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Treatment of Common Respiratory Tract Infections

Most respiratory tract infections are caused by viruses. Bacterial respiratory tract infections are usually treated empirically with antibiotic therapy that targets the most probable causative pathogens. Recommended antibiotic regimens for outpatient treatment of some common respiratory tract infections are listed in Table 1 for adults and Table 2 for children.

GROUP A STREPTOCOCCAL PHARYNGITIS — Most cases of acute pharyngitis are caused by viruses, such as influenza, SARS-CoV-2, Epstein-Barr, rhinovirus, and HIV, and should not be treated with antibiotics. Group A *Streptococcus* (GAS; *Streptococcus pyogenes*) is the most common bacterial pathogen.

Diagnosis – GAS pharyngitis should be diagnosed by nucleic acid amplification test or rapid antigen detection test; use of history and physical examination alone is unreliable. In adults, throat culture can be considered if a rapid antigen test is negative and clinical presentation suggests bacterial infection. In children and adolescents, throat culture is always recommended when a rapid antigen test is negative and GAS pharyngitis is suspected. Follow-up culture is not needed after a negative nucleic acid amplification test.

Standard Treatment – Patients who test positive for GAS should be treated with a 10-day course of penicillin or amoxicillin.[1] Those with a non-IgE-mediated allergy to penicillin can be treated with a first-generation cephalosporin such as cephalexin; the risk of cross-reactivity with penicillins and cephalosporins is low. Clindamycin or a macrolide such as azithromycin can be used in patients with a severe penicillin allergy, but >20% of GAS pharyngeal isolates may be resistant to these drugs.[2,3] Fluoroquinolones, tetracyclines, and trimethoprim/sulfamethoxazole should not be used for treatment of GAS pharyngitis because of the high prevalence of resistance.

SINUSITIS — Acute sinusitis is usually caused by a viral infection and should not be treated with antibiotics. Symptoms can be managed with analgesics, an intranasal corticosteroid, steam inhalation, and/or sterile nasal saline irrigation. Bacterial sinusitis should be suspected in patients with a high fever and symptoms that are severe, persist for ≥10 days, or recur following resolution of a viral upper respiratory tract infection. Potential pathogens include *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*. Bacterial sinusitis in otherwise healthy adults often improves without antibiotic therapy.[4,5]

Standard Treatment – Amoxicillin/clavulanate is the antibiotic of choice for empiric treatment of acute bacterial sinusitis in adults and children[5,6]; addition of clavulanate to amoxicillin improves its activity against beta-lactamase-producing organisms (e.g., *H. influenzae*, *M. catarrhalis*). A high dose of the amoxicillin component can be considered for patients at increased risk of resistant *S. pneumoniae* (e.g., ≥65 years old, comorbidities, immunosuppressed).

Doxycycline is an option for adults with a penicillin allergy, but resistance to doxycycline has increased, particularly among isolates of *S. pneumoniae* with reduced susceptibility to penicillin. Levofloxacin or moxifloxacin can also be used, but the FDA has warned that the risk of rare but serious adverse effects with fluoroquinolones, including tendinitis and tendon rupture, peripheral neuropathy, CNS effects, and QT-interval prolongation, generally outweighs their benefits for treatment of uncomplicated infections such as sinusitis.[7] A third-generation oral cephalosporin (e.g., cefpodoxime) with or without clindamycin is an alternative for patients with a non-IgE-mediated penicillin allergy; the risk of cross-reactivity between penicillins and later-generation cephalosporins is very low.[4-6,8]

Macrolides (e.g., azithromycin) and trimethoprim/sulfamethoxazole are not recommended for treatment of acute sinusitis because of increasing resistance among *S. pneumoniae*.[4]

Table 1. Empiric Treatment of Some Outpatient Bacterial Respiratory Tract Infections in Adults

Adult Regimen(s)[1]	Comments
Pharyngitis[2] (Group A *Streptococcus*; GAS)	
Preferred Regimen(s): Penicillin VK 500 mg PO bid or 250 mg PO qid x 10 days Amoxicillin 500 mg PO bid x 10 days Benzathine penicillin G 1.2 million units IM x 1 dose[3] **Penicillin Allergy (non-IgE-mediated):** Cefadroxil 1 g PO once/day x 10 days Cephalexin 500 mg PO bid x 10 days **Penicillin Allergy (severe):** Azithromycin 500 mg PO once/day x 5 days[4] Clindamycin 300 mg PO tid x 10 days	► GAS may be resistant to macrolides (e.g., azithromycin) and clindamycin. ► The risk of *Clostridioides difficile* infection is greater with clindamycin. ► Fluoroquinolones, tetracyclines, and trimethoprim/sulfamethoxazole should not be used because of the high prevalence of resistant GAS.
Acute Bacterial Sinusitis[2] (*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*)	
Preferred Regimen(s): Amoxicillin/clavulanate PO 875/125 mg bid or 500/125 mg tid x 5-7 days[5] **Penicillin Allergy (non-IgE-mediated):** Cefixime 400 mg PO once/day x 5-7 days[6] Cefpodoxime 200 mg PO bid x 5-7 days[6] **Penicillin Allergy (severe):** Doxycycline PO 100 mg bid or 200 mg once/day x 5-7 days Levofloxacin 500 or 750 mg PO once/day x 5-7 days Moxifloxacin 400 mg PO once/day x 5-7 days	► High-dose amoxicillin (2000 mg bid) improves activity against strains of *S. pneumoniae* with reduced susceptibility to penicillins. ► Resistance to doxycycline has increased among isolates of *S. pneumoniae* with reduced susceptibility to penicillin. ► Macrolides and trimethoprim/sulfamethoxazole are not recommended because of increasing resistance among pneumococci. ► Because of the risk of serious adverse effects, fluoroquinolones should be reserved for patients who lack other treatment options.
Acute Otitis Media (*Haemophilus influenzae, Streptococcus pneumoniae, Moraxella catarrhalis*)	
Preferred Regimen(s): Amoxicillin/clavulanate PO 875/125 mg bid or 2000/125 mg bid x 5-7 days[5] **Penicillin Allergy (non-IgE-mediated):** Cefdinir PO 600 mg once/day or 300 mg bid x 5-7 days[6] Cefpodoxime 200 mg PO bid x 5-7 days[6] **Penicillin Allergy (severe):** Doxycycline 100 mg PO bid x 5-7 days[7]	► *H. influenzae* is now the most common causative bacterial pathogen. ► High-dose amoxicillin (2000 mg bid) improves activity against strains of *S. pneumoniae* with reduced susceptibility to penicillins. ► Addition of clavulanate improves activity of amoxicillin against *H. influenzae* and *M. catarrhalis*.
Acute Exacerbations of Chronic Bronchitis (AECB)[2] (*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*)	
Preferred Regimen(s): Amoxicillin/clavulanate 875/125 mg PO bid x 5-7 days[5] Cefpodoxime 200 mg PO bid x 5-7 days **Penicillin Allergy (severe):** Doxycycline 100 mg PO bid x 5-7 days Levofloxacin 500 mg PO once/day x 5-7 days Moxifloxacin 400 mg PO once/day x 5-7 days	► Antibiotic treatment is not recommended for acute bronchitis. ► Because of the risk of serious adverse effects, fluoroquinolones should be reserved for patients who lack other treatment options.
Community-Acquired Pneumonia (*Streptococcus pneumoniae, Mycoplasma pneumoniae*[8])	
Preferred Regimen(s): **Outpatient without Comorbidities[9]** Amoxicillin 1 g PO tid x ≥5 days[10] Doxycycline 100 mg PO bid[11] x ≥5 days **Outpatient with Comorbidities[9]** Amoxicillin/clavulanate PO 500/125 mg tid or 875/125 mg bid **PLUS** either azithromycin[4] PO 500 mg x 1, then 250 mg once/day x 4 days or doxycycline 100 mg PO bid x ≥5 days Levofloxacin 750 mg PO once/day x ≥5 days Moxifloxacin 400 mg PO once/day x ≥5 days	► Amoxicillin has no activity against *M. pneumoniae*, *C. pneumoniae*, or *Legionella*. ► Macrolide monotherapy (e.g., azithromycin) may be considered only in areas where pneumococcal resistance rates to macrolides are <25% (rate is now >40% in many areas in the US). ► Doxycycline plus a beta-lactam could be considered for patients at risk for QT-interval prolongation. ► The risk of *C. difficile* infection is greater with fluoroquinolones.

1. Usual dosage for nonpregnant adults. Dosage adjustments may be needed for renal or hepatic impairment. Doxycycline, clarithromycin, and fluoroquinolones should be avoided, if possible, in pregnant women.
2. Most cases of acute pharyngitis, sinusitis, and bronchitis (acute and AECB) are viral and should not be treated with antibiotics.
3. For patients who are unlikely to complete a course of oral therapy.
4. Clarithromycin 500 mg PO bid (x 10 days for GAS and x ≥5 days for CAP) is an alternative, but it may increase the risk of cardiac adverse effects and death in patients with coronary artery disease.
5. High-dose amoxicillin/clavulanate (two 1000/62.5 mg extended-release tablets bid) should be considered for patients with severe disease and for those at risk of infection with *S. pneumoniae* with reduced susceptibility to penicillin.
6. Addition of clindamycin 300 mg q6h should be considered for patients at risk for infection with *S. pneumoniae* with reduced susceptibility to penicillin.
7. Azithromycin or clarithromycin is an alternative, but their activity against *S. pneumoniae* and *H. influenzae* has been declining.
8. Other possible pathogens include *Staphylococcus aureus*, *H. influenzae*, *M. catarrhalis*, *Chlamydophila pneumoniae,* and *Legionella* spp.
9. Chronic heart, lung, liver, or renal disease, diabetes, alcoholism, malignancy, or asplenia.
10. Alternatives include ceftriaxone, cefpodoxime, and cefuroxime (500 mg bid).
11. Should not be used for empiric treatment in areas where the rate of doxycycline-resistant *S. pneumoniae* is >25%.

Table 2. Empiric Treatment of Some Outpatient Bacterial Respiratory Tract Infections in Children

Pediatric Regimen(s)[1]	Comments
Pharyngitis[2] (Group A *Streptococcus*; GAS)	
Preferred Regimen(s): Penicillin VK 250 mg PO bid or tid (250 mg qid or 500 mg bid in adolescents) x 10 days Amoxicillin PO 50 mg/kg (max 1000 mg) once/day or 25 mg/kg (max 500 mg) bid x 10 days Benzathine penicillin G <27 kg: 600,000 units IM once; ≥27 kg: 1.2 million units IM once[3] **Penicillin Allergy (non-IgE-mediated):** Cefadroxil 30 mg/kg (max 1000 mg) PO once/day x 10 days Cephalexin 20 mg/kg (max 500 mg) PO bid x 10 days **Penicillin Allergy (severe):** Azithromycin 12 mg/kg (max 500 mg) PO once/day x 5 days[4] Clindamycin 7 mg/kg (max 300 mg) PO tid x 10 days	► GAS may be resistant to macrolides (e.g., azithromycin) and clindamycin. ► The risk of *Clostridioides difficile* infection is greater with clindamycin. ► Tetracyclines and trimethoprim/sulfamethoxazole should not be used because of the high prevalence of resistant GAS.
Acute Bacterial Sinusitis[2] (*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*)	
Preferred Regimen(s): Amoxicillin/clavulanate 45 mg/kg PO divided bid x 5-7 days[5] **Penicillin Allergy (non-IgE-mediated):** Clindamycin 30-40 mg/kg PO divided tid **PLUS** cefixime 8 mg/kg PO divided bid or cefpodoxime 10 mg/kg PO divided bid x 5-7 days **Penicillin Allergy (severe):** Levofloxacin 10-20 mg/kg PO divided q12-24h (max 500 mg/day) x 5-7 days	► High-dose amoxicillin (90 mg/kg/day) improves activity against strains of *S. pneumoniae* with reduced susceptibility to penicillins. ► The risk of *Clostridioides difficile* infection is greater with clindamycin and fluoroquinolones. ► Macrolides and trimethoprim/sulfamethoxazole are not recommended because of increasing resistance among pneumococci.
Acute Otitis Media (*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*)	
Preferred Regimen(s): Amoxicillin 90 mg/kg/day (max 4000 mg/day) PO divided q12h x 5-10 days Amoxicillin/clavulanate 90/6.4 mg/kg/day (max 4000 mg of amoxicillin/day) PO divided bid x 5-10 days **Penicillin Allergy (non-IgE-mediated):** Cefdinir 14 mg/kg (max 600 mg) PO divided q12-24h x 5-10 days Cefuroxime 30 mg/kg (max 500 mg/dose) PO divided q12h x 5-10 days Cefpodoxime 10 mg/kg (max 200 mg/dose) PO divided bid x 5-10 days **Penicillin Allergy (severe):** Azithromycin 10 mg/kg (max 500 mg) x 1, then 5 mg/kg (max 250 mg) once/day x 4 days[6]	► *H. influenzae* is now the most common causative bacterial pathogen. ► High-dose amoxicillin improves activity against strains of *S. pneumoniae* with reduced susceptibility to penicillins. ► Addition of clavulanate improves activity of amoxicillin against *H. influenzae* and *M. catarrhalis*.
Community-Acquired Pneumonia	
Outpatient, presumed typical bacteria[7] (*Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*) **Preferred Regimen(s):** Amoxicillin 90 mg/kg (max 1000 mg/dose) PO divided q8-12h x 5-7 days Amoxicillin/clavulanate 90 mg/kg (max 1000 mg amoxicillin/dose) PO divided bid x 5-7 days **Penicillin Allergy (non-IgE-mediated):** Cefdinir 7 mg/kg (max 300 mg/dose) PO q12h x 5-7 days Cefuroxime 15 mg/kg (max 500 mg/dose) PO q12h x 5-7 days **Penicillin Allergy (severe):** Clindamycin 30-40 mg/kg PO divided q6-8h x 5-7 days[8] Levofloxacin 10 mg/kg (max 750 mg) PO once/day[9] x 5-7 days	► High-dose amoxicillin (90 mg/kg/day) improves activity against strains of *S. pneumoniae* with reduced susceptibility to penicillins. ► Addition of clavulanate improves activity of amoxicillin against *H. influenzae* and *M. catarrhalis*. ► Macrolide monotherapy (e.g., azithromycin) should be considered only in areas where pneumococcal resistance rates to macrolides are <25% (rate is now >40% in many areas in the US).
Outpatient, presumed atypical bacteria[7] (*Mycoplasma pneumoniae, Chlamydophila pneumoniae*, *Legionella* spp.) **Preferred Regimen(s):** Azithromycin PO 10 mg/kg (max 500 mg) x 1, then 5 mg/kg (max 250 mg) once/day x 4 days	

1. Usual pediatric dosage. Dosage adjustments may be needed for renal or hepatic impairment.
2. Most cases of pharyngitis and sinusitis are viral and should not be treated with antibiotics.
3. For patients who are unlikely to complete a course of oral therapy.
4. Clarithromycin 7.5 mg/kg (max 250 mg) PO bid x 10 days is an alternative.
5. High-dose amoxicillin/clavulanate (90 mg/kg/day of amoxicillin) should be considered for patients with severe disease and for those at risk of infection with *S. pneumoniae* with reduced susceptibility to penicillin.
6. Azithromycin and other macrolides now have limited activity against *H. influenzae* and *S. pneumoniae*.
7. Children with community-acquired pneumonia caused by *S. pneumoniae* (or other "typical" bacteria) generally present with rapid onset of symptoms, high fever, ill appearance, and respiratory distress; those with "atypical" pneumonia usually have less severe disease, no respiratory distress, and a dry cough.
8. Clindamycin does not have activity against *H. influenzae*, *M. catarrhalis*, *M. pneumoniae*, *C. pneumoniae*, or *Legionella* spp.
9. Moxifloxacin is an alternative; <45 kg: 4 mg/kg (max 200 mg) PO q12h, 12-17 years old and ≥45 kg: 400 mg PO q12h.

ACUTE OTITIS MEDIA — Acute otitis media (AOM) is frequently associated with viral respiratory tract infections. It is most common in children. *S. pneumoniae* and *H. influenzae* are the most common bacterial pathogens. Since the introduction of routine pneumococcal vaccination in the US, the prevalence of *S. pneumoniae* has declined, but the pneumococcal serotypes that do cause AOM often have reduced susceptibility to amoxicillin.[9,10] *H. influenzae* that produce beta-lactamase and are resistant to amoxicillin are now a common cause of AOM in both children and adults.[9] *M. catarrhalis*, which also produces beta-lactamase and is resistant to amoxicillin, is another frequently isolated bacterial pathogen in children with AOM.[9,10] *Staphylococcus aureus* is a potential pathogen in adults.

Standard Treatment – Antimicrobial therapy can shorten the duration of AOM symptoms and prevent complications, but severe symptoms generally last only a few days and most infections in children resolve without treatment. Children <2 years old and those with severe infection (i.e., otorrhea, severe or persistent otalgia for >48 hours, or a temperature ≥102.2°F) should receive immediate antibiotic treatment. In children ≥2 years old with less severe symptoms, watchful waiting combined with analgesia is appropriate; if symptoms fail to improve within 48-72 hours, antibiotic therapy should be started. Adults with AOM should be treated with antibiotics.

Guidelines for treatment of AOM in children, which were last published in 2013, recommended high-dose amoxicillin (90 mg/kg/day) for initial treatment in most children. High doses are used to improve activity against less susceptible strains of *S. pneumoniae*.[11]

To treat beta-lactamase-producing *H. influenzae*, many expert clinicians now recommend standard- or high-dose amoxicillin/clavulanate for first-line empiric treatment of AOM in all children without a penicillin allergy.[10,12] Amoxicillin/clavulanate is the antibiotic of choice for adults; a high dose (2000/125 mg bid) is recommended for those who are at increased risk of infection with a resistant strain of *S. pneumoniae* (e.g., recent antibiotic use or hospitalization, ≥65 years old, immunocompromised).

A second- or third-generation cephalosporin (e.g., oral cefdinir, cefpodoxime, or cefuroxime, IM/IV ceftriaxone) can be used in adults or children with a history of non-IgE-mediated penicillin allergy; the risk of cross-reactivity between penicillins and later-generation cephalosporins is very low.[8]

Macrolides (e.g., azithromycin) now have limited activity against *S. pneumoniae* and *H. influenzae*; they should be considered only for patients with a history of serious penicillin allergy. Clindamycin may be an alternative for treatment of AOM caused by *S. pneumoniae* in patients with a serious penicillin allergy; it has no activity against *H. influenzae* or *M. catarrhalis*.

BRONCHITIS — Acute bronchitis in otherwise healthy persons is usually viral. Symptoms are caused by inflammation and are self-limited. Antibiotic treatment is not recommended.[6]

Acute exacerbations of chronic bronchitis (AECB) are also often viral in origin, but moderate to severe exacerbations in patients with COPD are usually treated with antibiotics.[13] As with sinusitis, bacterial AECBs are often caused by *S. pneumoniae*, *H. influenzae*, or *M. catarrhalis*. Amoxicillin/clavulanate is the treatment of choice. Doxycycline can be considered for patients who are allergic to penicillins. Because of the risk of serious adverse effects, a fluoroquinolone (levofloxacin or moxifloxacin) should be reserved for patients who lack other treatment options.[7]

COMMUNITY-ACQUIRED PNEUMONIA — Viruses are common causes of community-acquired pneumonia (CAP). The most common bacterial pathogens responsible for CAP in adults include *S. pneumoniae, H. influenzae, M. catarrhalis*, and *Mycoplasma pneumoniae*. In children ≥5 years old, *S. pneumoniae* and *M. pneumoniae* are most common. Pneumococcal vaccination has substantially reduced the incidence of CAP caused by *S. pneumoniae* in the US.[14]

Methicillin-resistant *S. aureus* (MRSA) and resistant gram-negative bacteria can sometimes cause CAP. Patients with previous respiratory isolation of one of these pathogens, a recent viral infection, or recent hospitalization with parenteral antibiotic treatment are at increased risk.[15]

Standard Treatment of Outpatient CAP – For many years, monotherapy with an oral macrolide such as azithromycin was a regimen of choice for empiric outpatient treatment of CAP in otherwise healthy **adults without comorbidities** (chronic heart, lung, liver or renal disease, diabetes, alcoholism, malignancy, or asplenia). The incidence of macrolide-resistant *S. pneumoniae* is now >40% in many areas in the US, however, and current guidelines recommend that oral macrolide monotherapy be considered only in areas where pneumococcal resistance rates

to macrolides are <25%. High-dose amoxicillin (1 g tid) or doxycycline is now recommended for empiric treatment of CAP in most cases.[15] High-dose amoxicillin monotherapy provides coverage against *S. pneumoniae*, but it has no activity against *M. pneumoniae, Chlamydophila pneumoniae,* or *Legionella* spp.; some experts would add a macrolide or doxycycline to cover these pathogens.

For outpatient treatment of CAP in **adults with comorbidities** (chronic heart, lung, liver or renal disease, diabetes, alcoholism, malignancy, or asplenia), an oral beta-lactam (amoxicillin/clavulanate, cefpodoxime, or cefuroxime) and either a macrolide (azithromycin, clarithromycin) or doxycycline is recommended. Monotherapy with an oral fluoroquinolone (levofloxacin or moxifloxacin) is an alternative.[15]

Macrolides and fluoroquinolones can prolong the QT interval and rarely cause life-threatening ventricular arrhythmias; these drugs should be used with caution in patients with cardiovascular disease or risk factors for QT-interval prolongation and arrhythmias.[16] Although clinical data are limited, some expert clinicians would use doxycycline plus a beta-lactam in such patients.

Children with CAP caused by *S. pneumoniae* (or other "typical" bacteria) generally present with rapid symptom onset, high fever, ill appearance, and respiratory distress. Those with CAP due to an "atypical" pathogen (e.g., *M. pneumoniae*) usually have less severe disease, a dry cough, and no respiratory distress. High-dose amoxicillin (90 mg/kg/day) is recommended for treatment of CAP presumed to be caused by typical bacteria in children; high-dose amoxicillin/clavulanate is an alternative. In children with suspected *M. pneumoniae* infection, macrolide monotherapy is recommended. Possible alternatives include doxycycline or a fluoroquinolone (levofloxacin or moxifloxacin).[17]

Duration of Antimicrobial Therapy – Antibiotic treatment for CAP should be continued until clinical stability is achieved (usually within 48-72 hours) and for at least 5 days. Short courses of treatment (5-7 days) appear to be similar in efficacy to longer courses (8-10 days).[18]

Newer Antibiotics – Data supporting the efficacy of newer FDA-approved antibiotics for treatment of CAP, including the fluoroquinolone delafloxacin *(Baxdela)*,[19] the tetracycline omadacycline *(Nuzyra)*,[20] and the pleuromutilin lefamulin *(Xenleta)*[21] are limited. Until more data become available, empiric regimens with a longer record of efficacy and safety are preferred.

Adjunctive Corticosteroids – There are no data supporting the use of adjunctive corticosteroids for treatment of mild to moderate CAP.[22]

ADVERSE EFFECTS — Beta-lactam antibiotics (penicillins and cephalosporins) can cause rash, diarrhea, nausea, vomiting, allergic reactions, hemolytic anemia, neutropenia, cholestatic hepatitis, serum sickness, and seizures. Amoxicillin/clavulanate and cephalosporin antibiotics cause a higher incidence of diarrhea than amoxicillin.

Doxycycline can cause GI adverse effects and photosensitivity.

Azithromycin and **clarithromycin** can cause GI adverse effects, headache, dizziness, vaginitis, and QT-interval prolongation. Clarithromycin can also cause dysgeusia and hepatic enzyme elevations. The FDA has warned that use of clarithromycin may increase the risk of cardiovascular morbidity and mortality in patients with heart disease.[23]

Use of **fluoroquinolones** has been associated with GI adverse effects, tremors, rash, oral and vaginal *Candida* infections, eosinophilia, neutropenia, leukopenia, increased aminotransferase and serum creatinine levels, insomnia, photosensitivity reactions, and peripheral neuropathy. They have also been reported to cause hyperglycemia and severe hypoglycemia, especially in older adults and patients with diabetes. Central nervous system effects, including seizures, delirium, agitation, nervousness, and disturbances in attention, memory, and orientation, have occurred. Other serious adverse effects include tendinitis, tendon rupture, aortic aneurysm, exacerbation of myasthenia gravis, *Clostridioides difficile* infection, and QT-interval prolongation (except delafloxacin[19]) and torsades de pointes.[24]

Clindamycin causes GI adverse effects and is associated with an increased risk of *C. difficile* infection. Skin rash is common and other allergic reactions can occur.

DRUG INTERACTIONS — Coadministration of antacids or products containing aluminum, calcium, magnesium, or iron can decrease absorption of **doxycycline** and **fluoroquinolones**. Administration should be separated by several hours.

Concurrent use of **azithromycin, clarithromycin,** or **fluoroquinolones** with other QT-interval-prolonging drugs can result in additive effects.[16]

Use of **fluoroquinolones** with antihyperglycemic drugs may increase the risk of hypoglycemia. Concurrent use of fluoroquinolones and nonsteroidal anti-inflammatory drugs (NSAIDs) may lower the seizure threshold.

PREGNANCY — Doxycycline, clarithromycin, and fluoroquinolones should be avoided if possible in pregnant women. ■

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