is made by physical examination, because lesions often are pustular with a hair follicle in the center.

Most common causative organism. *S aureus*.

Treatment. Folliculitis usually resolves spontaneously; however, in significant cases or in immune-compromised or diabetic patients, you may want to treat with topical agents and watch closely.

- Topical therapy with cleansing with Hibiclens or antibacterial soap, application of topical anti-infective agent such as benzoyl peroxide. If needed, you can use an application of topical erythromycin, clindamycin as Cleocin, mupirocin, or Bactroban.

Follow-up. If there is a change in the rash or development of systemic symptoms, follow-up is immediate; otherwise, it is as needed.

Furuncles and carbuncles

Definition. Folliculitis that extends beyond the hair follicle creates a furuncle, a walled off mass with pustular material inside. Multiple furuncles that coalesce into a large mass is a carbuncle. A carbuncle will drain through multiple sinus tracts.⁵

Most common causative organisms. *S aureus*.

Treatment. Incision and drainage are usual in an otherwise healthy host and addition of a systemic antibiotic. Any evidence of associated cellulitis with an ill-appearing patient or one who has an immune defect, diabetes, cirrhosis, chronic steroid use, burns, or obesity should lead to a high index of suspicion toward a necrotizing fasciitis.

Antibiotics.

- First-generation cephalosporin. Keflex: adult, 250 mg every 6 hours or 500 mg every 12 hours; pediatric, 25 to 50 mg/kg per day in divided doses every 6 hours.
- Augmentin: adult, 875 mg orally every 12 hours; pediatric, 30 to 40 mg/kg divided every 12 hours.

Follow-up. If change in rash or development of systemic symptoms, the follow-up is immediate; otherwise, it is 3 to 5 days for a compromised host or as needed in a healthy host.

Necrotizing fasciitis

Definition and cause. This surgical emergency is described as a necrosis of the fascia and the subcutaneous tissue. It may occur from an injury to the skin or from a preexisting skin rash, but in most cases it has no identifiable cause.⁶ Evidence suggests that predisposing

factors, such as age older than 50 years, diabetes, cirrhosis, immunosuppression, chronic renal failure, or cardiac disease, may attribute to developing necrotizing fasciitis.

Diagnosis. It can occur on any part of the body, but the perineum, extremities, and truncal areas are most involved. Presenting symptoms are swelling that may evolve into tense erythema that may progress to a dusky blue and pain out of proportion to what is visible. Palpable crepitus from air formation and soft tissue air on X-ray is also pathognomonic but not always present. Local symptoms may be accompanied by systemic symptoms of sepsis and shock.

Common bacterial organisms. Usually the cause is polymicrobial with both anaerobic and aerobic gram-positive and gram-negative organisms to include *Vibrio*, group A and B streptococci, enterococci, staphylococci, *Escherichia coli*, *Pseudomonas*, *Proteus*, *Serratia*, *Clostridium*, and rarely fungal organisms, including *Aspergillus*, *Zygomycetes*, and *Candida*.

Treatment. Treatment is immediate referral for surgical debridement and hospitalization for intravenous antibiotics and supportive treatment for sepsis.

Scabies

Definition and cause. Scabies is a highly contagious dermatosis caused by a mite, *Sarcoptes scabiei*.

Diagnosis and differential diagnosis. Common diagnoses include atopic dermatitis, dyshidrotic eczema, urticaria, pityriasis rosea, impetigo, and contact dermatitis. Symptoms are intense pruritus caused by the immune response of the mites' excretions and their burrowing in the skin. The pathognomonic sign is the burrow of the scabies that can be linear, curved, or S-shaped and pink-white to gray colored in appearance. Lesions are often in web spaces of fingers and wrists, in extensor surfaces of the elbows and knees, sides of hands and feet, axillary areas, buttocks, and waistline. Skin scraping to look for mites and eggs using mineral oil on a glass slide under microscopy is helpful, but without a positive finding it is not conclusive.

Treatment. All household members and close contacts should be treated whether they are symptomatic.

- Permethrin (Elmite or Acticin) cream 1% is applied from head to toe and everywhere in between for an 8- to 14-hour period and then washed off. This treatment should be reapplied in 1 week. All household bedding should be washed in hot water

and dried on a hot cycle or dry cleaned. Once cleaned all bedding should not be used for 72 hours.

Follow-up. If there is a change in rash or development of systemic symptoms, the follow-up is immediate; otherwise, it is 3 to 5 days for a compromised host or as needed in a healthy host.

Pediculosis (lice)

Definition and cause. Infestation of the hairy parts of the body with 2 of the 560 species of arthropods that suck blood and feed on mammals.⁷ *Pediculus humanus* and *Phthirus pubis* are those 2 species that cause human lice.

Diagnosis. Clinical observation of nits or lice.

Treatment.

- Malathion (Ovide) available by prescription is the most effective treatment, and no evidence shows development of resistance to this product to date, whereas resistance to permethrin or Nix has been shown. Use 1 of these 3 products on *dry* hair (as lice can hold their breath under water for 8 to 12 hours) for 30 minutes and follow by combing the hair with a fine-tooth comb to remove the nits. Use of wet-combing or use of petroleum, mayonnaise, and pomades is alternative to insecticides to kill lice but must be reapplied every 4 weeks until all nits hatch and can be removed.

Follow-up. Most schools will exclude children with lice, so letters may need to be written to explain when children can return, usually after the first treatment despite the presence of nits.

Paronychia

Definition. Infection of the skin bordering the nail. The infection will lead to swelling, erythema, and pain.

Paronychia can be acute or chronic.

Cause. Acute paronychia is most readily caused by nail biting, nail trauma, and thumb sucking, whereas chronic paronychia is caused by chronic exposure to water or irritants.

Causative bacterial organisms. Acute paronychia is caused by *S aureus*, streptococci, *Pseudomonas*, and anaerobes; chronic paronychia is caused by atypical mycobacteria, *Candida*, and gram-negative rods.

Treatment. Acute paronychia: warm soaks, incision, and drainage as needed, and antibiotics. Chronic paronychia: avoidance of overexposure to water or irri-

tants by wearing rubber gloves, emollients, topical steroids, soaks in acetic acid, or occasional oral antibiotics used for acute paronychia or referral to a dermatologist or surgeon for chronic paronychia for nail removal or eponychial marsupialization.⁸

- Antibiotics for acute paronychia. Augmentin: adult, 875 mg orally every 12 hours; pediatric, 30 to 40 mg/kg divided every 12 hours.
- Clindamycin: adult, 150 to 450 mg orally four times a day; pediatric, 8 to 20 mg/kg per day orally divided three times a day or four times a day.

Follow-up. If change in rash or development of systemic symptoms, follow-up is immediate; otherwise, it is as needed.

Onychomycosis

Definition. Fungal infection in the nail beds, nail matrix, or plate.⁹ Although mostly a cosmetic problem, mobility can be affected, indirectly adding to morbidity of persons with diabetes and venous stasis.

Causative bacterial organisms. *Trichophyton rubrum* and *Trichophyton mentagrophytes*

Differential diagnosis. Psoriasis, lichen planus, contact dermatitis, trauma, nail bed trauma, yellow nail syndrome.

Treatment.

- Fluconazole: one 150 mg tablet each week for 9 months.
- Itraconazole: 200 mg/day for 12 weeks for toenails and 200 mg/day for 6 weeks for fingernails, or pulse dosing of 400 mg/day for first week of the month for 2 to 3 pulses for fingernails and 3 to 4 pulses for toenails.
- Terbinafine: 250 mg/day for 12 weeks for toenails and 10 weeks for fingernails.

Follow-up. Special note: These drugs all have significant drug interactions in that they induce the cytochrome P-450 enzymes, changing the metabolism of many concomitant drugs. Laboratory evaluation of liver enzymes is warranted at baseline and then at 6 weeks for terbinafine.

Lyme disease

Definition. Multisystem inflammatory disease caused by an infection, which is spread by a tick bite.

Causative organisms. Spirochete *Borrelia burgdorferi*.

Diagnosis and differential diagnosis. The diagnosis of Lyme disease is often made clinically and occasionally

supported by appropriate laboratory testing (serum antibodies to *B burgdorferi*). Lyme disease has been described using 3 phases of infection.

- Early localized disease: erythema migrans (EM), often called a bull's-eye rash and associated symptoms
- Early disseminated disease: multiple EM and associated symptoms, Lyme carditis, neurologic features, including facial palsies, lymphocytic meningitis, and radiculoneuropathies
- Late disease: neurologic features, including peripheral neuropathies, chronic encephalopathies, arthritis, and migratory polyarthritis or monoarthritis (Sigal)

The transmission of disease from tick to human can take place only after the tick has been attached to the host for 24 to 48 hours and has had at least one blood meal. This is important to know because many patients will want antibiotic treatment after finding a tick. There are several different approaches to treatment. Empiric antibiotic prophylaxis is not recommended for patients who are not symptomatic. Persons who develop a skin lesion or other illness within 1 month after removing a tick should be instructed to seek medical attention to rule out any tick-borne diseases (Lyme disease, Rocky Mountain spotted fever, ehrlichiosis, tularemia, babesiosis, or Colorado tick fever). Lyme disease is the most common and is endemic to the Mid-North Atlantic states and in areas of the Great Lakes.

The Infectious Diseases Society of America has published guidelines to assist clinicians in the decisions about the treatment of patients diagnosed with possible Lyme disease. One option is to treat with antimicrobials only if the person is at risk because of a prolonged attachment. Another option is to treat only if the person develops or presents with EM or other systemic symptoms. All persons who exhibit late disease symptoms, seroconvert from negative to positive (serum antibodies to *B burgdorferi*), or both should be treated with a full 21-day course of antibiotics and receive follow-up evaluations.

Treatment. Antibiotics for early disease include

- Amoxicillin: adult, 500 mg orally every 8 hours for 14 to 21 days; pediatric, 25 to 50 mg/kg per day divided every 8 hours for 14 to 21 days.
- Doxycycline: adult, 100 mg orally twice daily for 14 to 21 days; pediatric (<45 kg), 2.2 mg/kg every 12 hours for 14 to 21 days.
- Nonanaphylaxis/urticaria reactions to penicillin. Cefuroxime axetil: adult, 500 mg every 8 hours for

14 to 21 days; pediatric, 30 mg/kg per day divided every 12 hours for 14 to 21 days.

- Allergy to penicillin. Erythromycin: adult, 250 mg orally every 6 to 8 hours for 14 to 21 days; pediatric, 30 to 50 mg/kg per day orally in equally divided doses for 14 to 21 days.

Patients with late disease symptoms need intravenous antibiotics.⁹⁻¹⁵

RESPIRATORY INFECTIONS

The respiratory system infections discussed herein include upper and lower respiratory tract infections, including otitis media, pharyngitis, sinusitis, bronchitis, and pneumonia. Most of these infections are usually viral in nature; however, they often become secondarily infected with a bacterial organism. We strongly recommend culture verification (as feasible) to determine organism and resistance patterns to guide antibiotic choices and changes but understand that empiric regimens must be started at the time of visit, and it is in that frame we make recommendations for empiric antibiotics regimens.

Acute otitis media (AOM)

Definition. Inflammation or infection and fluid in the middle ear accompanied by acute signs and symptoms of illness.

Causative bacterial organisms. Most common are *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*.

Diagnosis and differential diagnosis. A large percentage of AOM is caused by viruses (respiratory syncytial virus [RSV], rhinovirus, influenza virus, and adenovirus). Because of this, one treatment option recommended by the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP) is an observation period of 48 to 72 hours and limiting treatment to only symptomatic relief. Symptomatic relief may consist of pain management and antihistamines or decongestants. This decision should be based on the child's age (must be older than 6 months), severity of illness, and diagnostic certainty. A clinician should confirm a history of acute onset, identify signs of middle ear effusion, and evaluate for the presence of signs and symptoms of middle ear inflammation.

Treatment. Analgesics, antihistamines, decongestants, and antibiotics.

- If antibiotic therapy is chosen, the recommendations are Amoxicillin: adult, 500 to 875 mg orally every 12 hours for 10 days; pediatric, high dose 80 to 90 mg/kg day every 12 hours for 10 days to eradicate resistant *S pneumoniae* or 25 to 50 mg/kg per day divided every 8 to 12 hours for 10 days.
- Augmentin: adult, 500 to 875 mg orally every 12 hours for 10 days; pediatric (<40 kg), 90 mg/kg per day divided in 2 doses every 12 hours, or pediatric (>40 kg), 500 to 875 mg orally every 12 hours.
- Allergy to penicillin. Azithromycin: adult (1-, 3-, and 5-day options available) (5-day regimen), 500 mg once daily for 1 day, then 250 mg orally for 4 days; pediatric, 10 mg/kg per day for 1 day, then 5 mg/kg per day for 4 days.
- Nonanaphylaxis/urticaria reactions to penicillin. Cefuroxime: adult, 500 mg every 12 hours for 10 days; pediatric, 30 mg/kg per day divided every 12 hours for 10 days.

Follow-up. If the observation period option is used and the patient's condition worsens in the first 24 to 48 hours, the clinician should start antibiotics.^{10,16-19}

Pharyngitis

Definition. Inflammation and infection of the oropharynx, nasopharynx, or both.

Causative bacterial organisms. Group A *Streptococcus* (GAS), *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, *Neisseria gonorrhoeae*, and *Corynebacterium diphtheriae*.

Diagnosis and differential diagnosis. Most cases of pharyngitis are caused by viruses (influenza virus, parainfluenza virus, coronavirus, rhinovirus, adenovirus, enterovirus, herpes simplex virus, Epstein-Barr virus, and HIV). GAS is the most common bacterial cause and requires treatment with antibiotics; therefore, the main objective in evaluating a patient in the primary care setting is to identify, rule out, and treat GAS. Many clinicians use the "Centor Criteria," which include fever, tonsillar exudate, tender anterior cervical lymphadenopathy, and absence of cough. All adult patients with pharyngitis should be clinically screened using these criteria. Patients with none or one of these criteria should not be cultured or treated with antibiotics. Patients with 2 or more of these criteria should have their throat cultured for GAS, and antibiotics should be reserved for those with positive results. Patients with 3 or 4 of these criteria should be treated with antibiotics without the need for throat culture results.

Treatment. Analgesics, antipyretics, and antibiotics are used. When antibiotics are decided on, the recommendations are

- Penicillin VK: adult, 125 to 250 mg orally every 6 to 8 hours for 10 days; pediatric (<12 years), 25 to 50 mg/kg per day divided every 6 to 8 hrs (max, 3 g/day) for 10 days, or pediatric (>12 years), use adult dosing.
- Amoxicillin: adult, 500 to 875 mg orally every 12 hours for 10 days; pediatric, 25 to 45 mg/kg per day in divided doses every 12 hours for 10 days.
- Augmentin: adult, 500 to 875 mg orally every 12 hours for 10 days; pediatric (<40 kg), 90 mg/kg per day divided in 2 doses every 12 hours, or pediatric (>40 kg), 500 to 875 mg orally every 12 hours.
- Allergy to penicillin allergy. Azithromycin: adult (5-day regimen), 500 mg once daily for 1 day, then 250 mg orally for 4 days; pediatric, 10 mg/kg per day for 1 day, then 5 mg/kg per day for 4 days.

Follow-up. No follow-up is needed unless symptoms do not resolve; immediate follow-up is needed if the patient develops worsening complaints.^{10,19-21}

Acute bacterial sinusitis (ABS)

Definition. Inflammation and infection of the mucosal lining of one or more of the paranasal sinuses.

Causative bacterial organisms. *S pneumoniae*, *H influenzae*, *M catarrhalis*

Diagnosis and differential diagnosis. Sinusitis can be caused by or precipitated by several viruses (rhinovirus, parainfluenza, and influenza), allergic rhinitis, or nasal foreign bodies. The diagnosis of ABS is based on clinical criteria in patients who present with upper respiratory symptoms that are persistent, severe, or worsening after an initial viral upper respiratory infection (URI). The clinical criteria used to make the diagnosis of ABS in patients that have recently had a viral URI or allergic rhinitis event are new maxillary sinus pain, purulent nasal drainage, postnasal discharge, and cough. It is the general agreement that radiographs are not necessary for the diagnosis of sinusitis in children 6 years old and younger, and the American College of Radiology has taken the position that the diagnosis should be made on clinical grounds alone for all ages.

Treatment. Analgesics, decongestants, and antibiotics are used. Antibiotic recommendations include

- Amoxicillin: adult, 500 to 875 mg orally every 12 hours for 10 to 14 days; pediatric: high dose 80 to 90 mg/kg per day every 12 hours for 10 to 14 days to eradicate resistant *S pneumoniae* or 25 to 50 mg/kg per day divided every 8 to 12 hours for 10 days.
- Augmentin: adult, 500 to 875 mg orally every 12 hours for 10 to 14 days; pediatric (<40 kg), 90 mg/kg day divided in 2 doses every 12 hours, or pediatric (>40 kg), 500 to 875 mg orally every 12 hours for 10 to 14 days.
- Allergy to penicillin. Azithromycin: adult (5-day regimen), 500 mg once daily for 1 day, then 250 mg orally for 4 days; pediatric, 10 mg/kg per day for 1 day, then 5 mg/kg per day for 4 days.
- Nonanaphylaxis/urticaria reactions to penicillin. Cefuroxime: adult, 500 mg every 12 hours for 10 days; pediatric, 30 mg/kg per day divided every 12 hours for 10 days.
- Bactrim: adult, 1 DS (160 mg/800 mg) twice a day for 10 to 14 days; pediatric, 5 to 8 mg/kg per day as TMP every 12 hours for 10 days.
- Clindamycin: adult, 150 to 450 mg orally every 6 hours for 10 to 14 days; pediatric, 8 to 20 mg/kg per day orally divided every 6 to 8 hours for 10 to 14 days.
- Treatment failure. Levofloxacin: 500 mg orally once daily for 10 to 14 days or 750 mg orally once daily for 5 days. Not recommended for pediatric patients.

Follow-up. No follow-up is needed unless symptoms do not resolve; follow-up is immediate if the patient develops worsening complaints.^{10,22-24}

Acute bronchitis

Definition. Characterized by inflammation of the bronchi causing cough, usually with sputum production, and evidence of concurrent upper airway infection.

Causative bacterial organisms. *M pneumoniae*, *C pneumoniae*, and *Bordetella pertussis*. It is suspected that the bacterial pathogens that cause pneumonia can also cause acute bronchitis (*S pneumoniae*, *H influenzae*, *S aureus*, group A *Streptococcus*, *M catarrhalis*, anaerobes, and aerobic gram-negative bacteria), but no evidence is convincing to support this concept of “acute bacterial bronchitis.”

Diagnosis and differential diagnosis. The usual causes of acute bronchitis are viral infections that affect the upper airways (influenza A and B virus; parainfluenza type 1, 2, and 3; coronavirus; rhinovirus; RSV; and human meta-

pneumovirus). Cough is the most common symptom. Fever is relatively unusual. A chest X-ray can distinguish pneumonia from bronchitis. Patients that complain of a chronic cough, defined as lasting for longer than 3 weeks, can include noninfectious entities such as postnasal drip, asthma, and gastroesophageal reflux. The indications for a chest X-ray in patients with an acute cough to rule out pneumonia are patients with abnormal vital signs (increased respiratory rate, difficulty in respiratory effort, stridor or tachypnea, and oxygen saturations below 92%) or crackles on chest examination. The main treatment issue in cases of acute bronchitis is the use of antibiotics. Multiple studies indicate that patients with acute bronchitis do not benefit from antibiotics because bacteria are not usually responsible.

Treatment. Analgesics, decongestants, antipyretics, antitussives, vaporizers, β -agonist inhalers, and antibiotics. Antibiotics for suspected or proven *M pneumoniae*, *C pneumoniae*, or *B pertussis* include

- Azithromycin: adult (5-day regimen), 500 mg once daily for 1 day, then 250 mg orally for 4 days; pediatric, 10 mg/kg per day for 1 day, then 5 mg/kg per day for 4 days.
- Doxycycline: adult, 100 mg orally twice daily for 10 to 14 days; pediatric (<45 kg), 2.2 mg/kg every 12 hours for 10 to 14 days.
- Levofloxacin: 500 mg orally once daily for 10 to 14 days; not recommended for pediatric patients,

Follow-up. No follow-up is necessary unless symptoms do not resolve; immediate follow-up is needed if the patient develops worsening complaints.^{10,23-26}

Community-acquired pneumonia (CAP)

Definition. Acute infection of the lung parenchyma in a patient that has acquired the infection in the community rather than the hospital setting.

Causative bacterial organisms. Typical organisms are *S pneumoniae*, *H influenzae*, *S aureus*, GAS, *M catarrhalis*, anaerobes, and aerobic gram-negative bacteria. Atypical organisms include *C pneumoniae*, *Legionella*, *M pneumoniae*.

Diagnosis and differential diagnosis. Viruses such as influenza, RSV, parainfluenza virus, rhinovirus, adenovirus, varicella, and severe acute respiratory syndrome (SARS) are estimated to be the cause in up to 31% in adult patients with CAP, and, in young children, viruses are the most common cause. The diagnosis of CAP is based on the following clinical criteria: acute symptoms

associated with infection of the lower respiratory tract (fever, cough, tachypnea), presence of acute lung infiltrate on chest X-ray, auscultatory findings consistent with pneumonia, and lack of hospitalization or residence in a long-term facility in the past 2 weeks before infection.

Choosing between inpatient and outpatient treatment is a crucial decision that will influence the medication choice. Clinicians should use clinical judgment and mortality prediction tools (ATS, Infectious Disease Society of America [IDSA], or both) to determine whether a patient should be hospitalized or is able to receive outpatient therapy safely with scheduled follow-up care (need follow-up chest X-ray in 4 to 6 weeks). Hospitalization should depend on patient age, presence of comorbidities, and severity of presenting disease.

Treatment. Analgesics, antipyretics, inhalers, antibiotics, and prevention with immunizations (adult: pneumococcal vaccine and yearly influenza vaccine) are used. Pneumonia is a known complication of rubeola, varicella, pertussis, and *H influenzae* type B (HIB), which are all part of routine childhood vaccinations.

Antibiotics for outpatient treatment include

- Azithromycin: adult (5-day regimen), 500 mg once daily for 1 day, then 250 mg orally for 4 days; pediatric, 10 mg/kg per day for 1 day, then 5 mg/kg per day for 4 days.
- Erythromycin: adult, 250 mg orally every 6 to 8 hours for 10 to 14 days; pediatric, 30 to 50 mg/kg per day orally in equally divided doses for 10 to 14 days.
- Doxycycline: adult, 100 mg orally twice daily for 10 to 14 days; pediatric (<45 kg), 2.2 mg/kg every 12 hours for 10 to 14 days.
- Augmentin: adult, 500 to 875 mg orally every 12 hours for 10 to 14 days; pediatric (<40 kg), 90 mg/kg per day divided in two doses every 12 hours, or pediatric (>40 kg), 500 to 875 mg orally every 12 hours for 10 to 14 days.
- Nonanaphylaxis/urticaria reactions to penicillin. Cefuroxime: adult, 500 mg every 12 hours for 10 days; pediatric, 30 mg/kg per day divided every 12 hours for 10 days.
- Treatment failure. Levofloxacin: 500 mg orally once daily for 10 to 14 days. Not recommended for pediatric patients.

Follow-up. Obtain a follow-up chest X-ray in 4 to 6 weeks.^{10,27-30}

GENITOURINARY INFECTIONS

This section discusses infections of the genitourinary tract, including vaginitis, cervicitis, cystitis, and epididymitis with specific reference to the diagnosis and management of sexually transmitted diseases (STDs).

Cystitis (uncomplicated)

Definition. Bladder infection is usually caused by bacteria that ascend from the urethra, often with presenting symptoms of dysuria, pyuria, bacteriuria, urinary frequency, and urgency often associated with suprapubic tenderness.

Differential diagnosis. Urethritis is defined as a lower urinary tract infection of the urethra; symptoms can encompass those of cystitis but may include discharge, burning on urination. Pyelonephritis is defined as infection of the kidney(s) with symptoms of cystitis, flank pain, and fever.

Common causative bacterial organisms. *E coli*, *Proteus mirabilis*, *Pseudomonas* species, *Klebsiella pneumoniae*, *Enterobacter* species, *Candida* species.

Treatment. Increased fluid intake, cranberry juice, and antibiotics. For uncomplicated cystitis, defined as episodes occurring in healthy nonpregnant females with functionally and anatomically normal urinary tract, antibiotics include³¹

- TMP-SMX (sulfamethoxazole) (Bactrim-Septra): adult, 1 DS (800/160) tablet every 12 hours for 3 days.
- For sulfa allergy. TMP: 100 mg every 12 hours for 3 days.
- Ciprofloxacin 500 mg every 12 hours for 3 days or ciprofloxacin 500 mg extended release (ER) daily for 3 days.

Follow-up. No follow-up is needed unless symptoms do not resolve; immediate follow-up is needed if the patient's complaints worsen.

Special situations. Pediatric: neonates, uncircumcised boys, and children with functionally or anatomically abnormal urinary tracts are susceptible to urinary tract infections. Their presentations are remarkably different from adults. Young children aged 2 to 5 years may have abdominal complaints with nausea and vomiting and fever.³² Infants may present with poor feeding, fever, irritability, and malodorous urine.³² After age 5, typical symptoms will present. Be suspicious of an STD in a sexually active man. Rule out a functional or anatomic urinary tract defect.

Treatment.

- Amoxicillin: 20 to 40 mg/kg per day divided every 8 hours.
- TMP-SMX (Bactrim): 8 mg/kg per day as trimethoprim divided every 6 hours.³²

Vaginitis or cervicitis

Definition. Vaginal discharge with vulvar itching and irritation.

Diagnosis and differential diagnosis. Diagnosis is made on clinical history and physical examination of the vagina and its secretions. Testing of vaginal secretions for pH and with potassium hydroxide for amine testing for bacterial vaginosis and presence of pseudohyphae for *Candida* and motile protozoa for *Trichomonas*. Cervicitis may be asymptomatic or present with abdominal pain, dyspareunia, and abnormal menstrual bleeding. The pelvic examination will reveal mucopurulent exudates in the endocervical canal and a friable cervix when touched by a cotton swab.³³ Causative organisms, treatments, and special situations are given in [Table 1](#).

Epididymitis

Definition. Painful scrotal swelling that is often unilateral and can be associated with trauma, urinary tract infection, and STDs. Acute bacterial epididymitis is rare and is often accompanied by prostatitis.³⁴

Differential diagnosis. Testicular torsion, appendiceal torsion. STDs are of high suspicion in patients with penile discharge and strong history of unprotected sexual exposure.³⁵

Common bacterial organisms. *Pseudomonas* and streptococci, organisms that are common if STD is suspected, *N gonorrhoeae* and *Chlamydia trachomatis*.³⁴

Treatment. Antibiotics. Rule out urinary tract functional or anatomic abnormality and STDs.

- Ciprofloxacin: 500 mg orally every 12 hours for 10 days.
- Levofloxacin: 500 mg orally daily for 10 days.
- Sexually transmitted diseases. Ceftriaxone: 250 mg intramuscularly; doxycycline: 100 mg orally every 12 hours for 10 days.

GASTROINTESTINAL INFECTIONS

Diarrhea is discussed in this section, because it is likely to be the most encountered chief complaint in regard to the gastrointestinal system. Diarrhea's cause is first and foremost

viral; however, we will present in this section all the common bacterial pathogens and their treatment. Of note, we recognize that many pathologic entities still are not mentioned here, such as acute appendicitis, pancreatitis, or cholecystitis, whose causes could be infectious and are likely to be seen in an ambulatory care setting. However, because most of these entities are very likely to result in a hospital admission, we elected not to discuss them.

Acute diarrhea

Definition. Increased frequency of defecation (3 or more times per day or at least 200 g stool per day) lasting less than 14 days.

Causative bacterial organisms. Most common are *Salmonella*, *Shigella*, *Campylobacter*, pathogenic *E coli* (traveler's diarrhea), and *Clostridium difficile*. Less common are *Vibrio cholerae*, *Yersinia enterocolitica*, and *Listeria monocytogenes*. *Helicobacter pylori* is a common gastrointestinal pathogenic bacteria but will not be discussed because more often it is a chronic infection.

Diagnosis and differential diagnosis. The main causes of acute infectious diarrhea include viruses (norovirus, rotavirus, adenovirus, astrovirus), bacteria (as above), and protozoa (*Cryptosporidium*, *Giardia*, *Cyclospora*, and *Entamoeba histolytica*). These illnesses are typically short lived (lasting 1 to 3 days) and self-limited. However, if the symptoms are severe and are accompanied by systemic illness, fever, or bloody stools, the clinician should send stool cultures (stool cultures and ova and parasites; note that routine cultures sometimes have difficulty distinguishing pathogenic *E coli* from non-pathogenic *E coli*). If the patient has been recently in the hospital or exposed to antibiotics you should rule out *C difficile*. If the patient has recently traveled out of the country where the water may be contaminated, consider *E coli* or *Giardia*. In general, treatment should be supportive, and, if the decision to use antibiotics is made, the antibiotics should either be empiric or directed toward the actual bacteria or protozoa isolated in the stool culture.

Treatment. Rehydration, BRAT diet (banana, rice, apple sauce, toast), possibly antidiarrheal or antimotility medications (only recommended with certain bacteria and for severe cases and only in combination with antibiotics), possibly probiotics and antibiotics. A moderate-to-severe diarrheal illness can cause transient lactose intolerance, so instruct patients to avoid dairy products.

- Empiric antibiotics. Ciprofloxacin: adult, 500 mg orally twice a day for 5 to 7 days; pediatric, 20 to

Table 1. Treatment for Vaginitis or Cervicitis

Causative Organisms	Treatment	Special Situations
<i>Gardnerella Vaginalis</i>	<p>Metronidazole 500 mg 2 times a day × 7 d</p> <p>Metronidazole gel 0.75%, one full applicator intravaginally once a day for 5 d</p> <p>Clindamycin cream 2%, one full applicator intravaginally at bedtime for 7 d</p> <p>Clindamycin 300 mg 2 times a day × 7 d</p> <p>Clindamycin Ovules 100 g intravaginally at bedtime × 3 d</p>	<p>Pregnancy</p> <p>Metronidazole 500 mg 2 times a day × 7 d</p> <p>Metronidazole 250 mg 3 times a day × 7 d</p> <p>Clindamycin 300 mg 2 times a day × 7 d</p>
<i>Trichomonas vaginalis</i>	<p>Metronidazole 2 g × 1 dose</p> <p>Tinidazole 2 g × 1 dose</p> <p>Metronidazole 500 mg 2 times a day × 7 d</p>	
<i>Candida albicans</i>	<p>Butoconazole 2% cream 5 g intravaginally for 3 d</p> <p>Butoconazole 2% cream 5 g (Butoconazole 1-sustained release), single intravaginal application</p> <p>Clotrimazole 100 mg vaginal tablets for 7 d</p> <p>Clotrimazole 100 mg vaginal tablets, 2 tablets for 3 d</p> <p>Miconazole 2% cream 5 g intravaginally for 7 d</p> <p>Miconazole 100 mg one vaginal suppository for 7 d</p> <p>Miconazole 200 mg one vaginal suppository for 3 d</p> <p>Miconazole 1, 200 mg one vaginal suppository for 1 d</p> <p>Nystatin 100,000 U vaginal tablet for 14 d</p> <p>Tioconazole 6.5% ointment 5 g intravaginally a single application</p> <p>Tioconazole 0.4% cream 5 g intravaginally for 7 d</p> <p>Tioconazole 0.8% cream 5 g intravaginally for 3 d</p> <p>Fluconazole 150 mg orally × 1 dose</p>	<p>Recurrent vulvovaginitis with candidiasis treat with longer durations of therapy</p> <p>Pregnant patients use topical azoles only applied for 7 d</p>

<p><i>Chlamydiae trachomatis</i></p>	<p>Azithromycin 1000 mg orally in a single dose Doxycycline 100 mg orally 2 times a day for 7 d Erythromycin base 500 mg orally 4 times a day for 7 d Erythromycin ethylsuccinate 800 mg orally 4 times a day for 7 d Ofloxacin 300 mg orally 2 times a day for 7 d Levofloxacin 500 mg orally once daily for 7 d</p>	<p>Pregnancy Azithromycin 1000 mg orally in a single dose Amoxicillin 500 mg orally 3 times a day for 7 d Erythromycin base 500 mg orally 4 times a day for 7 d Erythromycin ethylsuccinate 800 mg orally 4 times a day for 7 d Erythromycin base 250 mg orally 4 times a day for 14 d Erythromycin ethylsuccinate 400 mg orally 4 times a day for 14 d</p> <p>Infants Conjunctivitis occurs 5–12 d after birth Treatment Erythromycin base or ethylsuccinate 50 mg/kg per day orally divided into 4 doses daily for 14 d</p> <p>Children, weight <45 kg Consider sexual abuse Erythromycin base or ethylsuccinate 50 mg/kg per day orally divided into 4 doses daily for 14 days</p> <p>Children, weight >45 kg Azithromycin 1000 mg orally × 1 dose</p> <p>Children, at least 8 y Azithromycin 1000 mg orally × 1 dose Doxycycline 100 mg orally 2 times a day for 7 d</p>
<p><i>Neisseria gonorrhoeae</i></p>	<p>Uncomplicated cervix, urethra, or rectal gonococcal disease Ceftriaxone 125 mg intramuscularly in a single dose Cefixime 400 mg orally in a single dose Ciprofloxacin 500 mg orally in a single dose Ofloxacin 400 mg orally in a single dose Levofloxacin 250 mg orally in a single dose Plus treat for <i>Chlamydia</i> if chlamydial infection is not ruled out</p>	<p>Heterosexual with history of recent travel Ceftriaxone 125 mg intramuscularly in a single dose Cefixime 400 mg orally in a single dose Plus treat for <i>Chlamydia</i> if chlamydial infection is not ruled out</p>

Adapted from Sexually Transmitted Diseases Treatment Guidelines, 2006. MMWR Weekly Report US Department of Health and Human Services, Centers for Disease Control and Prevention. August 4, 2006;55(RR-11).

Table 2. Common Antibiotics Used in Ambulatory Care

Antibiotics/Class	Cost	Mechanism of Action	Important Side Effects	Spectrum of Activity
<p>Penicillins Amoxicillin Ampicillins</p> <p>Penicillinase-resistant/β-lactamase inhibitors Penicillins Augmentin Nafcillin Methicillin Cloxacillin</p> <p>Antipseudomonal penicillins Carbenicillin Ticarcillin</p>	<p>\$, from \$0.23 to \$0.88/dose</p> <p>\$\$, from \$2.60 to \$6.00/dose</p>	<p>Inhibit the synthesis of completed crosslinks between the repeating disaccharide subunits of the bacterial cell wall. The penicillinase-penicillins resist the hydrolysis of the extracellular β-lactamase produced by <i>S aureus</i>, and <i>Staphylococcus epidermidis</i>.^{38,39}</p>	<p>Diarrhea Allergic reactions Inhibits effectiveness of birth control pills</p>	<p>Gram-positive infections, and gram-negative organisms <i>Escherichia coli</i> <i>Proteus mirabilis</i> <i>Haemophilus influenzae</i>, <i>Salmonella</i>, <i>Shigella</i>, and <i>Neisseria pseudomonas</i>.^{38,39}</p>
<p>Cephalosporins Generations by time of development and chemistry First generation Cephalothin Cephalexin: Keflex Cefazolin Cefadroxil Second generation Cefoxitin Cefaclor Cefuroxime axetil Third generation Cefotaxime Ceftriaxone (Rocephin) Cefixime Cefdinir (Omnicef) Fourth generation Cefepime</p>	<p>\$</p> <p>Generic \$\$; Cefin \$\$\$</p> <p>\$\$\$</p>	<p>Inhibit the synthesis of completed crosslinks between the repeating disaccharide subunits of the bacterial cell wall; have a higher degree of resistance to penicillinase.⁴⁰</p>	<p>Allergy, diarrhea, rare case of cholecystitis</p>	<p>Broad range of activity in pulmonary, urinary, surgical, and bone infections First generation: gram-positive and -negative organisms, no MRSA Second generation: less active toward gram-positive organisms and more active toward gram-negative organisms, including <i>H influenzae</i> and <i>Bacteroides</i> species, cefuroxime penetrates CSF, and cefoxitin active against β-lactamase-producing organisms Third generation</p>
<p>Carbapenems Ertapenem (Invanz) Meropenem (Merrem) Imipenem-cilastatin (Primaxin)</p>	<p>\$\$\$\$</p>	<p>Bactericidal β-Lactamase inhibitor Inhibit cell wall formation.⁴¹</p>	<p>All: lower seizure threshold All: allergy Meropenem: neutropenia Imipenem: nausea and vomiting</p>	<p>Carbapenems, because of their broad antibacterial spectrum covering gram-positive, gram-negative, and anaerobic bacteria, are useful for treatment of a wide variety of infections, including bacteremia, bone and soft-tissue infections, obstetric and gynecologic infections, complicated urinary tract infections, intraabdominal sepsis, and pneumonia.⁴¹</p>

<p>Tetracycline Doxycycline Minocycline Tigecycline-available intravenously only (glycycycline)</p>	<p>\$ \$\$</p>	<p>Bacteriostatic Inhibits bacterial replication by attaching to the 30S ribosomal subunit protein leading to disruption of transfer RNA to messenger RNA⁴²</p>	<p>Contraindicated in pregnancy and early childhood because of tooth discoloration and enamel Hypoplasia Minocycline is associated with drug-induced lupus when used long term GI distress: diarrhea, nausea, vomiting Photosensitivity, advise sunscreen Tigecycline: significant nausea and vomiting; must provide prophylaxis with antiemetics such as ondansetron</p>	<p>Despite resistance, this drug is still widely used to treat oral infections, acne, and genitourinary tract infections. In bioterrorism doxycycline has become prominent Gram-positive organisms: <i>Streptococcus pneumoniae</i>; groups A, B, C, and G <i>Streptococcus</i>; <i>Staphylococcus aureus</i> (minocycline); <i>Mycobacterium</i> (nontuberculous); MRSA (tigecycline); vancomycin-resistant enterococcus (tigecycline) Gram-negative organisms: <i>Moraxella catarrhalis</i>, <i>H influenzae</i>, <i>Aeromonas</i> Anaerobes: <i>Bacteroides fragilis</i>, <i>Actinomyces</i> Other: <i>Chlamydia</i>, <i>Mycoplasma pneumoniae</i>⁴²</p>
<p>Antimetabolites Sulfonamides-Sulfamethoxazole (SMX) Trimethoprim (TMP) Clinically relevant is the combination of TMP-SMX at 1:5 ratio Bactrim, Sulfatrim (multiple generics) Dose by TMP but check drug levels by the sulfamethoxazole component</p>	<p>Generic \$ Trade Bactrim \$ Trade Septra \$</p>	<p>TMP-SMX Bacteriostatic Inhibit nucleic acid synthesis of bacteria⁴³</p>	<p>Contraindicated in pregnancy because of folic acid synthesis Nausea and vomiting Photosensitivity; advise sunscreen with prolonged exposure to the sun</p>	<p>Treatment of upper and lower respiratory tract infections, genitourinary tract infections, deep organ abscess: splenic or liver Gram-positive organism: groups A, B, C, and G <i>Streptococcus</i>; <i>S aureus</i>; <i>Staphylococcus epidermidis</i>; <i>Listeria monocytogenes</i> Gram-negative organisms: <i>Neisseriae gonorrhoeae</i>, <i>Neisseriae meningitidis</i>, <i>M catarrhalis</i>, <i>H influenzae</i>, <i>Aeromonas</i>, <i>E coli</i>, <i>Klebsiella</i>, <i>Serratia marcescens</i>, <i>Burkholderia cepacia</i>, <i>Stenotrophomonas maltophilia</i>, <i>Nocardia</i> Other: <i>Chlamydia</i>⁴³</p>

<p>Quinolones Ciprofloxacin Ofloxacin Levofloxacin Moxifloxacin Gatifloxacin Trovafoxacin</p>	<p>\$\$\$\$ \$\$\$\$ \$\$\$\$ \$\$\$ \$\$\$</p>	<p>Bactericidal Inhibit bacterial DNA synthesis⁴⁴</p>	<p>Not approved for pediatrics Allergy Photosensitivity Arthralgias <i>Clostridium difficile</i></p>	<p>Used in the treatment of upper and lower respiratory tract infections; deep-organ abscess in the liver, spleen, or peritoneum; osteomyelitis; and cellulitis. Gram-positive organisms. <i>S. aureus</i>, <i>S. epidermidis</i>: all quinolones; <i>S. pneumoniae</i>, <i>Streptococcus viridans</i>, <i>Enterococcus faecalis</i>: levofloxacin, moxifloxacin, trovafloxacin, gatifloxacin; <i>Mycobacterium</i> species: levofloxacin, moxifloxacin⁴⁴ Gram-positive organisms: <i>S. aureus</i>; <i>S. pneumoniae</i>; groups A, B, C, and G <i>Streptococcus</i> Anaerobes: <i>B. fragilis</i>, <i>Actinomyces</i>, <i>Peptostreptococcus</i>⁴⁴</p>
<p>Lincosamides Clindamycin (Cleocin)</p>	<p>Generic \$\$ Trade \$\$\$</p>	<p>Bacteriostatic/bactericidal Inhibits bacterial protein synthesis by binding to the 50S subunit of RNA synthesis⁴¹</p>	<p>Pseudomembranous colitis Gastrointestinal complaints of nausea, diarrhea⁴¹</p>	<p>Gram-positive organisms: <i>S. aureus</i>; <i>S. pneumoniae</i>; groups A, B, C, and G <i>Streptococcus</i> Anaerobes: <i>B. fragilis</i>, <i>Actinomyces</i>, <i>Peptostreptococcus</i>⁴¹</p>
<p>Oxazolidinone Linezolid (Zyvox)</p>	<p>\$\$\$\$</p>	<p>Bactericidal/bacteriostatic-dependent on organism and concentration Inhibits bacterial protein synthesis through a unique interference of the bacterial translation process⁴⁵</p>	<p>Serious side effects with FDA black box warning: significant thrombocytopenia requires weekly CBC if therapy prolonged beyond 2 wk Peripheral neuropathies that are prevented by concomitant administration of vitamin B₆ (pyridoxine) 50 mg daily for adults and 25 mg daily for children Severe diarrhea⁴⁵</p>	<p>Gram-positive infections; marketed for MRSA infections <i>Enterococcus faecium</i> (vancomycin-resistant strains only) <i>Streptococcus agalactiae</i> <i>S. pneumoniae</i> (including multidrug resistant isolates [MDRSP] <i>Streptococcus pyogenes</i>)⁴⁵</p>
<p>Dapsone-Sulfone, antileprosy drug used exclusively for leprosy (Hansen disease), <i>Pneumocystis jarevoci</i> (<i>Pneumocystis carinii</i>) treatment for patients allergic to Bactrim and in dermatitis herpetiformis¹⁰</p>	<p>\$</p>	<p>Mechanism of action not known; thought to be both bactericidal and bacteriostatic</p>	<p>Use cautiously in G6PD-deficient patients because of reports of severe hemolysis in these patients. Hemolysis can occur in non-G6PD-deficient patients as well.¹⁰</p>	<p><i>P. jiroveci</i>, <i>P. carinii</i>, <i>Mycobacterium leprae</i></p>

<p>Antitubercular agents Echambutol (ETH) Cycloserine Seromycin Isoniazid (INH) Nydravid</p>	<p>\$ \$\$ \$</p>	<p>ETH inhibits the synthesis of ribonucleic acid and interferes with the protein metabolism of the mycobacteria Cycloserine inhibits cell wall synthesis INH is thought to act by interfering with cell wall mycolic acid synthesis⁴⁶</p>	<p>ETH: Optic neuritis, leading to blindness or visual impairment Cycloserine: seizure INH: hepatic toxicity⁴⁶</p>	<p>Used in combination to treat mycobacterial infections⁴⁶</p>
<p>Antitubercular agent Rifampin</p>	<p>\$</p>	<p>Bactericidal drug that inhibits bacterial RNA polymerase by binding to the B-subunit of the enzyme causing it to fall off the template⁴⁶</p>	<p>Cytochrome P-450 inducer of many drugs such as Coumadin, birth control pills, and methadone Drug-induced hepatitis⁴⁶</p>	<p>Usually an adjunct drug in the treatment of staphylococcal infections: <i>S. aureus</i> or mycobacterial infections; resistance to rifampin occurs rapidly with mycobacteria and staphylococci so it is never used alone for treatment⁴⁶</p>
<p>Macrolides Erythromycin Azithromycin Clarithromycin Biaxin</p> <p>Ketolides Telithromycin (Ketek)</p>	<p>\$ \$\$\$ \$\$ \$\$\$</p>	<p>Bacteriostatic/bactericidal; inhibits bacterial protein synthesis by binding to the 50S subunit of RNA synthesis⁴¹</p>	<p>Gastrointestinal effects Pseudomembranous colitis (erythromycin) Drug interactions with erythromycin, telithromycin, and clarithromycin because of interference with hepatic metabolism through the cytochrome P-450 system, thus reducing the metabolism of several important drugs such as warfarin, verapamil, cyclosporine, and lovastatin, leading to elevated drug levels and toxicities. Combination of simvastatin with telithromycin should be avoided Transient hearing loss has been associated with erythromycin and azithromycin⁴¹</p>	<p>Has anti-inflammatory properties Gram-negative and gram-positive bacteria, including mycobacteria; groups A, C, and G streptococcal infection; <i>S. aureus</i>; <i>S. pneumoniae</i>; <i>S. pyogenes</i>; <i>M. catarrhalis</i>; <i>H. influenzae</i>; <i>Salmonella typhi</i>; <i>Shigella</i>; anthrax; <i>Borrelia burgdorferi</i> Infections where macrolides are preferred: <i>Bartonella henselae</i> (cat-scratch fever), <i>Bordetella pertussis</i> (whooping cough), <i>Campylobacter jejuni</i>, <i>Chlamydia pneumoniae</i>, <i>Chlamydia trachomatis</i> (trachoma), <i>Helicobacter pylori</i>, <i>Haemophilus ducreyi</i>; <i>Mycobacterium avium</i> complex, <i>M. pneumoniae</i> Azithromycin has broader coverage over gram-negative organisms than erythromycin, and clarithromycin has better gram-positive coverage than erythromycin⁴¹</p>

\$ indicates no more than \$2/dose; \$\$, = \$2-\$5/dose; \$\$\$, \$5-\$10/dose; \$\$\$\$, more than \$10/dose; MRSA, methicillin-resistant Staphylococcus aureus; CSF, cerebral spinal fluid; GI, gastrointestinal; FDA, Food and Drug Administration; CBC, complete blood count; MDRSP, multidrug-resistant Streptococcus pneumoniae.
Source: Information on cost of medications derived from [Drugstore.com](http://www.drugstore.com). Available at: www.drugstore.com. Accessed on September 5, 2006.

30 mg/kg per day orally divided every 12 hours (max, 1.5 g/day) for 5 to 7 days.

- Azithromycin: adult (5-day regimen), 500 mg once daily for 1 day, then 250 mg orally for 4 days; pediatric, 10 mg/kg per day for 1 day, then 5 mg/kg per day for 4 days.
- Erythromycin: adult, 250 mg orally every 6 to 8 hours for 10 to 14 days; pediatric, 30 to 50 mg/kg per day orally in equally divided doses for 10 to 14 days.
- Bactrim: adult, 1 DS (800 mg/160 mg) tablet every 12 hours for 5 days; pediatric, 8 mg TMP/kg per day in divided doses every 12 hours for 5 days.

Treatment of *C difficile*. Rehydration, BRAT diet, and immediate cessation of inciting antibiotics. If antibiotics are still needed to treat the original infection, switch to a regimen less likely to cause *C difficile* infection.

- Metronidazole: adult, 250 to 500 mg 3 to 4 times per day for 10 to 14 days; pediatric, 20 mg/kg per day divided every 6 hours for 10 to 14 days.
- Vancomycin: adult, 125 mg orally 4 times per day for 10 days; pediatric, 40 mg/kg per day in divided doses, added to fluids.

Treatment of *Giardia*. Rehydration, BRAT diet.

- Metronidazole: adult, 250 to 500 mg 3 to 4 times per day for 10 to 14 days; pediatric, 20 mg/kg per day divided every 6 hours for 10 to 14 days.

Follow-up. No follow-up is needed unless symptoms do not resolve; immediate follow-up is needed if the patient's complaints worsen.^{10,35-37}

Common antibiotics used in ambulatory care and comparison of their cost, side effects, and spectrum of activity are given in Table 2. **JNP**

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