Community-acquired pneumonia (CAP) is a leading cause of death in the world and the sixth most common cause of death in the United States. It is the number one cause of death from infectious diseases in the United States. This article reviews the latest available guidelines from two leading organizations—the Infectious Diseases Society of America (IDSA) and the American Thoracic Society (ATS). The IDSA stratifies patients into three categories and recommends antibiotic management based on assigned categories: outpatients, patients admitted to a general medical floor (GMF), and patients requiring intensive care unit (ICU) admission. The ATS, in contrast, stratifies patients into four major groups based on the presence of two cardiopulmonary diseases, certain modifying risk factors that increase the likelihood of acquiring specific infections (such as with drug-resistant Streptococcus pneumoniae, enteric gram-negative organisms, or Pseudomonas aeruginosa), and also based on the site of treatment (such as outpatient setting, GMF, and ICU).

Many studies have been published on the topic of community-acquired pneumonia (CAP), and numerous national societies have published their recommendations for the management of CAP. These groups include the American Thoracic Society (ATS) in 1993, the British Thoracic Society in 1993, the Canadian Infectious Diseases Society in 1993, as well as the Infectious Diseases Society of America (IDSA) in 1998. The IDSA revised their guidelines in September 2000 and then updated them in December 2003. The ATS also revised its guidelines in June 2001. This article summarizes the latest guidelines from both the IDSA and the ATS and provides a concise review for the management of CAP.

Epidemiology
Pneumonia is a leading cause of death in the world and the sixth most common cause of death in the United States. It is the number one cause of death from infectious diseases in the United States. The overall rates of death due to pneumonia and influenza have increased by 59% from 1979 through 1994 and by 22% when adjusted for age greater than 65 years. Every year in the United States, there are from 5 million to 10 million cases of CAP leading to as many as 1.1 million hospitalizations and 45,000 deaths. It costs about $7,500 to manage a single in-hospital case of CAP, an amount that is more than 20-fold higher than the cost of outpatient treatment ($150 to $350). The mortality rate is less than 1% for persons with CAP who do not require hospitalization; however, the mortality rate averages from 12% to 14% among hospitalized patients with CAP. Among patients who are admitted to the intensive care unit (ICU), or who are bacteremic, or who are admitted from a nursing home, the mortality rate averages from 30% to 40%. Therefore, it is crucial that physicians recognize and treat CAP appropriately.

Definition
The IDSA defines CAP as “an acute infection of the pulmonary parenchyma that is associated with at least some symptoms of acute infection, accompanied by the presence of an acute infiltrate on a chest radiograph or auscultatory findings consistent with pneumonia (such as altered breath sounds and/or localized rales), in a patient not hospitalized or residing in a long-term care facility for more than 14 days before onset of symptoms.” Most patients have nonspecific symptoms such as fatigue, headache, myalgia, and anorexia. Symptoms of pneumonia may include fever or hypothermia, sweats, rigors, dyspnea, chest discomfort, new cough with or without sputum production, or a change in the color of respiratory secretions in patients with chronic cough.

Risk Factors
Persons with certain coexisting illnesses have an increased incidence of CAP. These illnesses include chronic obstructive pulmonary disease (COPD), diabetes mellitus, renal insufficiency, congestive heart failure (CHF), coronary artery disease, malignancy, chronic neurologic disease, and chronic liver disease. Persons with CAP and certain risk factors have
an increased mortality. These risk factors include diabetes mellitus, coronary artery disease, CHF, immunosuppression, neurologic disease, active malignancies, alcohol consumption, increasing age, bacteremia, leukopenia, hypotension, altered mental status, tachypnea, hypoxemia, aspiration pneumonia, and infections due to gram-negative organisms.5

The ATS emphasizes certain modifying factors that increase the risk of infection with drug-resistant and unusual pathogens.7 Risk factors for drug-resistant *Streptococcus pneumoniae* (DRSP) include age greater than 65 years, β-lactam therapy within the past 3 months, immunosuppression (either as the result of an illness or induced by treatment with corti-
costereoids), multiple medical comorbidities, alcoholism, and exposure to a child in a day care center. Risk factors for enteric gram-negative organisms are as follows: recent antibiotic therapy, underlying cardiopulmonary disease, residence in a nursing home, and multiple medical comorbidities. Risk factors for *P aeruginosa* are as follows: structural lung disease such as bronchiectasis, broad-spectrum antibiotic therapy that lasted for at least 7 days in the past month, corticosteroid therapy with at least 10 mg of prednisone per day, and malnutrition.

**Pathogens**

Several prospective studies of CAP have failed to identify an organism in 50% of cases. When an organism is identified, however, *S pneumoniae* is the most common etiologic agent. It accounts for about two thirds of all CAP cases and is estimated that 125,000 cases of pneumococcal pneumonia necessitate hospitalization each year. It is the most frequent cause of lethal CAP. Multidrug resistance (such as β-lactams, macrolides, doxycycline, and recently fluoroquinolone antibiotics) is an emerging problem and complicates the management of CAP. Therefore, it is important to recognize factors that place patients at risk for DRSP.


The ATS statement describes the possibility of “atypical pathogens” (*C pneumoniae*, *M pneumoniae*, and *Legionella pneumophila*) infecting or co-infecting all patients with CAP and therefore recommends therapy to account for this possibility. If patients with CAP require admission to the ICU, one must consider *S pneumoniae*, the atypical pathogens (especially *Legionella*) and enteric gram-negative organisms as the organisms responsible for the infection. *P aeruginosa* is responsible for infection in some patients with severe CAP and should be considered in patients with previously described specific risk factors because it necessitates a different treatment regimen.

**Diagnostic Studies**

The diagnosis of CAP is based on clinical, laboratory, and radiologic data. Physical examination to detect rales or bronchial breath sounds is not sensitive or specific for the detection of pneumonia. Therefore, all patients with CAP need a chest radiograph to establish the diagnosis. Chest radiographs are also useful for making alternate diagnoses of associated conditions such as parapneumonic effusions, lung abscesses, and multilobar involvement. Although computed tomography (CT) scans of the chest are significantly more sensitive in detecting pulmonary infiltrates, they are not endorsed by the IDSA or the ATS as a routine diagnostic study. In a patient in whom CAP is diagnosed based on abnormal findings on a chest radiograph, chest radiography should be repeated in 6 to 10 weeks to document the resolution of the pneumonia and to exclude underlying malignancy that can mimic an infectious infiltrate, especially in older smokers. Follow-up chest radiography, CT scanning of the chest, or both should be done in patients who do not show signs of improvement (eg, persistent shortness of breath or fever) or with worsening clinical status to rule out an empyema or an abscess.

The IDSA and the ATS differ in their recommendations of microbiologic studies to determine the etiology of CAP. The IDSA recommends routine sputum culture with Gram stain to optimize antibiotic therapy for each individual patient as well as to monitor for drug-resistance among pathogens. The ATS, however, does not recommend routine sputum culture with Gram stain (in the absence of suspected drug resistance) because studies have shown that a pathogen is not identified in 40% to 50% of all patients. Furthermore, these tests are not able to detect the atypical organisms that have been implicated in 3% to 40% of CAP cases. These atypical organisms are identified by either serologic testing for *Mycoplasma* species and *Chlamydia* species, or by urinary antigen for *Legionella* species.

Figure 1 provides an algorithm for the evaluation of CAP.

In a patient requiring hospitalization for CAP, blood cultures (two sets taken at separate sites) within 24 hours of admission have been shown to significantly lower the 30-day mortality. In addition, all hospitalized patients with CAP should have an assessment of oxygen saturation, routine chemistry panel, and complete blood cell counts. The ATS and the IDSA both recommend drainage of any significant pleural effusion (defined as greater than 10-mm thickness on a radiograph taken with the patient in the lateral decubitus position) to rule out the possibility of an empyema or a parapneumonic effusion.

The decision to treat a patient with CAP as an outpatient or to admit the patient to a hospital is an individual one, and it remains an “art of medicine.” The IDSA and the ATS, however, both recommend using mortality prediction rules such as the Pneumonia PORT (Patient Outcomes Research Team) prediction rule, which stratifies patients into five severity classes based on the patient’s demographics, comorbid conditions, physical findings, and diagnostic studies. A numeric score determines the severity class, and a lower severity class is associated with a lower risk of mortality. Therefore, patients in class I and II can be treated as outpatients, and patients in class III can be treated either as outpatients or briefly observed in the hospital, whereas class IV and V patients need to be
hospitalized. Multiple studies have validated the Pneumonia PORT prediction rule as providing a rational foundation for the decision regarding hospitalization and as identifying valid predictors of mortality.5,6

Management of Community-Acquired Pneumonia

The IDSA and the ATS vary in their stratification of patient categories and therefore subsequent treatment regimens. First, we will outline the IDSA recommendations for the management of CAP, then the ATS recommendations, and finally, briefly discuss the prevention of CAP.

Infectious Diseases Society of America Recommendations

The IDSA panel stratifies patients into three categories: those who do not require hospitalization, those who are admitted to the hospital on a general medical floor (GMF), and those admitted to the ICU.5,6

For outpatients, the preferred treatment regimen is a macrolide (clarithromycin or azithromycin if H influenza is suspected), doxycycline, or a fluoroquinolone antibiotic (specifically levofloxacin, moxifloxacin, or gatifloxacin). In these patients, an alternate treatment regimen would be amoxicillin and clavulanate potassium combination and a second-generation cephalosporin (eg, cefuroxime axetil, cefpodoxime, or cefprozil), but these agents are not active against atypical pathogens.5,6

For the treatment of patients hospitalized on a GMF, the IDSA prefers a combination of a β-lactam plus a macrolide antibiotic or monotherapy with a fluoroquinolone antibiotic.5,6

Patients who require hospitalization in the ICU should always be treated with combination therapy. This therapy should be with either a β-lactam plus a macrolide or with a β-lactam plus a fluoroquinolone antibiotic. The goal of combination therapy in ICU patients is to provide optimal coverage for the two most commonly identified causes of lethal pneumonia—S pneumoniae and Legionella species. The IDSA prefers the following β-lactams and β-lactam–β-lactamase inhibitor combinations: cefotaxime, ceftriaxone, ampicillin and sulbactam combination, or piperacillin and tazobactam combination. For patients with hypersensitivity to β-lactams, clindamycin and fluoroquinolone antibiotics are recommended. For patients with structural lung disease such as bronchiectasis or cystic fibrosis, the IDSA recommends antimicrobial agents with coverage for Pseudomonas species.5,6

Figure 2 provides an outline of IDSA guidelines.

American Thoracic Society Recommendations

The ATS stratifies patients into four groups based on the absence or presence of two cardiopulmonary diseases (COPD and CHF), the modifying risk factors previously discussed, and the site of treatment (eg, outpatient setting, GMF, ICU).7

• Group I—Outpatient treatment for persons with no cardiopulmonary disease and no modifying factors should be with a macrolide (such as azithromycin or clarithromycin) with doxycycline as a second choice. The ATS believes that broader-spectrum coverage with a new antipneumococcal fluoroquinolone antibiotic such as levofloxacin, moxifloxacin, or gatifloxacin would be effective but unnecessary and could lead to the overuse of this valuable class of antibiotics, thereby contributing to the growing problem of antibiotic resistance.7
• Group II—Outpatients with either cardiopulmonary disease or modifying factors are treated with a combination of a β-lactam plus a macrolide antibiotic or with a fluoroquinolone antibiotic or a β-lactam inhibitor combination. The ATS believes that broader-spectrum coverage with a new antipneumococcal fluoroquinolone antibiotic such as levofloxacin, moxifloxacin, or gatifloxacin would be effective but unnecessary and could lead to the overuse of this valuable class of antibiotics, thereby contributing to the growing problem of antibiotic resistance.7

antibiotic alone. Doxycycline can be used in place of a macrolide antibiotic. The recommended β-lactams are cefpodoxime proxetil, cefuroxime, high-dose ampicillin (1 g every 8 hours), and amoxicillin and clavulanate combination.2

- **Group IIIA**—For patients hospitalized on a GMF with cardiopulmonary disease or risk factors for DRSP or infection with enteric gram-negative organisms, therapy can be with either an intravenously administered β-lactam plus a macrolide or monotherapy with an intravenously administered antipseudomoccal fluoroquinolone antibiotic. The recommended β-lactams and β-lactam-β-lactamase inhibitor combinations are cefotaxime sodium, ceftriaxone sodium, ampicillin sodium and sulbactam sodium combination, and high-dose ampicillin. The macrolide antibiotic can be given either orally or intravenously, depending on the severity of the illness.7

- **Group IIIB**—For the patient admitted on a GMF without risk factors for DRSP or infection with enteric gram-negative organisms and without cardiopulmonary disease, the ATS recommends either intravenously administered azithromycin (500 mg daily) alone or a fluoroquinolone antibiotic alone. An alternative treatment regimen for patients with hypersensitivity to azithromycin is the combination of a β-lactam plus doxycycline to provide coverage for atypical organisms.7

For severely ill patients with CAP, therapy should cover *S pneumoniae* and *Legionella* species, but patients should be stratified based on the identification of risk factors for *P aeruginosa* infection.7

- **Group IVA**—In the absence of pseudomonal risk factors, recommendations are to use a β-lactam that is active against DRSP plus either a macrolide or a fluoroquinolone antibiotic. The ATS does not support the use of β-lactams that are active against *P aeruginosa* when this organism is not suspected. Because data are lacking, the ATS does not recommend using fluoroquinolone antibiotics as monotherapy in patients with severe CAP until more studies are published.7

- **Group IVB**—If pseudomonal risk factors are present, recommendations are to use two antipseudomonal agents that also provide coverage for DRSP and *Legionella* species. Such a regimen could include selected β-lactams and β-lactam-β-lactamase inhibitor combinations (such as cefepime hydrochloride, piperacillin sodium and tazobactam sodium combination, imipenem, and meropenem) plus an antipseudomonal quinolone antibiotic (ciprofloxacin is the only quinolone antibiotic active against *P aeruginosa*). An alternative could be a triple-drug regimen that consists of selected β-lactams plus an aminoglycoside plus either azithromycin or a nonpseudomonal quinolone antibiotic (such as levofloxacin, moxifloxacin, or gatifloxacin). In patients with hypersensitivity to β-lactam, aztreonam can be substituted if the patient has risk factors for *Pseudomonas* infection.7

Figure 3 outlines the ATS guidelines.

**Checklist**

- **Outpatient Treatment**
  - Group I—No cardiopulmonary disease (CPD), no modifying factors (MFs)
    - macrolide OR
    - doxycycline
  - Group II—CPD or MFs
    - β-lactam plus either a macrolide or doxycycline OR
    - fluoroquinolone antibiotic alone

- **Hospitalized Patients on General Medical Floor**
  - Group IIIA—CPD or MFs
    - intravenously administered (IV) β-lactam plus either a macrolide or doxycycline OR
    - fluoroquinolone antibiotic alone
  - Group IIIB—No CPD or MFs
    - IV azithromycin alone (or β-lactam plus doxycycline for azithromycin-hypersensitive patients) OR
    - fluoroquinolone antibiotic alone

- **Hospitalized Patients in Intensive Care Unit**
  - Group IVA—No risk factor for *Pseudomonas* infection
    - IV β-lactam plus either IV azithromycin or IV fluoroquinolone antibiotic
  - Group IVB—Risk factor for *Pseudomonas* infection
    - IV antipseudomonal β-lactam plus IV antipseudomonal fluoroquinolone antibiotic OR
    - IV antipseudomonal β-lactam plus IV aminoglycoside plus either IV azithromycin or IV fluoroquinolone antibiotic (aztreonam plus aminoglycoside plus IV antipseudomonal fluoroquinolone antibiotic for β-lactam–hypersensitive patients)

**Prevention**

Prevention of CAP infection is mainly with the use of a US Food and Drug Administration–approved vaccine, which is about 60% effective in preventing bacteremia in immunocompetent adults with pneumococcal infections. The vaccine should be given routinely to patients older than 65 years and to all patients with asplenia. The vaccine is also recommended for patients aged 64 years or younger if they have certain coexisting illnesses that were listed previously.6 Revaccination is recommended for patients older than 65 years who initially received the vaccine more than 5 years earlier and the initial
vaccine was administered at age less than 65 years. If the initial vaccine was given at age greater than 65 years, then repeated vaccination is not indicated. The IDSA states that patients can be given the pneumococcal vaccine immediately after an episode of pneumonia.

Comment
Using a composite of both guidelines, we can simplify the treatment regimens. For outpatients, monotherapy with either a β-lactam, a macrolide antibiotic, doxycycline, or a fluoroquinolone antibiotic should be sufficient.

For patients requiring admission to a GMF or with the absence of risk factors for DRSP or infection with enteric gram-negative organisms, the recommended treatment is with a combination of a β-lactam plus a macrolide or monotherapy with a fluoroquinolone antibiotic.

For severely ill patients with CAP (eg, patients requiring admission to the ICU or having risk factors for P aeruginosa infection), treatment should always be with a combination of at least two drugs and the drugs should be appropriately selected for the suspected organism. Examples include a β-lactam plus a macrolide antibiotic, a β-lactam plus a fluoroquinolone antibiotic, and a β-lactam plus an aminoglycoside plus a macrolide antibiotic.

References