

By Ann Marie Hart, PhD, RN, FNP,
Alison Patti, MPH, CHES,
Brendan Noggle, MPH,
Erica Haller-Stevenson, MPH, CHES,
and Lisa B. Hines, MPH, CHES

Acute Respiratory Infections and Antimicrobial Resistance

Managing viral infections without the inappropriate use of antibiotics.

Overview: Antimicrobial resistance:

many nurses are aware of the risk but may not know that inappropriate management of acute respiratory infection contributes to it significantly. For example, more than half of antibiotics prescribed for respiratory infections are unwarranted because viruses are the cause. It is important that nurses understand antimicrobial resistance and learn how to help patients, family members, and friends manage acute respiratory infections appropriately.

After supper one evening, your sister-in-law calls, asking for advice. She developed a bad cough two days ago, she says, and now is coughing “nonstop,” producing yellow phlegm. Over-the-counter herbal lozenges have given her no relief. She feels sure that it’s bronchitis. She takes care of her elderly mother, who lives nearby, and is afraid of infecting her, too. Should she make an appointment with her NP, she asks you, or should she just break into a bottle of ciprofloxacin (Cipro) that had been prescribed two months earlier and that she hadn’t opened?

The average nurse might find this a familiar situation. People often consult friends and family members who are nurses when they develop an acute respiratory infection. In a recent, as-yet unpublished survey (conducted by one of us [AMH] and another colleague), 83% of 104 RNs said that they



Snort. Sniffle. Sneeze.

No Antibiotics Please.

Treat colds and flu with care.
Talk to your doctor.

As a parent, you want to help your child feel better. But antibiotics aren't always the answer. They don't fight the viruses that cause colds and flu. What will? Fluids and plenty of rest are best. Talk to your doctor. Find out when antibiotics work – and when they don't. The best care is the right care.

**For more information, please call 1-888-246-2675
or visit www.cdc.gov/getsmart.**



Courtesy of the CDC

frequently gave advice to friends and family members on managing acute respiratory infections, and 74% said that these same people frequently asked about taking antibiotics for such infections. Nonetheless, most RNs surveyed said that they had received very little education on the management of acute respiratory infection or the appropriate use of antibiotics for acute respiratory infections. (Contact the lead author for more information on this study; see page 63.)

RESISTANCE: A GROWING PROBLEM

The overuse of antibiotics in treating acute respiratory infection—and the significant contribution of such overuse to the current crisis of antimicrobial resistance—are well documented. Experts from many leading health organizations, including the Centers for Disease Control and Prevention (CDC),¹ the World Health Organization,² and the Institute of Medicine,³ recognize antimicrobial resistance as one of the most serious public health threats

Get Smart: Know When Antibiotics Work

The CDC's public awareness campaign targets antimicrobial resistance.

In 1995 the Centers for Disease Control and Prevention (CDC) developed a campaign to reduce inappropriate antibiotic use and rising rates of antimicrobial resistance. In 2003 the campaign was branded and launched as Get Smart: Know When Antibiotics Work. The Get Smart campaign has three objectives: to promote providers' adherence to appropriate prescribing guidelines, to decrease the demand for antibiotics for viral upper respiratory infections from healthy adults and parents of young children, and to increase adherence to antibiotic regimens prescribed for upper respiratory infections. The campaign is aimed at both the general public and health care providers because the knowledge, attitudes, and behaviors of both groups contribute to the use of antibiotics. A primary focus of the Get Smart campaign is the development and dissemination of educational materials such as fact sheets, brochures, and posters for the general public, as well as adult and pediatric "academic detailing sheets" for providers. The latter give disease-specific diagnostic and treatment guidelines for various acute respiratory infections (go to www.cdc.gov/getsmart).

Educational materials for the general public. The Get Smart campaign has also developed brochures, posters, and information sheets for a variety of audiences, including Spanish-speaking, American Indian, and Alaska Native populations. Two question-and-answer pages specifically designed for parents address runny noses and fluid in the middle ear. All of the materials are available at the campaign's Web site and may be downloaded, copied, and distributed without alteration free of charge.

Large quantities are available for purchase from the Public Health Foundation (go to http://bookstore.phf.org/index.php?cPath=69_55 or call [877] 252-1200 between 9 AM and 4:30 PM EST).

In addition to developing and distributing written materials, the Get Smart campaign, in partnership with the Food and Drug Administration, developed a national media campaign to provide a coordinated public message on appropriate antibiotic use. The media campaign was launched in 2003 and is currently being disseminated through print, television, radio, and outdoor media.

Materials for health care providers include guidelines for the management of acute respiratory infection in both adults and children as well as quick summary sheets of those guidelines. The campaign also offers several tools to help clinicians educate patients on appropriate antibiotic use. For example, a viral "prescription pad" is available that reinforces the patient's diagnosis of a viral illness and not a bacterial infection. The pad provides recommendations for symptomatic relief that the clinician can check off and explains when the patient should return if the symptoms do not subside.

The Get Smart campaign has also supported the development of a curriculum for medical students on the appropriate use of antibiotics (a collaboration with the University of California, San Diego, and the Association of American Medical Colleges). And there are two curricula for medical residents. One is modeled after the medical school curriculum and is under development at the Oregon Health and Science University. The other curricu-

of the 21st century. And results from two large national studies of prescribing data indicate that ambulatory care clinicians prescribe antibiotics for acute respiratory infections 40% to 50% of the time—and the vast majority of such infections are viral.^{4,5} Several factors have been blamed for this inappropriate prescribing, including patients' expectations of and requests for antibiotics⁶ and the tendency to prescribe when sinus tenderness and discolored nasal discharge are present on physical examination.⁷ Several studies indicate that antibiotic prescribing rates have decreased over the past 15 years,⁸⁻¹⁰ but inappropriate prescribing still occurs and broader spectrum antibiotics are being used more frequently.^{4,9} Therefore, education of both prescribers and consumers is necessary to reduce overuse.

Factors contributing to antimicrobial resistance.

Any use of or exposure to antibiotics, regardless of the reason for its use, can contribute to antimicro-

bial resistance.¹¹ Antimicrobial resistance results when microbes change in ways that reduce or eliminate the effectiveness of medications to treat or prevent infections.¹² Antibiotics are often prescribed for infections that they can't treat, but even when they're prescribed appropriately, nonadherence to the treatment regimen can play a role in the development of antimicrobial resistance. Patients often don't take antibiotics as prescribed (for example, they may share them with family members, take only part of the prescribed course, or save some pills for future use), and as a result, the most resistant among the infecting bacteria survive and reproduce.

Cultural and economic factors influence patterns of antimicrobial use. For example, in Western societies, patients often expect to receive a written prescription at the end of an office visit. The prescription legitimizes the patient's visit to the provider and, in effect, serves as an official designation that the patient is sick.¹³ Patients may ask specifically for

lum is designed to increase residents' proficiency in the diagnosis of acute otitis media using video otoscopy, among other techniques, and is available from the Children's Hospital of Pittsburgh of the University of Pittsburgh Medical Center at www.eprom.pitt.edu/34_viewPage.asp?pageID=1579464186. Plans are also under way to develop continuing education courses for nurses, NPs, physician assistants, and pharmacists.

HEDIS performance measures.

The CDC and the National Committee for Quality Assurance (a not-for-profit organization involved in health care improvement) have written four measures for the Healthcare Effectiveness Data and Information Set (HEDIS), the performance measurement tool used by more than 90% of the nation's health plans. The pediatric measures, which became part of HEDIS in 2004, assess the testing of children with pharyngitis and the treatment of children with upper respiratory infections for their appropriateness. The adult measures, which became part of HEDIS in 2006 and 2008, assess providers' avoidance of antibiotic treatment in adults with acute bronchitis and data on antibiotic prescribing practices.

antibiotics because they've received them previously for similar symptoms or they believe antibiotics will make them feel better, faster.¹⁴ Providers often feel pressure from patients to prescribe antibiotics,¹⁵ and they are more likely to over-prescribe antibiotics when they have a high practice volume¹⁶ or when they are uncertain about the patient's condition or diagnosis.¹⁷

Drug-resistant *Streptococcus pneumoniae* risk.

While most acute respiratory infections are viral, most cases of bacterial sinusitis, acute otitis media, and community-acquired pneumonia are caused by *Streptococcus pneumoniae*. The CDC estimates that in 2006 there were 41,400 cases (13.8 cases per 100,000 people) of invasive, potentially fatal *S. pneumoniae* infections (such as bacteremia and meningitis) in the United States.¹⁸ Pneumococcal infections cause substantial illness and death in the

elderly, young children, and people with chronic diseases and contribute significantly to the cost of health care. Because treatment for pneumococcal infections is complicated by resistance to commonly prescribed antibiotics such as penicillin, it's important to understand the risk factors associated with drug-resistant *S. pneumoniae* infections.

There is a strong association between recent antibiotic use and the development of drug-resistant *S. pneumoniae* infection. Patients with acute otitis media, pneumonia, or meningitis caused by resistant strains of pneumococci are much more likely to have taken antibiotics recently than are those



Name: _____
Date: ___/___/___



Diagnosis:

- Cold or Flu
- Middle ear fluid (Otitis Media with Effusion, OME)
- Cough
- Viral Sore Throat
- Other: _____

You have been diagnosed with an illness caused by a virus. Antibiotics do not cure viral infections. If given when not needed, antibiotics can be harmful. The treatments prescribed below will help you feel better while your body's own defenses are fighting the virus.

General Instructions:

- Drink extra water and juice.
- Use cool mist vaporizer or saline nasal spray to relieve congestion.
- For sore throats, use ice chips or sore throat spray; lozenges for older children and adults.

Specific medicines:

- Fever or aches:
- Ear pain:
- _____
- _____

Use medicines according to the package instructions or as directed by your doctor. Stop the medication when the symptoms get better.

Follow up:

- If not improved in ___ days, if new symptoms occur, or if you have other concerns, please call or return to the office for a recheck.
- Other: _____



Signed: _____

www.cdc.gov/getsmart

infected with susceptible strains.^{19,20} Even when one considers other risk factors for invasive pneumococcal disease, such as recent hospitalization and underlying immunosuppressive conditions, recent antibiotic use remains the single most predictive factor for infection with resistant pneumococci.²¹

Although further research is needed to better understand the link between antimicrobial resistance and treatment failures, Feikin and colleagues note that treatment failures because of drug resistance in *S. pneumoniae* have been reported in cases of meningitis and otitis media.²² There is also evidence of failures in macrolide treatment (for example, with azithromycin or clarithromycin) in patients whose bacteremia is caused by erythromycin-resistant *S. pneumoniae*.²³ While the relationship is less clear, fluoroquinolone treatment failures (for example, with levofloxacin or moxifloxacin) have occurred among patients with fluoroquinolone-resistant pneumococcal pneumonia.²⁴ β -lactam and cephalosporin failures in pneumonia treatment are more likely among patients with highly resistant rather than intermediately resistant *S. pneumoniae*.²²

ETIOLOGY AND MANAGEMENT OF RESPIRATORY INFECTIONS

Acute respiratory infection is a broad term covering several types of infection, including the common cold, rhinosinusitis, pharyngitis, bronchitis, otitis media, influenza, and pneumonia. CDC treatment guidelines for the first four of these (which affect virtually all people, regardless of age and other variables) will be discussed below. These recommendations apply to otherwise healthy adults and children older than two years. Keep in mind that these are general guidelines and may not apply to all patients. For example, some of the over-the-counter medications mentioned should be used with caution in people with certain chronic conditions (such as hypertension and benign prostatic hypertrophy), young children, and older adults; serious adverse events do sometimes occur with these medications.²⁵ It's important to note that over-the-counter cold and cough preparations are not approved for children younger than two years of age and that deaths have been associated with their use in this population.²⁶

The common cold, also known as a nonspecific upper respiratory infection, is probably the most frequently occurring illness in humans. Colds are acute viral infections characterized by nasal, sinus, pharyngeal, or bronchial inflammation, or a combination of these. Mild fever, body aches, fatigue, and colored nasal secretions are common. Several viral families have been linked to colds, including adenovirus, respiratory syncytial virus, and rhinovirus; however, rhinovirus is by far the most common etiologic agent and is transmitted through aerosolized particles that enter the body directly through the nose or eyes (or

indirectly, from the hands to the nose or eyes). Colds typically resolve without treatment in one to two weeks, and most people report starting to feel better within one week, though symptoms sometimes persist for more than two weeks.^{27,28}

The most recent epidemiologic estimates of the frequency of the common cold are based on data collected from 1965 to 1981.²⁹ The data indicate that the frequency of infection decreases with age, with children four years of age or younger having 4.9 colds per year, children between the ages of five and 19 years having 2.8 colds per year, adults 20 to 39 years old having 2.2 colds per year, and adults over the age of 40 having 1.6 colds per year.

The search for effective treatments to cure a cold, alleviate its symptoms, or shorten its course is ongoing. Several studies of antibiotic treatment in children and adults have shown that antibiotics don't alter the course of the common cold.^{30,31} Secondary bacterial infections are a rare complication of the common cold, and prophylactic use of antibiotics does not prevent them. The current evidence doesn't support the effectiveness of commonly used measures such as vitamin C, zinc, or echinacea supplements; warm, humidified air; or increased fluid intake.³²⁻³⁶ Therefore, clinicians should focus on symptom management in treating colds. Products containing first-generation antihistamines (such as brompheniramine) and decongestants (such as pseudoephedrine) have been shown to be somewhat effective in relieving coughs associated with the common cold in adults.³⁷ Currently, there are no research-based recommendations for symptom relief in children. As noted above, the Food and Drug Administration (FDA) recently advised against the use of over-the-counter cough and cold preparations in children younger than two years of age; the FDA is still reviewing the safety of these products when used by children two to 11 years old.³⁸

Rhinosinusitis refers to inflammation of the nasal mucosa and the paranasal sinus cavities. Rhinosinusitis is usually a viral infection and has a similar course to the common cold. According to a CDC report, *Principles of Appropriate Antibiotic Use for Acute Rhinosinusitis in Adults*, bacterial rhinosinusitis is usually a secondary infection resulting from sinus obstruction or impaired mucus clearance caused by colds, allergies, and other sources of irritation or inflammation.³⁹

Differentiating viral from bacterial rhinosinusitis is difficult and can't be done on the basis of clinical findings alone. Purulent or yellow or green nasal discharge occurs when sloughed mucosal cells and leukocytes are present in either a viral or a bacterial illness; its presence isn't necessarily indicative of bacterial rhinosinusitis.³⁹ For adults, guidelines recommend reserving a diagnosis of bacterial rhinosinusitis for those who have severe one-sided sinus pain with swelling and fever or for those with

symptoms lasting more than seven days and who also have sinus pain and purulent nasal discharge.³⁹ Pediatric guidelines recommend limiting the diagnosis of bacterial rhinosinusitis to children with severe symptoms (for example, sinus pain and fever higher than 102°F) or to those with nonspecific symptoms (for example, cough, nasal congestion) who show no improvement after 14 days.⁴⁰

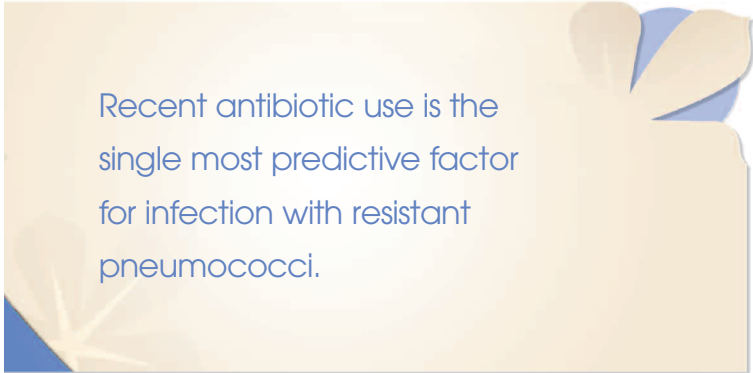
Regardless of the etiology of the rhinosinusitis, management in adults and children should focus on reassuring patients and their caregivers that the symptoms usually resolve spontaneously. Results of studies on the symptomatic treatment of sinusitis have been inconclusive; however, it's probably reasonable to assume that opening the sinus passages with topical or oral decongestants (or both) might be helpful. In addition, sinus pain and pressure might be relieved with nonsteroidal antiinflammatory drugs (NSAIDs) or an analgesic, such as acetaminophen (Tylenol and others).⁴¹ For bacterial rhinosinusitis, both adult and pediatric guidelines recommend treatment with amoxicillin. As a general rule, clinicians should prescribe antibiotics that have as narrow a spectrum as possible while still being effective against the most likely infectious organisms—in this case, *S. pneumoniae* and *H. influenzae*.³⁹⁻⁴¹

Pharyngitis (sore throat) occurs frequently in otherwise healthy adults and children and can have either infectious or noninfectious causes (such as esophageal reflux or allergy). The most common bacterial cause of infectious pharyngitis in both adults and children is group-A β -hemolytic streptococcus (GABHS), caused by *Streptococcus pyogenes*.⁴² It's difficult to estimate the percentage of infectious pharyngitis resulting from GABHS, but experts agree that most cases of infectious pharyngitis in adults and children are viral and don't result from GABHS.^{31, 42, 43} Studies have reported GABHS as the cause in 5% to 26% of adult cases⁴⁴⁻⁴⁷ and of 15% to 36% of pediatric cases.^{44, 47-49}

No one sign or symptom differentiates GABHS from viral pharyngitis, not even—contrary to popular belief—exudative tonsillitis (whitish spots on the tonsils) or severe throat pain. In adults and children, GABHS pharyngitis usually develops quickly and is associated with fever, sore throat, headache, and enlarged cervical lymph nodes. Runny nose, nasal congestion, and cough are rare, and their presence usually indicates a viral infection.^{42, 43, 50}

The most current guideline for diagnosing GABHS pharyngitis advises clinicians to take into account a combination of clinical findings (for example, the sudden onset of sore throat, the presence of fever, or tonsillar exudate) and diagnostic tests (for example, rapid antigen tests or pharyngeal cultures). While the newer rapid antigen tests are convenient, inexpensive, and specific (95% or higher), they are

associated with false negative rates of 10% to 20%. Therefore, pharyngeal cultures should be used to confirm negative rapid antigen results in children and adolescents, the age group most prone to developing GABHS pharyngitis and its sequelae (for example, rheumatic fever and glomerulonephritis). Some people are chronic streptococcal carriers and will test positive for GABHS even when they're not acutely ill; therefore, except under special circumstances, rapid antigen testing should be done only in patients with symptoms consistent with GABHS pharyngitis.⁴²



Recent antibiotic use is the single most predictive factor for infection with resistant pneumococci.

Penicillin remains the first-line antibiotic choice for treatment of GABHS pharyngitis; for patients allergic to penicillin, erythromycin is the first choice.⁴² Symptom management for both viral and GABHS pharyngitis should focus on reducing throat pain by drinking warm or cool fluids, according to personal preference, and taking acetaminophen and NSAIDs. In addition, results from two recent studies indicate that short-term use of oral glucocorticoids may be helpful in reducing the pain and swelling associated with severe pharyngitis.^{51, 52}

Acute bronchitis is marked by a sudden cough, productive or nonproductive, that has persisted for less than three weeks with no evidence of pneumonia, common cold, acute asthma, or exacerbation of chronic obstructive pulmonary disease. In most otherwise healthy patients with an acute cough, the absence of tachycardia, tachypnea, fever, and abnormal findings on chest examination indicates that pneumonia isn't likely. Note that the presence of purulent sputum does not distinguish acute bronchitis from pneumonia.⁵³

Acute bronchitis has been linked to several bacteria and viruses as well as noninfectious etiologies. Known viral etiologic agents include influenza viruses, picornavirus (including rhinovirus), respiratory syncytial virus, among others.^{54, 55} Known bacterial etiologic agents include *S. pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, and *Bordetella pertussis*.⁵⁵⁻⁵⁷ Atypical etiologic agents include *Chlamydia pneumoniae* (also known as *Chlamydophila pneumo-*

Other Factors Contributing to Antibiotic Treatment Failure

What if more prudent antibacterial use isn't always enough to prevent the spread of resistance?

The mutations that make bacteria resistant to antibiotics reduce the organisms' overall fitness. This "fitness cost" means that the energy spent on defending against antimicrobial medications makes the bacterium less competitive in other ways.

Efforts to slow the emergence of resistance through more prudent antibiotic use are rooted in the assumption that, in the absence of antibiotics, these resistant, less-fit bacteria will be unable to compete with sensitive but highly fit bacterial strains and will die off. Eventually, as this line of thinking goes, the bacterial population will revert to its original antibiotic-sensitive state. But what if this assumption isn't always correct?

A growing body of evidence suggests that, at least in some cases, other mutations occur in resistant bacteria, helping them compensate for the fitness costs of resistance.¹ These resistant bacteria achieve an intermediate level of overall fitness and are better able to compete with antibiotic-sensitive strains. When this occurs, resistant strains of bacteria can survive even in the absence of antibiotics.

One implication of these findings is that, even with better prescribing practices and treatment compliance, it may be difficult to prevent resistant strains of bacteria from spreading. And even bacteria that haven't acquired resistance to antibiotics can contribute to treatment failure.

Noninherited resistance, or resistance because of phenotypic characteristics, is less well known and understood than acquired resistance, but recent research indicates that it too may be a significant factor in some treatment failures.^{2,3}

Even when an infection is successfully treated with an antibiotic, the medication plays only a supportive role in effecting a cure. Many other factors of the host, such as age, general health, and genetic characteristics, also come into play. Likewise, in treatment failure, factors such as the host's immune response may be more determinative of the outcome than the damage done directly by bacterial toxins.

Bacteria that are genetically sensitive to a given antibiotic can still survive in its presence, depending on the physiologic state of the bacterial cells and the physical structure of the bacterial population. For example, bacteria are usually most susceptible to antibiotics while they divide, and some bacterial cells may not be dividing or may reproduce too slowly to be affected by the medication. In other cases, a growing mass of bacteria can form a structure called a biofilm, in which some bacterial cells can be embedded too deeply to be reached by the diffusing antibiotic. Therefore, noninherited resistance may well prolong infections, make infections more difficult to treat, and promote acquired resistance.

For more on these topics, see the work of Emory University biologist Bruce R. Levin: www.biology.emory.edu/research/Levin/pubs/index.html.—James M. Stubenrauch, senior editor

REFERENCES

1. Levin BR, et al. Compensatory mutations, antibiotic resistance and the population genetics of adaptive evolution in bacteria. *Genetics* 2000;154(3):985-97.
2. Levin BR, Rozen DE. Non-inherited antibiotic resistance. *Nat Rev Microbiol* 2006;4(7):556-62.
3. Levin BR. Microbiology. Noninherited resistance to antibiotics. *Science* 2004;305(5690):1578-9.

niae) and *Mycoplasma pneumoniae*.^{55,57} Regardless of etiology, most patients recover from acute bronchitis without antibiotics⁵⁷; therefore, otherwise healthy adults and children with bronchitis should not routinely be treated with antibiotics.^{58,59}

For a variety of reasons, including improvements in diagnosis, increased reporting of the disease, and the fact that the vaccine's effectiveness diminishes over time, rates of *B. pertussis* infection (whooping cough) are on the rise, and the disease is estimated to be responsible for 20% of prolonged cough illnesses (those lasting longer than three weeks) in adults and adolescents.⁶⁰ Current guidelines recom-

mend that people who experience a cough for two or more weeks with symptoms typical of pertussis (for example, paroxysmal coughing, posttussive vomiting, an inspiratory whooping sound, or some combination of these) and no other likely etiology for the cough (such as asthma) should be evaluated for *B. pertussis* infection.⁶¹ Patients with suspected or confirmed *B. pertussis* infection should be treated with a macrolide antibiotic (for example, azithromycin, clarithromycin, or erythromycin).⁵⁶ A macrolide antibiotic should also be administered to close contacts of a person with pertussis, if there are no contraindications. All cases of confirmed pertus-

sis should be reported to officials at the applicable state health department, who will then assist with tracing and identifying those who should receive prophylactic treatment.⁶²

Management of uncomplicated acute bronchitis should focus on reassuring patients and their caregivers that bronchitis is usually a viral illness that resolves in two weeks without treatment. Patients should also be advised to get an evaluation by a clinician for a persistent cough (one that lasts longer than two weeks) or a cough accompanied by extreme lethargy, anorexia, difficulty breathing, or cyanosis. Unfortunately, research efforts to date have yet to identify the best way to decrease cough. Inhaled and oral β_2 -receptor agonists (such as albuterol [Proventil and others]) may be of some help in cases of acute bronchitis when airflow obstruction and wheezing are present, but these medications are not recommended for routine use in acute bronchitis.⁵³ The use of antitussive agents, such as dextromethorphan and codeine, in patients with acute bronchitis has not been thoroughly studied. Mixed results have been achieved with these medications in patients experiencing cough from the common cold.⁵³ Until further data are available, a short trial of antitussive agents for cough associated with acute bronchitis is probably a reasonable treatment option. But expectorants and mucolytic agents (such as guaifenesin) have been shown to be of no benefit to patients with cough from acute bronchitis and are not recommended for routine use.⁵³

NURSING MANAGEMENT

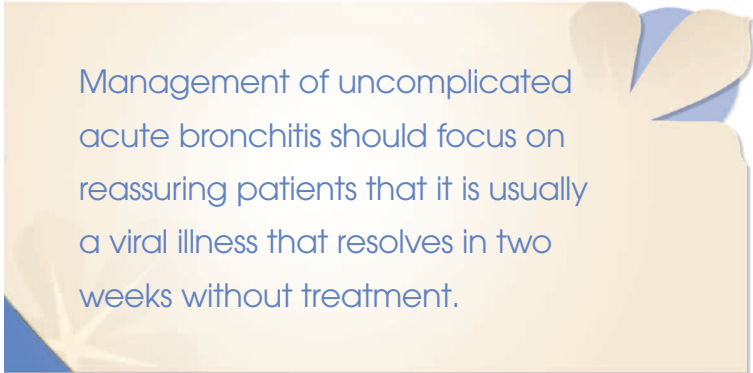
With regard to your sister-in-law's question—should she see her NP or take previously prescribed antibiotics?—the first option is clearly the best choice. Make sure she understands that antibiotics are serious drugs to be used only for diagnosed bacterial infections, that antibiotics can produce adverse effects, and that each antibiotic targets specific microbes. Explain that taking antibiotics for viral infections has contributed to a crisis of antimicrobial resistance. Emphasize that she should not press her clinician for a prescription for an antibiotic, nor should she take any previously prescribed, leftover antibiotics. Let her know that viral infections usually last 10 to 21 days, and correct her misconception about productive coughs warranting antibiotic treatment.

Be sure to tell your sister-in-law—and any other friends and family members who have similar concerns—about the Get Smart: Know When Antibiotics Work campaign, the CDC's effort to educate the public on antimicrobial resistance and the proper use of antibiotics. Direct her to the campaign Web site at www.cdc.gov/getsmart. It provides plenty of easy-to-understand information that will help reinforce your message.

If your sister-in-law's cough is mild and she isn't experiencing extreme lethargy or difficulty breathing,

advise her to wait up to three weeks before seeing her health care provider, unless her symptoms worsen.

And should she make her usual visit to her elderly mother? Your sister-in-law would be wise to avoid visiting and caregiving until her cough is resolved; most acute respiratory infections, whether they're of a viral or a bacterial origin, can be spread to others by respiratory droplets and skin contact. Regarding her use of herbal lozenges, you can inform her that



Management of uncomplicated acute bronchitis should focus on reassuring patients that it is usually a viral illness that resolves in two weeks without treatment.

they haven't been shown to be efficacious in treating acute respiratory infections. In the meantime, she can reduce the spread to others in close contact with her by washing her hands frequently and by covering her mouth and nose with a tissue or her elbow when she sneezes or coughs. ▼

Ann Marie Hart is an assistant professor at the Fay W. Whitney School of Nursing at the University of Wyoming in Laramie. Alison Patti is the program director for the Get Smart: Know When Antibiotics Work campaign at the Centers for Disease Control and Prevention (CDC) in Atlanta. Brendan Noggle, formerly the drug-resistant Streptococcus pneumoniae coordinator for the Respiratory Diseases Branch at the CDC, is a birth outcomes epidemiologist at the Georgia Division of Public Health in Atlanta. Erica Haller-Stevenson, formerly the deputy program director of the Get Smart: Know When Antibiotics Work campaign, is the community and media liaison for Steps to a Healthier San Antonio at the San Antonio Metropolitan Health District in TX. Lisa B. Hines, formerly a health communications specialist working on the Get Smart: Know When Antibiotics Work campaign, is the senior advisor for communication and outreach at the CDC's National Center for Public Health Informatics' Division of Emergency Preparedness and Response in Atlanta. Contact author: Ann Marie Hart, ammhart@uwyo.edu. The authors of this article have disclosed no other significant ties, financial or otherwise, to any company that might have an interest in the publication of this educational activity.

REFERENCES

1. Centers for Disease Control and Prevention. Preventing emerging infectious diseases: A strategy for the 21st century overview of the updated CDC Plan. *MMWR Recomm Rep* 1998;47(RR15):1-14.
2. World Health Organization. Drug resistance threatens to reverse medical progress [press release]. *WHO Information Office* 2000 Jun 12. <http://www.who.int/inf-pr-2000/en/pr2000-41.html>.

3. Smolinski MS, et al., editors. *Microbial threats to health: emergence, detection, and response*. Washington, D.C.: National Academies Press; 2003. http://www.nap.edu/catalog.php?record_id=10636.
4. Ladd E. The use of antibiotics for viral upper respiratory tract infections: an analysis of nurse practitioner and physician prescribing practices in ambulatory care, 1997–2001. *J Am Acad Nurse Pract* 2005;17(10):416-24.
5. Roumie CL, et al. Trends in antibiotic prescribing for adults in the United States—1995 to 2002. *J Gen Intern Med* 2005;20(8):697-702.
6. Stivers T, et al. Why do physicians think parents expect antibiotics? What parents report vs what physicians believe. *J Fam Pract* 2003;52(2):140-8.
7. Dosh SA, et al. Predictors of antibiotic prescribing for non-specific upper respiratory infections, acute bronchitis, and acute sinusitis. An UPRNet study. Upper Peninsula Research Network. *J Fam Pract* 2000;49(5):407-14.
8. McCaig LF, et al. Trends in antimicrobial prescribing rates for children and adolescents. *JAMA* 2002;287(23):3096-102.
9. McCaig LF, et al. Antimicrobial drug prescription in ambulatory care settings, United States, 1992–2000. *Emerg Infect Dis* 2003;9(4):432-7.
10. Finkelstein JA, et al. Reduction in antibiotic use among US children, 1996–2000. *Pediatrics* 2003;112(3 Pt 1):620-7.
11. Jacobs RF. Judicious use of antibiotics for common pediatric respiratory infections. *Pediatr Infect Dis J* 2000;19(9):938-43.
12. Levy SB. The challenge of antibiotic resistance. *Sci Am* 1998;278(3):46-53.
13. Avorn J, Solomon DH. Cultural and economic factors that (mis)shape antibiotic use: the nonpharmacologic basis of therapeutics. *Ann Intern Med* 2000;133(2):128-35.
14. Mainous AG, 3rd, et al. Patient knowledge of upper respiratory infections: implications for antibiotic expectations and unnecessary utilization. *J Fam Pract* 1997;45(1):75-83.
15. Hart AM, et al. Balancing acts: deciding for or against antibiotics in acute respiratory infections. *J Fam Pract* 2006;55(4):320-5.
16. Cadieux G, et al. Predictors of inappropriate antibiotic prescribing among primary care physicians. *CMAJ* 2007;177(8):877-83.
17. Arnold SR, et al. Antibiotic prescribing for upper respiratory tract infection: the importance of diagnostic uncertainty. *J Pediatr* 2005;146(2):222-6.
18. Centers for Disease Control and Prevention. *Active bacterial core surveillance report. Emerging infections program network, Streptococcus pneumoniae, 2006*. Atlanta; 2007 May. Active Bacterial Core Surveillance Reports; <http://www.cdc.gov/ncidod/dbmd/abcs/survreports/spneu06.pdf>.
19. Pallares R, et al. Risk factors and response to antibiotic therapy in adults with bacteremic pneumonia caused by penicillin-resistant pneumococci. *N Engl J Med* 1987;317(1):18-22.
20. Block SL, et al. Penicillin-resistant *Streptococcus pneumoniae* in acute otitis media: risk factors, susceptibility patterns and antimicrobial management. *Pediatr Infect Dis J* 1995;14(9):751-9.
21. Dowell SF, Schwartz B. Resistant pneumococci: protecting patients through judicious use of antibiotics. *Am Fam Physician* 1997;55(5):1647-54, 1657-8.
22. Feikin DR, et al. Mortality from invasive pneumococcal pneumonia in the era of antibiotic resistance, 1995–1997. *Am J Public Health* 2000;90(2):223-9.
23. Lonks JR, et al. Failure of macrolide antibiotic treatment in patients with bacteremia due to erythromycin-resistant *Streptococcus pneumoniae*. *Clin Infect Dis* 2002;35(5):556-64.
24. Fuller JD, Low DE. A review of *Streptococcus pneumoniae* infection treatment failures associated with fluoroquinolone resistance. *Clin Infect Dis* 2005;41(1):118-21.
25. Budnitz DS, et al. National surveillance of emergency department visits for outpatient adverse drug events. *JAMA* 2006;296(15):1858-66.
26. Centers for Disease Control and Prevention. Infant deaths associated with cough and cold medications—two states, 2005. *MMWR Morb Mortal Wkly Rep* 2007;56(1):1-4.
27. Gwaltney JM, Jr., et al. Rhinovirus infections in an industrial population. II. Characteristics of illness and antibody response. *JAMA* 1967;202(6):494-500.
28. Winther B, et al. *Common cold model in children: symptom profile and duration of illness*. Interscience Conference on Antimicrobial Agents and Chemotherapy; 1999 Sep 26–29; San Francisco: American Society for Microbiology; 1999. p. 418.
29. Monto AS, Sullivan KM. Acute respiratory illness in the community. Frequency of illness and the agents involved. *Epidemiol Infect* 1993;110(1):145-60.
30. Rosenstein N, et al. The common cold—principles of judicious use of antimicrobial agents. *Pediatrics* 1998;101(1 Suppl):181-4.
31. Snow V, et al. Principles of appropriate antibiotic use for treatment of nonspecific upper respiratory tract infections in adults. *Ann Intern Med* 2001;134(6):487-9.
32. Douglas RM, et al. Vitamin C for preventing and treating the common cold. *Cochrane Database Syst Rev* 2007(3):CD000980.
33. Jackson JL, et al. Zinc and the common cold: a meta-analysis revisited. *J Nutr* 2000;130(5S Suppl):1512S-1515S.
34. Turner RB, et al. An evaluation of *Echinacea angustifolia* in experimental rhinovirus infections. *N Engl J Med* 2005;353(4):341-8.
35. Singh M. Heated, humidified air for the common cold. *Cochrane Database Syst Rev* 2006;3:CD001728.
36. Guppy MP, et al. Advising patients to increase fluid intake for treating acute respiratory infections. *Cochrane Database Syst Rev* 2005(4):CD004419.
37. Pratter MR. Cough and the common cold: ACCP evidence-based clinical practice guidelines. *Chest* 2006;129(1 Suppl):72S-74S.
38. Center for Drug Evaluation and Research. *Public health advisory: nonprescription cough and cold medicine use in children. FDA recommends that over-the-counter (OTC) cough and cold products not be used for infants and children under 2 years of age*. Rockville, MD: U.S. Food and Drug Administration; 2008 Jan 17. http://www.fda.gov/cder/drug/advisory/cough_cold_2008.htm.
39. Hickner JM, et al. Principles of appropriate antibiotic use for acute rhinosinusitis in adults: background. *Ann Emerg Med* 2001;37(6):703-10.
40. O'Brien KL, et al. Acute sinusitis—principles of judicious use of antimicrobial agents. *Pediatrics* 1998;101(1 Suppl):174-7.
41. Rosenfeld RM, et al. Clinical practice guideline: adult sinusitis. *Otolaryngol Head Neck Surg* 2007;137(3 Suppl):S1-S31.
42. Bisno AL, et al. Practice guidelines for the diagnosis and management of group A streptococcal pharyngitis. Infectious Diseases Society of America. *Clin Infect Dis* 2002;35(2):113-25.
43. Schwartz B, et al. Pharyngitis—principles of judicious use of antimicrobial agents. *Pediatrics* 1998;101(1 Suppl):171-4.
44. Danchin MH, et al. Burden of acute sore throat and group A streptococcal pharyngitis in school-aged children and their families in Australia. *Pediatrics* 2007;120(5):950-7.
45. Huovinen P, et al. Pharyngitis in adults: the presence and coexistence of viruses and bacterial organisms. *Ann Intern Med* 1989;110(8):612-6.
46. Komaroff AL, et al. The prediction of streptococcal pharyngitis in adults. *J Gen Intern Med* 1986;1(1):1-7.
47. McIsaac WJ, et al. A clinical score to reduce unnecessary antibiotic use in patients with sore throat. *CMAJ* 1998;158(1):75-83.
48. McIsaac WJ, et al. The validity of a sore throat score in family practice. *CMAJ* 2000;163(7):811-5.
49. Tanz RR, Shulman ST. Diagnosis and treatment of group A streptococcal pharyngitis. *Semin Pediatr Infect Dis* 1995;6(2):69-78.

50. Cooper RJ, et al. Principles of appropriate antibiotic use for acute pharyngitis in adults: background. *Ann Intern Med* 2001;134(6):509-17.
51. Kiderman A, et al. Adjuvant prednisone therapy in pharyngitis: a randomised controlled trial from general practice. *Br J Gen Pract* 2005;55(512):218-21.
52. Olympia RP, et al. Effectiveness of oral dexamethasone in the treatment of moderate to severe pharyngitis in children. *Arch Pediatr Adolesc Med* 2005;159(3):278-82.
53. Braman SS. Chronic cough due to acute bronchitis: ACCP evidence-based clinical practice guidelines. *Chest* 2006;129(1 Suppl):95S-103S.
54. Freymuth F, et al. [Epidemiology and diagnosis of respiratory syncytial virus in adults]. *Rev Mal Respir* 2004;21(1):35-42.
55. Louie JK, et al. Characterization of viral agents causing acute respiratory infection in a San Francisco University Medical Center Clinic during the influenza season. *Clin Infect Dis* 2005;41(6):822-8.
56. Tiwari T, et al. Recommended antimicrobial agents for the treatment and postexposure prophylaxis of pertussis: 2005 CDC Guidelines. *MMWR Recomm Rep* 2005;54(RR-14):1-16.
57. Macfarlane J, et al. Prospective study of the incidence, etiology and outcome of adult lower respiratory tract illness in the community. *Thorax* 2001;56(2):109-14.
58. Gonzales R, et al. Principles of appropriate antibiotic use for treatment of uncomplicated acute bronchitis: background. *Ann Intern Med* 2001;134(6):521-9.
59. O'Brien KL, et al. Cough illness/bronchitis—principles of judicious use of antimicrobial agents. *Pediatrics* 1998;101(1 Suppl):178-81.
60. Guris D, et al. Changing epidemiology of pertussis in the United States: increasing reported incidence among adolescents and adults, 1990–1996. *Clin Infect Dis* 1999;28(6):1230-7.
61. Braman SS. Postinfectious cough: ACCP evidence-based clinical practice guidelines. *Chest* 2006;129(1 Suppl):138S-146S.
62. Centers for Disease Control and Prevention. *National notifiable diseases surveillance system*. 2008. <http://www.cdc.gov/ncepi/diss/nndss/nndssh.htm>.



3.5 HOURS

Continuing Education

EARN CE CREDIT ONLINE

Go to www.nursingcenter.com/CE/ajn and receive a certificate within minutes.

GENERAL PURPOSE: To explain the phenomenon of antimicrobial resistance and guide registered professional nurses in the appropriate management of acute respiratory infections.

LEARNING OBJECTIVES: After reading the two articles on antimicrobial resistance and taking the test on the next page, you will be able to

- discuss the development of antimicrobial resistance.
- outline the etiology and manifestations of some of the most common bacterial and viral infections.
- plan the appropriate interventions for managing common bacterial and viral infections.

TEST INSTRUCTIONS

To take the test online, go to our secure Web site at www.nursingcenter.com/CE/ajn.

To use the form provided in this issue,

- record your answers in the test answer section of the CE enrollment form between pages 48 and 49. Each question has only one correct answer. You may make copies of the form.
- complete the registration information and course evaluation. Mail the completed enrollment form and registration fee of \$29.95 to **Lippincott Williams and Wilkins CE Group**, 2710 Yorktowne Blvd., Brick, NJ 08723, by June 30, 2010. You will receive your certificate in four to six weeks. For faster service, include a fax number and we will fax your certificate within two business days of receiving your enrollment form. You will receive your CE certificate of earned contact hours and an answer key to review your results. There is no minimum passing grade.

DISCOUNTS and CUSTOMER SERVICE

- Send two or more tests in any nursing journal published by Lippincott Williams and Wilkins (LWW) together, and deduct \$0.95 from the price of each test.
- We also offer CE accounts for hospitals and other health care facilities online at www.nursingcenter.com. Call **(800) 787-8985** for details.

PROVIDER ACCREDITATION

LWW, publisher of *AJN*, will award 3.5 contact hours for this continuing nursing education activity.

LWW is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center's Commission on Accreditation.

LWW is also an approved provider of continuing nursing education by the American Association of Critical-Care Nurses #00012278 (CERP category A), District of Columbia, Florida #FBN2454, and Iowa #75. LWW home study activities are classified for Texas nursing continuing education requirements as Type 1. This activity is also provider approved by the California Board of Registered Nursing, provider number CEP 11749, for 3.5 contact hours.

Your certificate is valid in all states.

TEST CODE: AJN0608