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# Cough, Sneeze, Sniffle: Management of Respiratory Tract Infections

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***Upon completion of this module, the subscriber will be able to:***

1. Describe the different types of respiratory tract infections.
2. Recognize the signs and symptoms associated with the different types of respiratory tract infections.
3. List non-drug treatment options for the various types of respiratory tract infections.
4. List drug treatment options for the various types of respiratory tract infections.
5. Explain treatment challenges (including antimicrobial resistance) associated with respiratory tract infections.

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# Cough, Sneeze, Sniffle: Management of Respiratory Tract Infections

## Introduction

Respiratory tract infections (RTI) are one of the main reasons patients seek medical attention either from their primary care provider or local pharmacist. Studies have found that antibiotics are prescribed for 50-70% of respiratory tract infections, despite the fact that the majority of them are viral in nature and would have resolved on their own.[1,2] This inappropriate use of antibiotics is alarming as it contributes to the development of antibiotic resistance.

Respiratory tract infections involve the ears, mouth, nose, sinuses, throat, airway, and lungs. The respiratory tract can be further divided into the upper and lower respiratory tract. The upper respiratory tract (URT) consists of the ears, nose, sinuses, and throat, whereas the lower respiratory tract (LRT) consists of the airway and lungs.

The purpose of this continuing education is to provide an overview of the most common upper respiratory tract infections (URTI) and lower respiratory tract infections (LRTI) including definitions, patient presentation or associated symptoms, non-drug therapy, drug therapy, and treatment challenges.

## Upper Respiratory Tract Infections (URTI)

### *Common Cold*

The "common cold" is a benign, self-limited, syndrome caused by over 200 types of viruses with Rhinovirus being the most common.[3] It is the most frequently occurring acute (sudden onset) illness in the United States (US) and affects patients of all ages.[4] The common cold is associated with a substantial economic burden that includes not only the cost of treatment but also the loss in productivity (i.e., missed school and work days, etc.).[5] Annual absences due to the common cold were 26 and 23 million lost days from school and work, respectively.[6] A telephone survey of 4,051 US households between 2000-2001 reported that about 500 million annual non-influenza viral respiratory infections occur with estimated annual direct costs of $17 billion and indirect costs of $22.5 billion.[5]

The incidence of the common cold is approximately six to eight per year in children and two to four per year in adults.[4] Children tend to experience more episodes due to lack of acquired immunity. There is typically seasonality associated with the various types of viruses responsible for the common cold; however, based on the variability of offending viruses, the common cold can occur yearlong.

Risk factors for the common cold include children in daycare settings and exposure to children in daycare settings, and potentially sleep deprivation and psychological stress.[7,8] Patients with underlying lung disease, smokers, and those who are immunocompromised (i.e. have an impaired immune system such as that which may occur in cancer patients) typically have more severe symptoms than those not suffering from these conditions. Popular myths and misconceptions regarding the risk for getting the common cold, such as exposure to cold temperatures or going outside with wet hair, are not supported by scientific evidence.[9]

The common cold spreads quickly by hand contact with an infected person or contaminated surface and exposure to airborne particle droplets from an infected person's sneezing or coughing.[6] Hand hygiene is the most consistent and reliable way to prevent transmission (spread). Alcohol-based hand gels evaporate quickly and may be less effective than soap and water although they have been shown to reduce respiratory illness in the home.[10,11] Common cold viruses may remain infectious on skin for up to two hours and on environmental surfaces for several hours.[12] It is also recommended to cough or sneeze into shirtsleeves to prevent droplet "spray" of secretions.

The common cold is defined as a mild URTI involving a sore/scratchy throat, malaise (a general feeling of discomfort, illness, weakness, and fatigue), and low-grade fever initially followed by nasal congestion and discharge (rhinorrhea), cough, and sneezing. Symptoms usually peak around day three or four and resolve by day seven.[13] Residual symptoms may last for up to two weeks. Nasal discharge is usually thin and clear initially and can become thick and purulent (pus-like). This is often mistaken for a bacterial sinus infection.[14]

Antibiotics are ineffective for treating viruses. Therefore, patients suffering from the common cold should not be treated with antibiotics. Antibiotics have no role in reducing the severity or duration of symptoms of the common cold, and exposure to antibiotics can contribute to adverse effects, costs, and bacterial resistance.[15] None of the antiviral drugs available can treat the common cold. Thus, treatment is focused on symptomatic relief and emphasis should be placed on prevention.

Sore, scratchy throat and low-grade fevers may be treated with analgesics such as acetaminophen (APAP) or ibuprofen. APAP is safe and effective for pain and fever when taken as directed. Although APAP is routinely used for these indications, studies have shown excess consumption can cause liver damage. The Food and Drug Administration (FDA) Office of New Drugs indicates that nearly half of all cases of APAP-related liver failure are due to overdose from combination products containing APAP with many resulting in liver transplant or death. The majority of these cases of severe liver injury occur when patients concurrently consume multiple APAP-containing products and inadvertently exceed the maximum recommended dose of 4,000 mg per day and/or consume alcohol while taking APAP.[16] This has also led to manufacturers reassessing the need to lower the recommended total daily maximum dose to 3,000 mg.[17] Ibuprofen is also safe and effective when used as directed. Ibuprofen use is associated with gastrointestinal (GI) upset and should be taken with food and only as needed at the lowest possible dose to minimize this risk. The recommended doses of acetaminophen and ibuprofen may be found in **Table 1.**

Antihistamines are frequently used to relieve sneezing and rhinorrhea associated with the common cold despite lack of supportive evidence. A Cochrane review published in 2009, found that when used alone, antihistamines offer little benefit and may result in substantial sedation.[19] However, the authors also concluded that the combination of antihistamines and nasal decongestants (both topical and oral) may be more beneficial than either product alone.

The first generation antihistamines, such as diphenhydramine, may provide slight improvement in symptoms for rhinorrhea and sneezing. However, their usefulness is limited by side effects including significant sedation and excessive dryness of the eyes, nose, and mouth. The authors concluded that antihistamines overall do not provide a clinically significant reduction in symptoms and there is an increased risk of excess sedation specifically with the first-generation antihistamines (e.g., diphenhydramine).[19] They also concluded that the second-generation or non-sedating antihistamines, such as loratidine, are not effective. Furthermore, they discourage physicians and pharmacists from prescribing or recommending antihistamines to treat the symptoms of the common cold in children and that they should be used cautiously in adults.[6,19]

A Cochrane review of five studies evaluated the role of decongestants for the treatment of the common cold in adults.[20] The authors found a 13% short-term decrease in nasal congestion for adolescent or adult patients receiving a single dose of decongestant compared to those who received placebo. However, subsequent doses were not significantly better at relieving nasal congestion than placebo. Another study demonstrated that a 60 mg dose of pseudoephedrine administered four times daily over three days improved congestion and subjective improvement scores in adult patients.[21] Intranasal decongestants relieve nasal congestion temporarily but should be limited to two or three days due to rebound congestion. Rebound congestion occurs after using a topical nasal de-

**Table 1.** Analgesic dosing for adults and children[18]

| Drug | Dose | |
|---|---|---|
| | **Infants and Children ≤ 12 years** | **Adult, adolescent, and children > 13 years** |
| **Acetaminophen** | 10-15 mg/kg/dose Q4-6h; do not exceed 5 doses in 24 hours | 325-650 mg Q4-6h or 1,000 mg Q6-8h; max dose 3,000-4,000 mg/day |
| **Ibuprofen** *(infants older than 6 months)* | 10 mg/kg/dose Q6-8h; max dose 40mg/kg/day | 200-400 mg Q4-6h; max dose 1,200 mg/day |

≤ = less than or equal to
> = greater than

congestant for more than 72 hours. Patients will develop worsening or severe nasal congestion that is only relieved with additional use of the nasal decongestant. Patients may also experience headaches, anxiety, or restlessness. Studies of decongestants have not included patients less than 12 years of age and there have been a number of anecdotal reports of serious toxicity in young children using oral decongestants.[22]

Combination antihistamine-decongestant products may have a role in the treatment of common cold-associated congestion, rhinorrhea, and sneezing in adolescents and adults; however, they have not been shown to be effective in young children. Mild benefits need to be weighed against the risk of experiencing adverse effects.[19,23]

The Drug Enforcement Agency restricts the sale of pseudoephedrine-containing cold medications to behind the counter due to the use of this ingredient in the illegal production and sale of methamphetamine.[24] The amount of pseudoephedrine that a single individual can purchase on a monthly basis is restricted and pharmacies are required to retain records of these logs for two years (check the laws in your own state as they may be more strict).[24] An alternative oral decongestant available over-the-counter is phenylephrine. However, a 10 mg dose was not significantly more effective than placebo in one study.[25]

Cough associated with the common cold is usually due to postnasal drip or nasal congestion. The American College of Chest Physicians guidelines do not recommend cough suppressants for cough caused by URTI.[26] This is due to the lack of evidence to support the effectiveness of any over-the-counter cough suppressant at reducing the frequency or severity of cough in children or adults.[27,28] In contrast, two studies included in a Cochrane review suggest dextromethorphan 30 mg was effective for cough suppression.[29] Combination antihistamine/decongestant medications may also have a modest benefit, but their use is associated with an increased risk of adverse effects.[29] None of the available cough suppressants are approved to treat cough in children. The American Academy of Pediatrics warns against the use of antihistamine/decongestant combination products or cough suppressants as their use has been associated with serious adverse effects and dosing errors.[30] Although codeine is effective in suppressing chronic cough, trials of the effectiveness of codeine in patients with acute cough due to the common cold have found no consistent benefit compared with placebo.[29]

Other therapies that have been evaluated for the relief of rhinorrhea and sneezing associated with the common cold are ipratropium bromide and cromolyn sodium. In one study of 411 adult patients who had cold symptoms for less than 36 hours prior to study entry, ipratropium nasal spray administered as two 42 mcg sprays per nostril three or four times daily reduced the volume of nasal discharge by 26 percent and the severity of rhinorrhea by 31 percent compared with placebo spray.[31] Ipratropium use was also associated with reduced sneezing, although nasal congestion was not improved. A review of seven trials comparing ipratropium and placebo (2,144 participants) found improvement in rhinorrhea with ipratropium.[32] The authors also concluded there was a twofold increase in adverse effects (nasal dryness, blood-tinged mucus, and epistaxis or bloody nose) in patients assigned to ipratropium.

Intranasal and inhaled cromolyn sodium may also improve common cold symptoms. A study of 118 adult patients with symptoms of runny nose, throat pain, or cough for less than 24 hours compared the use of sodium cromoglycate dry powder (20 mg per inhalation), sodium cromoglycate aqueous nasal spray (5.2 mg per dose), or matching placebos every two hours during waking hours on days one and two, and four times daily on days three to seven.[33] Symptoms resolved faster in patients treated with sodium cromoglycate than with placebo. Adverse effects were mild and did not differ among the three treatment groups. Drug cost and prescription status makes the use of this drug therapy prohibitive.

Guaifenesin, an expectorant, has been compared to placebo in a study with questionable effect.[34] An additional review identified two studies comparing guaifenesin to placebo and found patient-reported cough was decreased with guaifenesin in one study, but no difference from placebo in the other.[29]

Patients with the common cold should be encouraged to maintain hydration (fluid intake), get plenty of rest, and be assured that symptoms should resolve in about 7-14 days. Patients should also avoid antibiotics as they are not effective for the common cold and may increase the likelihood of resistance and adverse effects. Lastly, patients should seek medical attention if symptoms worsen.

**Table 2:** Antibiotic Recommendations for the Treatment of Bacterial Sinusitis*

| Indication | Children | | Adults | |
|---|---|---|---|---|
| | **First-line** | **Second-line** | **First-line** | **Second-line** |
| **Initial** | amoxicillin-clavulanate (amoxicillin component: 45 mg/kg/day PO Q12h) | amoxicillin-clavulanate (amoxicillin component: 90 mg/kg/day PO Q12h) | amoxicillin-clavulanate (500/125 mg PO Q8h or 875/125 mg PO Q12h) | • amoxicillin-clavulanate (2,000/125 mg PO Q12h)<br>• doxycycline 100 mg PO Q12h or 200mg PO daily) |
| **Severe beta-lactam (penicillin or cephalosporin) allergy** | ----- | levofloxacin (10-20 mg/kg/day PO Q12-24h) | ----- | • doxycycline 100 mg PO Q12h or 200 mg PO daily)<br>• levofloxacin 500 mg PO daily<br>• moxifloxacin 400 mg PO daily |
| **Mild beta-lactam (penicillin or cephalosporin) allergy** | ----- | clindamycin (30-40 mg/kg/day PO Q8h) **plus** cefixime (8 mg/kg/day PO Q12h) **or** cefpodoxime (10 mg/kg/day PO Q12h) | | |
| **Risk for antibiotic resistance or failed initial therapy** | ----- | • amoxicillin-clavulanate (90 mg/kg/day PO Q12h)<br>• clindamycin (30-40 mg/kg/day PO Q8h) **plus** cefixime (8 mg/kg/day PO Q12h) **or** cefpodoxime (10 mg/kg/day PO Q12h)<br>• levofloxacin (10-20 mg/kg/day PO Q12-24h) | ----- | • amoxicillin-clavulanate (2,000/125 mg PO Q12h)<br>• levofloxacin 500 mg PO daily<br>• moxifloxacin 400 mg PO daily |
| **Severe infection requiring hospitalization** | ----- | • ampicillin-sulbactam (200-400 mg/kg/day IV Q6h)<br>• ceftriaxone (50 mg/kg/day IV Q12h)<br>• cefotaxime (100-200 mg/kg/day IV Q6h)<br>• levofloxacin (10-20 mg/kg/day PO Q12-24h) | ----- | • ampicillin-sulbactam (1.5-3 g IV Q6h)<br>• levofloxacin 500 mg PO or IV daily<br>• moxifloxacin 400 mg PO or IV daily<br>• ceftriaxone (1-2 g IV Q12-24h)<br>• cefotaxime (2 g IV Q4-6h) |

*Adapted from the IDSA Bacterial Rhinosinusitis Guidelines[40]

## *Rhinosinusitis*

Rhinosinusitis or sinusitis is defined as inflammation and/or infection of the lining of the nasal passages and nasal sinuses. Despite the fact that the majority of these infections are viral in nature, antimicrobials are prescribed for up to 81% of adults presenting with sinusitis.[35,36] Sinusitis has been shown to be the fifth leading indication for antibiotic prescribing in the outpatient setting.[37] In 1996, the total direct healthcare costs associated with sinusitis were estimated to exceed $3 billion per year.[38]

Antibiotic over-prescribing is a major concern in the management of acute sinusitis, largely due to the difficulty in differentiating between bacterial sinusitis and viral sinusitis. This difficulty stems from the similar presentation of viral and bacterial sinusitis and from how difficult and/or painful it is to obtain cultures. The main difference; however, is that viral infections usually resolve on their own within 7-10 days. It is estimated that approximately 70% of patients improve on their own in studies and 90-98% of all cases are caused by a virus.[36,39] If symptoms persist longer than this or worsen, it is likely bacterial in nature. Bacterial sinusitis may persist for four weeks and may become chronic (lasting greater than 3 months).

There are a variety of factors that can be associated with sinusitis including allergies, trauma, environmental exposures, anatomic abnormalities, and systemic diseases.[40] Factors associated with antibiotic resistance in bacterial sinusitis include: age less than 2 year or greater than 65 years; daycare; prior antibiotics within the past three months or hospitalization in the past five days; comorbidities (additional diseases/conditions); and immunocompromised state.[41]

Adults with sinusitis tend to experience nasal congestion; rhinorrhea; tooth, facial, or sinus pain/pressure; ear pressure/pain; cough; and/or headache. Children may have rhinorrhea and cough. If patients have a fever, it may suggest a bacterial infection. If a child presents with fever greater than 102.2 °F or facial pain and swelling are present, this may be signs of a bacterial infection as well. Many of the symptoms of chronic sinusitis overlap with acute sinusitis with additional symptoms that can include laryngitis, non-productive (dry) cough, and headache.

The most common microorganisms that cause acute bacterial sinusitis are *Streptococcus pneumoniae, Haemophilus influenzae,* and *Moraxella catarrhalis. Staphylococcus aureus, Streptococcus pyogenes,* fungi, and anaerobes are also pathogens responsible for causing sinusitis; however, much less frequently.[41]

Supportive therapy may be considered to relieve symptoms in both viral sinusitis and bacterial sinusitis. Congestion is usually one of the predominant symptoms of sinusitis. The Infectious Diseases Society of America (IDSA) Rhinosinusitis guidelines recommend against the use of topical and oral decongestants despite the evidence to support subjective improvement in nasal congestion.[41] The authors conclude that the risks associated with topical or oral decongestant use (as above) exceed their benefits. Decongestants may have a role in relieving congestion especially in viral sinusitis when used for a short course in adults, but they should be avoided in children. The guidelines also recommend against the use of antihistamines as they can dry nasal mucosa and disturb the clearance of mucosal secretions.[41]

Analgesics can be used to relieve sinus pain, headache, and/or fever. Intranasal corticosteroids are recommended specifically for those patients with allergic rhinitis. Benefits of intranasal corticosteroids may be attributed to their anti-inflammatory properties which thereby reduce mucosal swelling and promote drainage.[42] Saline irrigation is also recommended as it has been shown to provide symptomatic relief, is inexpensive, and safe.[41] Saline irrigation may cause nasal burning or irritation.

Antibiotic treatment recommendations may be found in **Table 2.** Antibiotics should be continued for 5-7 days in adults and 10-14 days in children.[41]

## *Pharyngitis*

Pharyngitis is an infection of the oropharynx or nasopharynx. Viral causes are the most common followed by *Streptococcus pyogenes* (Group A *Streptococcus* or GAS) as the primary bacterial pathogen. "Strep" throat is responsible for 5-15% of sore throat visits in adults and 20-30% in children.[43,44] The estimated economic burden of pediatric pharyngitis in the US ranges from $224 million to $539 million annually including indirect costs related to parental time away from work.[45] Strep throat is difficult to differentiate from viral pharyngitis based solely on clinical findings (symptoms). Although all age groups are susceptible, epidemiologic data show that certain groups

are at higher risk such as children ages 5-15 years old, parents of school-age children, and those who work with children. GAS rarely causes pharyngitis in children less than 3 years of age.[46] Due to this diagnostic challenge, swabbing the throat and testing for GAS pharyngitis using rapid antigen detection and/or culture should be performed. If the rapid antigen testing is negative in children and adolescents, results should be confirmed with a throat culture; however, if a rapid antigen test is positive, there is no need to confirm the result with culture.[46] Other organisms (pathogens) can cause pharyngitis such as other *Streptococcus* species, *Arcanobacterium haemolyticum, Corynebacterium diptheriae, Neisseria gonorrhoea, Mycoplasma pneumoniae,* anaerobes, and *Fusobacterium necrophorum;* however, they do not routinely require antibiotic therapy. Despite improvements in antimicrobial prescribing for children and adults with acute pharyngitis, a substantial number of patients continue to receive inappropriate antimicrobial therapy.[47-49] Inappropriate antimicrobial use for URTI, including acute pharyngitis, has been a major contributor to the development of antimicrobial resistance among common pathogens.[49]

Patients typically have symptoms of a sore throat with rapid, sudden onset. Other concomitant symptoms include: pain upon swallowing; fever; redness and swelling of the tonsils and pharynx; enlarged, tender lymph nodes; red, swollen uvula; petechiae on the soft palate (roof of mouth); and a scarlatiniform (wide-spread small red papules) rash. Children may also experience headache, nausea, vomiting, and abdominal pain.[46,47] Complications associated with GAS pharyngitis are acute rheumatic fever, acute glomerulonephritis (inflammation of the small blood vessels in the kidneys), and reactive arthritis. In addition, patients may develop peritonsillar abscess, retropharyngeal abscess (throat infections), cervical lymphadenitis (swollen lymph nodes in the neck), mastoiditis (infection of the bone behind the ear), otitis media, sinusitis, and necrotizing faciitis (flesh eating disease).

Seasonal outbreaks occur most often in winter and early spring.[46] Spread of infection occurs through direct contact with droplets of nasal secretions or saliva. If GAS patients are left untreated they can be contagious for up to a week after the acute illness. Treatment with antibiotics reduces the infectious period to 24 hours.

Analgesics such as APAP or ibuprofen may be used to relieve pain; however, APAP is preferred. Rest, fluids, lozenges, and saltwater gargles may be encouraged.[50] If GAS is confirmed through laboratory testing and clinical symptoms, antibiotics should be initiated. See **Table 3** for antibiotic recommendations. Antibiotic therapy should be continued to complete a 10-day course.

**Table 3:** Antibiotic Recommendations for the Treatment of Bacterial Pharyngitis*

| Indication | Children | Adults |
|---|---|---|
| **No beta-lactam (penicillin or cephalosporin) allergy** | • penicillin VK (50 mg/kg/day PO divided Q8h)<br>• amoxicillin (50 mg/kg/day PO divided Q8h)<br>• penicillin benzathine (< 27 kg: 0.6 million units IM; ≥ 27 kg: 1.2 million units IM) | • penicillin VK (250 mg PO Q6h or 500 mg PO Q12h)<br>• amoxicillin (500 mg PO Q8h)<br>• penicillin benzathine (1.2 million units IM) |
| **Beta-lactam (penicillin) allergy** | • cephalexin** (20 mg/kg/dose PO Q12h)<br>• cefadroxil** (30 mg/kg PO daily)<br>• clindamycin (7 mg/kg/dose PO Q8h)<br>• azithromycin (12 mg/kg PO daily)<br>• clarithromycin (7.5 mg/kg/dose PO Q12h) | • cephalexin** (500 mg PO Q12h)<br>• cefadroxil** (1,000 mg PO daily)<br>• clindamycin (300mg PO Q8h)<br>• azithromycin (500 mg X1 dose then 250 mg daily X5 days)<br>• clarithromycin (250-500 mg PO Q12h) |

*Adapted from the IDSA Pharyngitis Guidelines[46]
**Avoid in severe beta-lactam allergy
< = less than
≥ = greater or equal to

## *Otitis Media*

Otitis Media (OM) is defined as inflammation of the middle ear and is the most common diagnosis for which antibiotics are prescribed in children in the US. In 1995, the direct cost of OM was estimated at approximately $2 billion, with indirect costs estimated to be an additional $1 billion.[51] In 2000, there were more than 16 million office visits and 13 million antibiotic prescriptions written for OM.[49] Acute bacterial OM usually follows a viral URTI that causes eustachian tube dysfunction and mucosal swelling in the middle ear.[52] Bacteria may colonize the nasopharynx, enter the middle ear, and lead to infection if the bacteria are not properly cleared.[53] Children are more susceptible to OM than adults because their eustachian tube is shorter and more horizontal which facilitates bacterial entry into the middle ear.[52] Other risk factors for the development of OM are daycare setting, lack of breastfeeding, pacifier use, early age of first diagnosis, nasopharyngeal colonization, siblings in the home, lower socioeconomic status, male gender, allergy, exposure to cigarette smoke, urban population, and immunodeficiency.[54]

*Streptococcus pneumoniae* is responsible for approximately 20-35% of all acute bacterial OM cases which makes up the majority of cases. Similar to the other URTIs, *Haemophilus influenzae* and *Moraxella catarrhalis* are also implicated in approximately 20-30% of cases.[55] Other less frequently encountered pathogens include *Staphylococcus aureus, Streptococcus pyogenes,* and gram negative bacilli such as *Pseudomonas aeruginosa.*[52] Viruses may be the cause in up to 45% of OM cases.[53]

Patients with acute OM present with a rapid onset of symptoms including: fever; ear pain; tugging on the ear; irritability; difficulty sleeping, accompanied by signs such as a gray, bulging, limited or non-motile tympanic membrane (TM); air-fluid level behind the TM; or discharge from the ear.[55] Children may also experience rhinorrhea, nasal congestion, or cough in the days preceding OM symptoms as OM usually follows a viral URTI. Complications of OM are infrequent but include mastoiditis, bacteremia (blood stream infection), meningitis (inflammation of the lining of the brain), and/or hearing loss that may lead to speech and language developmental delays.

Up to 80% of OM cases resolve on their own without intervention. In a review, authors reported that nine studies demonstrated no symptomatic benefit at 24 hours, 4% greater relief at 2-3 days, and 9% benefit for symptoms at 4-7 days.[56] There was no difference in clinical outcome at 7-14 days. The duration of OM was equal for observation and antibiotic groups. This analysis also concluded that antibiotics provided resolution of symptoms in 95% of patients with OM. Another review of the role of antibiotics for the treatment of OM found no reduction in pain at 24 hours and a reduction in pain of 7% at 2 days.[57] Antibiotics also did not influence other complications or OM recurrence rates. The major limitation to these studies was a lack of consistent definition of OM which lead the OM guideline authors to recommend observation off antibiotics an initial option, albeit controversial, for certain patient populations.[51] **Table 4** lists the criteria for initial antibiotic treatment versus observation for children with OM. The decision to treat should be at the discretion of the prescribing clinician. If observation off antibiotics is selected, close follow-up is recommended.

As ear pain is the most common symptom of OM, APAP or ibuprofen may be used for relief of pain and fever. These should be initiated early regardless of antibiotic administra-

**Table 4:** Criteria for antibiotics or observation off antibiotics in children with OM*

| Age | Confirmed Diagnosis | Uncertain Diagnosis |
|---|---|---|
| **Less than 6 months** | Antibiotics recommended | Antibiotics recommended |
| **6 months to 2 years** | Antibiotics recommended | Severe illness: **antibiotics recommended<br>Non-severe illness: ***observation off antibiotics |
| **2 years or older** | Severe illness: **antibiotics recommended<br>Non-severe illness: ***observation off antibiotics | Observation |

*Adapted from the American Academy of Pediatrics Subcommittee on Management of Acute Otitis Media[51]
**Severe illness: moderate to severe ear pain or fever ≥ 102.6° F
***Non-severe illness: mild ear pain and fever < 102.6° F

tion.[51] Decongestants, antihistamines, topical corticosteroids, and expectorants have not been proven effective for the treatment of symptoms associated with OM and should be avoided due to the risk of adverse effects.[58,59]

Surgical intervention with tympanostomy tubes is a common and effective method for the prevention of recurrent OM. They are small tubes surgically placed into the TM under general anesthesia which help to aerate the middle ear. Children with recurrent OM defined as having more than three episodes in six months or four or more episodes in a year should be considered for tympanostomy tube placement.

If the decision is made to treat with antibiotics, treatment duration should be determined based on patient age and severity of illness. Patients less than 5 years old and children with severe disease, should receive a standard 10-day course of antibiotics. For children 6 years of age or older with mild to moderate OM, a 5-7 day course is appropriate.[51] See **Table 5** for the treatment of OM with antibiotics.

## *URTI Summary*

Despite improvements in antimicrobial prescribing for children and adults with URTIs, a substantial number of patients continue to receive inappropriate antibiotic therapy. Inappropriate antibiotic use for upper respiratory tract infections has been a major contributor to the development of antimicrobial resistance among common pathogens such as *Streptococcus penumoniae, Haemophilus influenzae,* and *Staphylococcus aureus.* Every time antibiotics are administered for an URTI, the patient is at an increased risk of selection and colonization of resistant organisms that may be passed to others. Decreasing the use of antibiotics is beneficial to society as a whole and the benefit-harm relationship for the patient should be closely assessed. Reassurance to patients regarding symptomatic relief is essential.

Resistance to antibiotics may be reduced by limiting exposure to antibiotics, limiting the spectrum of activity of selected antibiotics to that specifically required to treat the identified pathogen, using the appropriate dose of antibiotic to achieve effective concentrations at the site of infection, and treating for the shortest effective duration.

**Table 5:** Antibiotic Recommendations for the Treatment of Otitis Media*

| Indication | Drug and dose | Treatment Failure |
|---|---|---|
| **First line** | • amoxicillin 80-90 mg/kg/day divided Q12h | • amoxicillin-clavulanate 80-90 mg/kg/day (of amoxicillin component) divided Q12h<br>• ceftriaxone 50 mg/kg/day IM or IV for 3 days |
| **If severe symptoms (severe ear pain and fever ≥ 102.6° F)** | • amoxicillin-clavulanate 80-90 mg/kg/day (of amoxicillin component) divided Q12h | • Clindamycin 30-40 mg/kg/day divided Q8h |
| **Severe beta-lactam (penicillin or cephalosporin) allergy** | • azithromycin 10 mg/kg day 1, then 5 mg/kg/day days 2-5<br>• clarithromycin 15 mg/kg/day divided Q12h | ----- |
| **Mild beta-lactam (penicillin or cephalosporin) allergy** | • cefdinir 14 mg/kg/day once daily or divided Q12h<br>• cefuroxime 30 mg/kg/day divided Q12h<br>• cefpodoxime 10 mg/kg daily<br>• cefprozil 30 mg/kg/day divided Q12h | ----- |

*Adapted from American Academy of Pediatrics Subcommittee on Management of Acute Otits Media: Diagnosis and management of acute otitis media[51]

## Lower Respiratory Tract Infections (LRTI)

### *Bronchitis*

Bronchitis is an inflammation of the bronchial tube lining characterized by cough without pneumonia. It may be classified as either acute or chronic in nature. Acute bronchitis affects patients of all ages; however, chronic bronchitis primarily occurs in adults. Bronchitis affects approximately 5% of adults annually with a higher incidence in the fall and winter months.[60] In the US, acute bronchitis is the ninth most common illness among outpatients.[61]

Viruses such as rhinovirus, parainfluenza virus, adenovirus, coronavirus, and influenza virus are usually considered the cause of acute bronchitis.[60] *Mycoplasma pneumoniae, Chlamydophila pneumoniae,* and *Bordetella pertussis* (whooping cough) are classified as atypical organisms that may be implicated in acute bronchitis.

Acute bronchitis typically starts with non-specific upper respiratory symptoms; however, cough is the hallmark sign. The onset may be rapid; however, the cough persists from 5 days up to several weeks despite resolution of the other symptoms. The cough is initially non-productive (dry) followed by productive cough with purulent sputum. Fever is uncommon and rarely exceeds 102.2° F. Patients may also experience congestion, malaise, and/or headache. The diagnosis of chronic bronchitis is reserved for patients who have cough and sputum production on most days of the month for at least three months of the year during two consecutive years.[62]

Treatment of acute bronchitis is focused on symptomatic relief. Analgesics such as APAP or ibuprofen may be used to reduce fever. Patients should be encouraged to drink plenty of water as there is some evidence to support its role in thinning mucosal secretions and is es-

**Table 6:** Antibiotic Recommendations for the Treatment of Acute Bronchitis*

| Pathogen | Therapeutic Options/Recommendations | |
|---|---|---|
| **Viruses** | | |
| **Adenovirus** | None available | |
| **Coronavirus** | None available | |
| **Influenza virus** | • oseltamivir (adults: 75 mg PO Q12h X5 days; children ≤ 15 kg: 30 mg Q12h, 16-23 kg: 45 mg Q12h, 24-40 kg: 60 mg Q12h, ≥ 41 kg: 75 mg Q12h X5 days)<br>• zanamivir (adults and children ≥ 7 years old: 2 puffs [5 mg/puff] Q12h) | |
| **Parainfluenza virus** | None available/supportive care | |
| **Respiratory syncytial virus** | None available/supportive care | |
| **Rhinovirus** | None available | |
| **Atypical Bacteria** | | |
| ***Bordetella pertussis*** | **First line**<br>• azithromycin (adults: 500 mg PO day 1 then 250 mg daily days 2-5; children: 10 mg/kg day 1, then 5 mg/kg/day days 2-5)<br>• clarithromycin (adults: 500 mg PO Q12h X 7 days; children: 7.5 mg/kg/dose PO Q12h) | **Second line**<br>• trimethoprim-sulfamethoxazole (adults: 160/800 mg PO Q12h; children: 8-12 mg/kg divided Q12h) |
| ***Mycoplasma pneumoniae***<br>***Chlamydophila pneumoniae*** | • azithromycin (adults: 500 mg PO day 1 then 250 mg daily days 2-5; children: 10 mg/kg day 1, then 5 mg/kg/day days 2-5)<br>• doxycycline (adults: 100 mg PO Q12h; avoid in children)<br>• no therapy (as data do not support improved outcomes of bronchitis with antibiotics) | |

*Adapted from American College of Chest Physicians Bronchitis Guidelines[65]

sential to maintaining hydration.[63] Cough suppressants such as dextromethorphan may be occasionally useful. According to the 2001 guidelines of the American College of Physicians (ACP) for the treatment of uncomplicated acute bronchitis, antibiotics are not recommended, regardless of cough duration.[64] The 2006 acute bronchitis recommendations from the American College of Chest Physicians (ACCP) state that routine treatment with antibiotics is not needed.[65] If specific pathogens are isolated, antibiotic treatment may be initiated at the discretion of the prescriber. **Table 6** includes pathogen specific treatment recommendations.

## *Community-Acquired Pneumonia (CAP)*

Pneumonia is inflammation of the lung and is the sixth leading cause of mortality (death) in adults in the US and the single greatest cause of death in children worldwide.[66,67] According to one estimate, three million cases of pneumonia are diagnosed annually with a cost of more than $20 billion.[68] Pneumonia affects patients of all ages and may occur at any time of the year. Clinical manifestations tend to be more severe in the very young, elderly, and patients who are immunocompromised.

The most common offending pathogens responsible for causing CAP in otherwise healthy adults include *Streptococcus pneumoniae* (up to 75% of all cases) followed by *Haemophilus influenzae, Mycoplasma pneumoniae, Chlamydophila pneumoniae, Legionella pneumophila,* and a variety of viruses, specifically, influenza.[69] These pathogens similarly cause CAP in children; however, viruses are common.[70] See **Table 7** for common offending pathogens and treatment recommendations for children with CAP. *Staphylococcus aureus* and other gram negative organisms may cause CAP; however, much less frequently and typically in patients with comorbidities such as alcoholism and diabetes mellitus.

Patients with pneumonia typically have some or all of the following symptoms: rapid onset of fever, chills, shortness of breath, productive cough, rust-colored sputum (especially with *Streptococcus pneumoniae*), and chest pain on inspiration. Prior to the selection of antibiotic therapy, a decision regarding the most appropriate environment for the patient to be treated (i.e., outpatient setting, inpatient general medicine, or inpatient intensive care unit) needs to be made. In adults, there are a few severity of illness scores that may be utilized to help guide location of therapy: the Pneumonia Severity Index (PSI) and the CURB-65 criteria are the most common. The PSI is fairly long and cumbersome to complete whereas the CURB-65 is quite simple and more widely utilized. There is no evidence to suggest superiority of either scale.[71] CURB-65 is calculated by assigning one point to each of the following positive factors: BUN > 20 mg/dL, respiratory rate ≥ 30 breaths/min, low blood pressure (systolic < 90 mmHg; or diastolic ≤ 60 mmHg), and age ≥ 65 years.[69] This score is based on the factors that are most predictive of mortality risk associated with CAP. Patients with a CURB-65 score of 0-1 may be treated in the outpatient setting, patients with a score of 2 should be admitted inpatient to the general medicine floor, and those patients with a score of 3 or more should be admitted to the intensive care unit. For children the decision to treat in the outpatient versus inpatient setting is based primarily on age and severity of illness. Children with moderate to severe CAP as defined by: respiratory distress and hypoxemia ($SpO_2$ < 90%); infants less than 3-6 months of age; suspicion or documentation of a virulent pathogen such as methicillin-resistant *Staphylococcus aureus* (MRSA); and children for whom there is concern for inadequate follow-up should initially be admitted to the hospital for treatment.[70]

A chest X-ray is required to evaluate patients with suspected CAP. This assists in the confirmation of the diagnosis and helps to differentiate CAP from other common causes of fever and cough (e.g., acute bronchitis). Chest computed tomography (CT) may also be performed. Development of an infiltrate (fluid in the lungs) on chest X-ray is typically delayed or more specifically, patients will experience symptoms prior to the infiltrate appearing on radiographs. Additionally, it is not recommended to perform a follow-up chest X-ray at the end of therapy to assess resolution because it can take weeks for an infiltrate to completely resolve. Blood cultures should also be obtained in patients admitted to the intensive care unit or those with moderate to severe CAP.[69,70] The adult guidelines also recommend evaluating blood cultures in patients with the following comorbidities (alcoholism, asplenia, chronic liver disease, severe obstructive lung disease) or those with a positive pneumococcal urinary antigen.[69] Blood cultures should be drawn prior to the first dose of antibiotics. Blood cultures have been reported to be positive in approximately 5-14% of patients. However, obtaining appropriate blood cultures is considerably important in severe CAP, as patients with severe disease are more likely to be infected with pathogens other than

**Table 7:** Common Offending Pathogens and Empiric Treatment Recommendations for the Treatment of Community-Acquired Pneumonia [CAP] in Children)*

| Patient Location/Age | Common Pathogens | Treatment Recommendations for Presumed Bacterial CAP | Treatment Recommendations for Presumed Atypical CAP | Treatment for Presumed Viral CAP |
|---|---|---|---|---|
| **Outpatient** | | | | |
| **< 5 years (preschool)** | Viruses (RSV, parainfluenza virus, influenza, adenovirus, metapneumovirus)<br><br>*Streptococcus pneumoniae*<br>*Haemophilus influenzae*<br><br>Consider atypical organisms:<br>*Mycoplasma pneumoniae*<br>*Chlamydophila pneumoniae* | amoxicillin (90 mg/kg/day PO divided Q12h)<br><br>Alternative:<br>amoxicillin-clavulanate (amoxicillin component 90 mg/kg/day PO divided Q12h) | azithromycin (10 mg/kg PO on day 1, then 5 mg/kg/day days 2-5)<br><br>Alternatives:<br>clarithromycin (15 mg/kg/day PO divided Q12h) or<br>erythromycin (40 mg/kg/day PO divided Q6h) | No antibiotics recommended for viruses; supportive care only<br><br>If influenza: oseltamivir** |
| **≥ 5 years** | | amoxicillin (90 mg/kg/day PO divided Q12h; maximum of 4 g/day)<br><br>If atypical infection cannot be ruled out: **ADD** azithromycin (10 mg/kg PO on day 1, then 5 mg/kg/day days 2-5)<br><br>Alternative:<br>amoxicillin-clavulanate (amoxicillin component 90 mg/kg/day PO divided Q12h; maximum of 4 g/day) | azithromycin (10 mg/kg PO on day 1, then 5 mg/kg/day days 2-5; maximum of 500 mg on day 1 and 250 mg on days 2-5 )<br><br>Alternatives:<br>clarithromycin (15 mg/kg/day PO divided Q12h; maximum of 1 g/day) or<br>erythromycin (40 mg/kg/day PO divided Q6h) or<br>doxycycline for children > 7 years old | If influenza: oseltamivir or zanamivir (children > 7 years old)** |
| **Inpatient (all ages)** | | | | |
| **Fully immunized with conjugate vaccines for *Haemophilus influenzae* type b and *Streptococcus pneumoniae;* local penicillin resistance in pneumococcus minimal** | *Streptococcus pneumoniae*<br>*Mycoplasma pneumoniae*<br>*Chlamydophila pneumoniae*<br>*Haemophilus influenzae* | ampicillin or penicillin G<br><br>Alternatives:<br>ceftriaxone or cefotaxime<br><br>addition of vancomycin or clindamycin for suspected community-acquired MRSA** | azithromycin in addition to ceftriaxone or cefotaxime (if atypical not confirmed)**<br><br>Alternatives:<br>clarithromycin (15 mg/kg/day PO divided Q12h; maximum of 1 g/day) **or**<br>erythromycin (40 mg/kg/day PO divided Q6h);<br>doxycycline for children > 7 years old;<br>levofloxacin for children who have reached growth maturity who cannot tolerate macrolides | If influenza: oseltamivir or zanamivir (children > 7 years old)** |
| **Not fully immunized with conjugate vaccines for *Haemophilus influenzae* type b and *Streptococcus pneumoniae;* local penicillin resistance in pneumococcus significant** | | ceftriaxone or cefotaxime<br><br>addition of vancomycin or clindamycin for suspected community-acquired MRSA<br><br>Alternatives:<br>levofloxacin<br>addition of vancomycin or clindamycin for suspected community-acquired MRSA** | | |

*Adapted from: The Management of Community-Acquired Pneumonia in Infants and Children Older than 3 Months of Age: Clinical Practice Guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America[70]
**Refer to the full guidelines for intravenous and oral dose recommendations
< = less than
> = greater than
≥ = greater than or equal to

**Table 8:** Antibiotic Recommendations for the Treatment of Community-Acquired Pneumonia in Adults*

| Treatment Recommendations | | Comments |
|---|---|---|
| **Empiric Treatment** | **Outpatient:**<br>*For patients who are previously healthy with no risk factors for drug-resistant* Streptococcus pneumoniae:<br>• Macrolide<br>• Doxycycline | **Macrolides:**<br>• azithromycin 500 mg X1 then 250 mg daily X4 days or 500 mg daily X3 days<br>**Other:**<br>• doxycycline 100 mg Q12h |
| | *For patients with any of the following comorbidities: chronic renal, hepatic, heart, or lung disease, diabetes mellitus, alcoholism, malignancies, asplenia, immunosuppressing conditions or current use of immunosuppressing medications, use of antimicrobials within previous 90 days, or other risk factors for drug-resistant* Streptococcus pneumoniae, *or in areas with > 25% of infections with high level macrolide-resistant* S. pneumoniae:<br>• Respiratory fluoroquinolone<br>• Beta-lactam + macrolide (or doxycycline for patients with macrolide allergy/intolerance, or concern for drug interactions or adverse effects such as QT prolongation) | **Respiratory fluoroquinolones:****<br>• moxifloxacin 400 mg daily<br>• levofloxacin 750 mg daily<br>• gemifloxacin 320 mg daily<br>**Ciprofloxacin is not considered a respiratory fluoroquinolone due to the lack of *S. pneumoniae* coverage<br><br>**Beta-lactams (preferred):**<br>• amoxicillin 1 g Q8h<br>• amoxicillin/clavulanate 2 g Q12h<br>• ceftriaxone 1 g Q24h (2 g if patient ≥ 100 kg)<br>• cefpodoxime 200 mg Q12h<br>• cefuroxime 500 mg Q12h |
| | **Inpatient, Non-ICU:**<br>• Respiratory fluoroquinolone<br>• Beta-lactam + macrolide<br><br>*For patients with documented beta-lactam allergy* ***and*** *fluoroquinolone allergy or potential fluoroquinolone drug interaction or adverse effect concern:*<br>• Tigecycline 100mg X1 then 50 mg Q12h | Consider previous antimicrobial therapy when selecting empiric antimicrobials (i.e., if a patient was receiving a beta-lactam or a macrolide prior to admission, consider a respiratory fluoroquinolone or if a patient was receiving a fluoroquinolone prior to admission, consider a beta-lactam + macrolide, etc.)<br><br>**Beta-lactams (preferred):**<br>• ceftriaxone 1 g Q24h (2 g if patient ≥ 100 kg)<br>• cefotaxime 1 g Q8h (2 g if patient > 80 kg)<br>• ampicillin/sulbactam 1.5 g Q6h (3 g if patient > 80 kg)<br>• ertapenem 1 g Q24h<br>• ceftaroline 600 mg Q12h |
| | **Inpatient, ICU:**<br>• Beta-lactam + macrolide (intravenous formulation)<br>• Beta-lactam + respiratory fluoroquinolone (intravenous formulation)<br><br>*For documented beta-lactam allergy:*<br>• Respiratory fluoroquinolone + aztreonam | **Beta-lactams (preferred):**<br>• ceftriaxone 1 g Q24h (2g if patient ≥ 100 kg)<br>• cefotaxime 1 g Q8h (2g if patient > 80 kg)<br>• ampicillin/sulbactam 1.5 g Q6h (3g if patient > 80 kg)<br><br>**Other:**<br>• aztreonam 1-2 g Q8h<br><br>The IV formulation of the selected macrolide or respiratory fluoroquinolone is utilized in initial therapy due to possible reduced GI absorption of oral medications in hypotensive patients. |
| | ***Pseudomonas* risk:**<br>• Antipseudomonal beta-lactam + antipseudomonal fluoroquinolone<br>• Antipseudomonal beta-lactam + aminoglycoside + either antipneumococcal fluoroquinolone or macrolide<br><br>*For patient with a documented beta-lactam allergy:*<br>• Aztreonam + antipneumococcal fluoroquinolone + aminoglycoside | **Antipseudominal beta-lactams:**<br>• piperacillin-tazobactam<br>• imipenem<br>• meropenem<br>• cefepime |

*Adapted from the IDSA/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults[69]

*Streptococcus pneumoniae.*[72,73] Sputum cultures are also recommended; however, they frequently provide a low yield due to the poor quality of specimens. Laboratory testing to evaluate for respiratory viruses is additionally recommended for children and adults. Lastly, urinary antigen tests are available to detect *Streptococcus pneumoniae* and *Legionella pneumophila* although the pneumococcal urinary antigen test is not recommended in children due to the incidence of false-positive results (i.e., says the antigen is present when it really is not).[70] Patients often have an elevated white blood cell count found in the complete blood count (CBC).

Treatment is focused on eradication of the offending pathogen. Aside from influenza, there is no recommended treatment for viral infection. The mainstay of therapy will involve symptomatic and supportive care. Patients should be encouraged to maintain hydration and may take APAP or ibuprofen to reduce fever. **Table 8** outlines the antibiotic treatment recommendations of CAP for adults. Treatment in adults should be continued for 5-7 days unless specific pathogens (e.g., *Legionella* species, etc.) have been isolated, the patient did not initially respond to therapy, or complications arose (e.g., meningitis, etc.). Treatment in children should be continued for 10 days; however, shorter courses may be utilized in patients with mild CAP who are treated in the outpatient setting.[70]

Vaccinations considerably help to reduce the incidence of CAP.[74] All patients 6 months of age or older should receive an influenza vaccination annually. Children should be vaccinated with vaccines for bacterial pathogens including *Streptococcus pneumoniae, Haemophilus influenzae* type b, and pertussis. The pneumococcal vaccine is recommended for adults 65 years of age or older and for those with selected high-risk comorbidities (e.g., immunocompromised patients). Adults should also receive a one-time pertussis booster.

## *Healthcare-Associated Pneumonia (HCAP)*

Hospital-acquired pneumonia (HAP) is defined as pneumonia that occurs 48 hours or more after hospital admission and was not developing at the time of admission.[75] Ventilator-associated pneumonia (VAP) occurs 48-72 hours after intubation and Healthcare-Associated pneumonia (HCAP) is pneumonia in patients with specific risk factors. See **Table 9** for a list of healthcare-associated risk factors.[76] These different types of pneumonia overlap considerably and will be referred to as HCAP for the purposes of this section.

HCAP is the second most common infection occurring in the hospitalized patient in the US and is associated with high morbidity (illness) and mortality (some reports of 33-50%).[76] HCAP may lengthen hospital stay by about 7-9 days per patient and is associated with an excess cost of $40,000 per patient.[77] HCAP may occur at any time and typically develops because this patient population is particularly at risk for colonization with resistant pathogens.

HCAP is rarely caused by viral pathogens. Common bacterial pathogens include gram negative organisms such as *Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae, Enterobacter, Serratia* species, *Proteus* species, and *Acinteobacter* species. Infections due to gram positive organisms, specifically *Staphylococcus aureus* (especially methicillin-resistant *Staphylococcus aureus*), are increasing.[78,79]

Patients with HCAP typically tend to experience cough and fever, similar to those patients with CAP. Patients who are ventilated (on a breathing tube) may have an increased need for suctioning secretions from the tube. Imaging and sputum cultures should be evaluated. Patients typically have an elevated white blood cell count as seen on the CBC.

Treatment is focused on eradication of the offending pathogen. Patients should receive adequate hydration and may be given APAP or ibuprofen to reduce fever.

| **Table 9:** Healthcare Associated Risk Factors[78] |
|---|
| • Hospitalization for ≥ 2 days in the preceding 90 days |
| • Antibiotics in the preceding 90 days |
| • Residence in a nursing home or extended care facility |
| • Home infusion therapy (including antibiotics) |
| • Chronic hemodialysis within 30 days |
| • Home wound care |
| • Family member with a multidrug-resistant pathogen |

Please see **Table 10** for antibiotic treatment recommendations for HCAP. Treatment should be continued for 7-8 days unless specific pathogens (e.g., *Pseudomonas* or *Acinetobacter* species, etc.) have been isolated.

### *LRTI Summary*

Bronchitis is predominantly caused by viruses, and similar to URTIs, should be treated symptomatically. Antibiotics should be withheld based on current guideline recommendations. This also may prevent the development of resistance. Bronchitis is also considered a mild LRTI. In contrast, there are substantial rates of morbidity and mortality associated with bacterial pneumonia. It may be mild to moderate or severe in nature and antibiotics are generally required to treat this infection. The shortest, most narrow spectrum agent is preferred.

## Conclusion

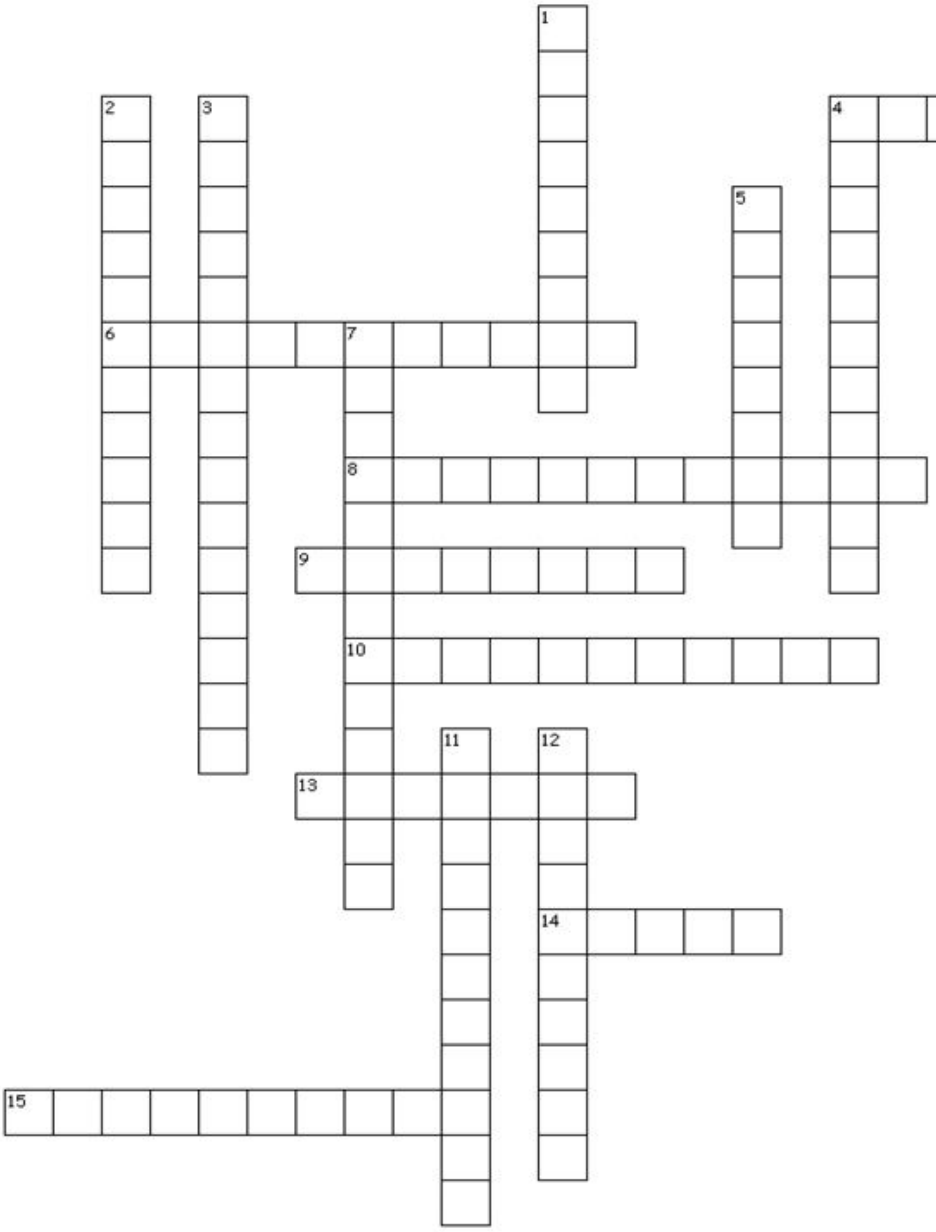
Respiratory tract infections remain the most common cause of morbidity from acute illness and are the most common reason patients seek medical attention. Careful patient assessment and evaluation of clinical signs and symptoms is essential to rule out viral causes versus bacterial causes to prevent unnecessary antibiotic prescribing.

**Table 10:** Antibiotic Recommendations for the Treatment of Healthcare-Associated Pneumonia in Adults*

| **Healthcare-Associated Pneumonia [Includes Healthcare-Associated Pneumonia (HCAP), Hospital-acquired Pneumonia (HAP), and Ventilator-Associated Pneumonia (VAP)]** | | **Comments** |
|---|---|---|
| **Empiric Treatment of Choice** | **Antipseudomonal beta-lactam** (e.g., cefepime, ceftazidime, piperacillin/tazobactam, imipenem, meropenem, or doripenem) +/- **Antipseudomonal fluoroquinolone** (e.g., ciprofloxacin, levofloxacin) **or** **Aminoglycoside** (e.g., amikacin, gentamicin, tobramycin) +/- | These agents provide adequate coverage for gram negative organisms implicated in HCAP:<br>*Escherichia coli*<br>*Klebsiella pneumoniae*<br>*Pseudomonas aeruginosa*<br>*Enterobacter* species<br>*Citrobacter* species<br>*Serratia* species<br>*Acinetobacter* species |
| | **Glycopeptide or oxazolidinone** (e.g., vancomycin or linezolid) | These agents provide adequate MRSA coverage:<br>MRSA more common in patients with diabetes mellitus, head trauma, ICU admission, and non-ventilated patients<br>Consider local MRSA prevalence |
| **Alternative Empiric Treatment Options** | For patients with a true type I (anaphylactic) hypersensitivity reaction to beta-lactams (i.e. penicillins or cephalosporins), consider aztreonam for gram negative coverage including *Pseudomonas* | |

*Adapted from American Thoracic Society and Infectious Diseases Society of America. Guidelines for the Management of Adults with Hospital-Acquired, Ventilator-associated, and Healthcare-associated Pneumonia[78]
+/- = with or without
Empiric = treatment based on observation and experience without confirmed pathogen

# Respiratory Tract Infections Crossword Puzzle



***Across***

4. Abbreviation for acetaminophen
6. _____ clavulanate
8. Treatment for atypical pneumonia
9. Streptococcus _____
10. Popular management for OM
13. Primary cause of URTI
14. Most common symptom of pneumonia
15. Most common "common cold" virus

***Down***

1. May cause tooth pain
2. Influenza antiviral
3. Relieves congestion
4. Should be avoided for the treatment of viruses
5. Inhaled product that may relieve cold symptoms
7. Atypical organism
11. Expectorant
12. Preferred treatment for pharyngitis

***Answer Key:***

***Across***
4. APAP
6. Amoxicillin
8. Azithromycin
9. Pyogenes
10. Observation
13. Viruses
14. Cough
15. Rhinovirus

***Down***
1. Sinusitis
2. Oseltamivir
3. Pseudoephedrine
4. Antibiotics
5. Cromolyn
7. Chlamydophila
11. Guaifenesin
12. Penicillin

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