EMERGENCY MEDICINE PRACTICE

AN EVIDENCE-BASED APPROACH TO EMERGENCY MEDICINE

Community-Acquired Pneumonia: Deciding Whom To Admit And Which Antibiotics To Use

September 1999

Volume 1, Number 4

Authors

Peter M. DeBlieux, MD
Program Director, LSU Emergency Medicine Residency; Associate Professor of Emergency Medicine, Pulmonary and Critical Care Medicine; Department of Emergency Medicine, Charity Hospital, New Orleans, LA.

Ellen M. Slaven, MD
Assistant Clinical Professor of Emergency Medicine, LSU Emergency Medicine Baton Rouge; Infectious Disease Fellow, LSU New Orleans Department of Internal Medicine; Department of Emergency Medicine, Charity Hospital, New Orleans, LA.

Peer Reviewers

Stephen Karas Jr., MD
Clinical Professor of Emergency Medicine, University of California—San Diego, La Jolla, CA.

CME Objectives

Upon completing this article, you should be able to:

1. list common etiologies of community-acquired pneumonia;
2. describe common presenting signs and symptoms of community-acquired pneumonia;
3. identify appropriate diagnostic studies for the evaluation of a patient with community-acquired pneumonia;
4. discuss empiric treatment options in patients with community-acquired pneumonia; and
5. identify and review pitfalls in the management of patients with community-acquired pneumonia.

Date of original release: September 1, 1999.
Date of most recent review: August 30, 1999.
See "Physician CME Information" on back page.

AT the close of the millennium, pneumonia remains "the captain of the men of death." This famous aphorism of Osler still portrays a stark truth well-known to emergency physicians. Yet, recent developments in the approach to this disease may alleviate its pestilent sting.

This article distills the major published guidelines regarding the management of community-acquired pneumonia and the important literature upon which these guidelines are based. Two major concerns to the emergency physician are whom to admit and which antibiotics to use. While about 75% of patients may be appropriately treated as outpatients,[1] the real question remains, "How do we best identify the 25% who require admission?"

Pneumonia: Background

Definition

The Infectious Disease Society of America (IDSA) suggests the following definition for community-acquired pneumonia: an acute infection of the pulmonary parenchyma associated with: 1) symptoms of acute infection; and 2) the presence of an acute infiltrate on chest x-ray *or* auscultatory findings consistent with pneumonia. To qualify for the "community" aspect of this definition, the patient cannot have been hospitalized or treated in a nursing home for 14 days before presentation of the acute illness; otherwise, the pneumonia is considered nosocomial.[1] (See **Table 1**.)

Not all authorities agree with this definition. The pneumonia Patient Outcomes Research Team (PORT) cohort study included nursing-home patients but excluded patients with HIV.[2] It also excluded patients who had been hospitalized within the previous seven days. Unlike the IDSA guidelines, both the PORT study and most other major investigations regarding pneumonia require an infiltrate on chest x-ray for study inclusion.

Etiology

Although the majority of patients diagnosed with community-acquired pneumonia are treated as outpatients, the vast majority of evidence regarding pathogens is derived from hospitalized patients. Etiologies for pneumonia include bacteria, viruses, and chemical contaminants. Common infectious agents are listed in **Table 2**. In a meta-analysis that included 33,148 patients, *Streptococcus pneumoniae* was the leader, accounting for 13.4% of all patients with pneumonia. *Haemophilus influenzae* was second (at 2.5%), and *Mycoplasma pneumoniae* was third (at 1.5%).[3] Despite frequent microbiologic investigations, *at least one-third of all patients with community-acquired pneumonia never have a definitive pathogen identified*.[4]

The failure to discover an etiologic agent is a common theme in the pneumonia literature. In one study, a definitive pathogen was found in only 16.5% (458) of patients.[5]

Epidemiology

Pneumonia is the major cause of death worldwide and the most significant cause of infectious death in the United States. Each year, approximately 4 million adults are diagnosed with community-acquired pneumonia, leading to 600,000 hospitalizations.[1] The financial impact of this disease is enormous, and medical costs are conservatively placed at $4 billion per year.

Even considering the advancing age of our patient population, the incidence of pneumonia has increased steadily over the past decade. Presentation is most common during the winter months, and the incidence of bacterial community-acquired pneumonia increases following influenza outbreaks. However, pneumonia remains an important concern in all months of the year.

Table 1. IDSA Definition Of Community-Acquired Pneumonia.

- An acute infection of the pulmonary parenchyma
- Symptoms of an acute infection: cough, fever, myalgias, dyspnea, etc.
- Presence of an acute infiltrate on radiograph; **or**
- Auscultatory findings consistent with pneumonia
- Not hospitalized or residing in a care facility for 14 days before onset of symptoms

Table 2. Common Etiologies For Community-Acquired Pneumonia.

Bacterial
Streptococcal pneumonia
Haemophilus influenzae
Mycoplasma pneumoniae
Gram-negative bacilli
Staphylococcus aureus
Moraxella catarrhalis
Legionella pneumophilia
Chlamydia pneumoniae

Viral
Influenza
Parainfluenza
Respiratory syncytial virus
Adenovirus

Other
Mycobacterium tuberculosis
Pneumocystis carinii

Pathophysiology

Mechanisms for pneumonia include one or more of the following: micro-aspiration, macro-aspiration, and hematogenous spread. Micro-aspiration occurs commonly in normal hosts, but a combination of immune mechanisms and the protective action of the lung cilia help prevent disease. Macro-aspiration occurs in patients with abnormal swallowing mechanisms, as occurs in patients with stroke or neuromuscular disorders. Sedative-hypnotic drugs and alcohol intoxication are other important contributors to macro-aspiration. Patients who suffer from macro-aspiration are prone to lung abscess formation. Hematogenous spread to the lungs can occur in patients with bacteremia, especially in those with a distant focus of infection, such as a septic joint or skin ulcer. Intravenous drug abusers may develop tricuspid endocarditis and septic pulmonary emboli.

Morbidity And Mortality

Despite advances in antibiotic therapy, the overall mortality reported in patients with pneumonia has remained constant, at about 25% over the past four decades.[6] However, mortality is usually less than 1% in those patients not requiring hospitalization.[6]

Mortality is closely associated with age, underlying disease, and the degree of physiologic impairment on presentation to the ED. Alcoholism is another important risk factor. Much of the current data regarding mortality comes from the PORT cohort study.[2] This important study used data on 14,199 adult inpatients with community-acquired pneumonia to derive a prediction rule. This rule stratified patients into five classes with respect to the risk of death within 30 days. The rule was then validated using data on more than 40,000 additional patients.

The PORT algorithm (see "PORT Recommendations" on page 13) will help the emergency physician quickly identify those patients most likely to benefit from hospitalization. It will also identify those who may require intensive care.

Practice Guidelines

Numerous organizations have published guidelines on the management of community-acquired pneumonia. The most important English language guidelines are by the American Thoracic Society (ATS),[7] the British Thoracic Society,[8] the Canadian Infectious Disease Society,[9] and the Infectious Diseases Society of America (IDSA).[1] These guidelines often conflict in key points.

Because emergency medicine physicians were not asked to contribute to these "consensus" guidelines, it is

not surprising that these recommendations fall short regarding the emergency management of pneumonia. None of these guidelines are ideal for emergency medicine practice; the ATS guidelines are best in regards to diagnostic testing (with decreased emphasis on microbiologic studies such as cultures and Gram's stains), while the IDSA guidelines on antibiotic selection are more current regarding antibiotic resistance patterns.

The IDSA emphasizes the microbiology aspects of the evaluation. While they attempt an evidence-based approach, they provide no scientifically valid literature to defend their position. Indeed, the expert panel states, "The Panel agrees that no studies have clearly demonstrated the cost-effectiveness or other advantages of attempts to identify etiologic pathogens..." but goes on to give several theoretical arguments to support their position.[1] It is not unexpected for the IDSA to suggest that cultures or Gram's stains are necessary in the management of an infectious disease.

Differential Diagnosis

The differential diagnosis for community-acquired pneumonia is extensive. Many variant conditions result in respiratory symptoms, fever, and pulmonary infiltrates. **Table 3** identifies some common mimics of pneumonia. Congestive heart failure, pulmonary embolus, neoplasm, and chronic obstructive pulmonary disease exacerbation lead the list of diagnoses that should be considered. Prior chest radiographs, in those patients with pre-existing pulmonary pathology, may be valuable in differentiating acute from chronic conditions.

Pulmonary embolism is the one mimic that can kill an otherwise healthy person. During the evaluation of a patient with possible pneumonia, determine whether the patient has risk factors for pulmonary embolism. If the diagnosis of pneumonia is in doubt, consider obtaining a rectal temperature in patients with presumed pneumonia, as a rectal temperature of greater than 102˚F is unlikely to be associated with pulmonary embolism.[10]

If warranted, lower-extremity Doppler ultrasound, helical CT scan, or pulmonary angiography may aid in differentiating pulmonary embolism from community-acquired pneumonia. The V/Q scan is unlikely to be helpful in distinguishing pneumonia from PE, as patients with an infiltrate on chest x-ray will have a non-diagnostic V/Q scan 82% of the time.[11]

Table 3. Differential Diagnosis Of Pneumonia.

Pulmonary embolus
Congestive heart failure
Chronic obstructive pulmonary disease
Chronic interstitial lung disease
Pulmonary neoplasm
Adult respiratory distress syndrome
Aspirin overdose
Heroin overdose
Major burns
Surgery or trauma
Hantavirus pulmonary syndrome
Sarcoidosis
Aspiration
Acute bronchitis
Hemorrhage
Drug reaction
High altitude pulmonary edema
Chemical pneumonitis

History And Physical Examination

The history and physical examination can determine whether the patient with pulmonary symptoms or fever needs a chest x-ray and further diagnostic testing. It can also help assess the risk of death in a patient found to have an infiltrate on chest x-ray. However, history and physical examination *cannot* determine the pathogen responsible for pneumonia. No specific constellation of symptoms, physical findings, or immediately available laboratory tests can reliably distinguish the etiology of pneumonia.[12] The rare exceptions include a chest film diagnostic for a lung abscess or a "classic" presentation of tuberculosis.

The history and physical should also determine the possibility of HIV-related disease. If patients are at high risk for HIV, the physician is more likely to consider and treat for *Pneumocystis carinii* pneumonia and tuberculosis (TB). In some urban hospitals, more than 45% of patients hospitalized for community-acquired pneumonia are HIV-positive, and nearly one-fifth of these patients are unaware of their HIV status.[13]

In the patient with possible pneumonia, the history and physical examination should target high-risk findings. These are listed in the PORT algorithm. (See "PORT Recommendations," Part 1 and Part 2, on page 13.)

History

Many patients present to the ED with signs and symptoms of respiratory infection: cough, sputum production, dyspnea, and fever. The majority of patients with respiratory complaints will have a benign illness, such as an upper-respiratory tract infection or bronchitis. The rate of radiographic pneumonia varies between 12% and 30% in ED patients who undergo chest films for cough and fever.[14]

Historical characteristics are not definitive in distinguishing "typical" from "atypical" pneumonias.[7] The typical bacterial pneumonia, such as *Pneumococcus,* is often described as a sudden onset of rigor (shaking chill) followed by fever, cough, rust-colored sputum, and pleuritic chest pain. "Atypical pneumonia" was thought to have both upper and lower respiratory tract signs and symptoms, constitutional symptoms (especially myalgias and arthralgias), a protracted course, and a lack of response to penicillin. *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, *Legionella pneumophilia*, and, less frequently, *Coxiella burnetii* and *Chlamydia psittaci* represent the atypical pathogens.

Unfortunately, these supposedly classic presentations aren't all that common. Many patients with pneumococcal pneumonia do not have the "typical" constella-

tion of symptoms. In one study of 268 hospitalized patients with community-acquired pneumonia, almost 40% of those diagnosed with pneumococcal pneumonia presented with flu-like symptoms: fever, cough, nasal discharge, sore throat, and muscular pain.[7] Patients with the atypical organism *Legionella* may present with a fulminant picture compatible with *Pneumococcus*. Since it is impossible to clinically differentiate "typical" from "atypical," the terms are being abandoned, except when referring to antibiotic susceptibility.

Important historical data in patients with possible pneumonia includes: patient age, presence of comorbid illness, immunosuppression, place of residence (nursing home or military barracks), occupational exposures, recent travel, and exposure to animals. Protracted fever, night sweats, hemoptysis, weight loss, and recent tuberculosis exposure are vital historical clues that suggest TB.

While cough and dyspnea are the most common symptoms of pneumonia for patients of all ages, they are statistically less common in the elderly.[15] Slightly more than half of patients 65 years and older reported fever and chills, compared with 85% of patients 18-44 years old. Confusion tends to be a significant symptom of pneumonia in the elderly.

Ask the patient whether he or she has been vomiting. The inability to take oral medication may mandate hospitalization in a patient with pneumonia.

Past medical history is crucial to determine immune suppression. Ask all patients with possible pneumonia if they have ever been tested for the AIDS virus and what the result of that test was. Determine risk factors for infection with HIV, including male homosexual sex, exchanging sex for drugs, sex with prostitutes, injection drug use, and sexual contact with persons at risk for infection.

Comorbid conditions play a significant role in evaluating the need for hospitalization. The PORT study identified neoplastic disease, liver disease, congestive heart failure, cerebrovascular disease, and renal disease as the most important underlying conditions that increase the risk of death in patients with pneumonia.[2] Other studies have found that alcoholism, diabetes, HIV, chronic illnesses, and immunosuppressive medications are important considerations.[12,13]

Patients who have been hospitalized within 14 days of presentation or who have recently received antibiotics are at increased risk for resistant pathogens. Consider the possibility of gram-negative pneumonias in the case of nursing-home and recently hospitalized patients. Patients who have failed a recent course of broad-spectrum antibiotics may have tuberculosis or PCP.

The history should also determine the patient's social situation. Social factors that significantly influence hospitalization decisions include homelessness or the lack of a telephone or car. The presence of a reliable caretaker in the home is an additional consideration. When considering home therapy, determine whether the patient can afford the prescribed antibiotics. (See also "Clinical Pathway: The Management Of Patients With Community-Acquired Pneumonia" on page 12.)

Physical Examination

Determine Clinical Stability

The initial assessment of the patient suspected of pneumonia should focus on the vital signs and respirations. Signs of impending respiratory failure include tachypnea, grunting, sitting upright or in a "tripod position," nasal flaring, diaphoresis, cyanosis, and altered mental status. Patients in distress may require resuscitation, including oxygen therapy and perhaps intubation, before completing the examination.

Vital signs vary widely in patients with pneumonia, and they are an important aspect of the PORT score. The presence of hypotension on presentation is strongly associated with mortality and the need for intensive care.

Consider obtaining a rectal temperature in a patient suspected of pneumonia who is afebrile by oral thermometry. A rectal temperature is more accurate in a patient with pneumonia who may have tachypnea or mouth breathing.[16] Both hyperpyrexia and a sub-normal temperature will increase the PORT score.

Chest Examination

Physicians have performed the traditional physical exam of the chest for hundreds of years despite little objective data on accuracy or reproducibility. A number of prospective studies have demonstrated that physical findings are neither sensitive nor specific in the diagnosis of pneumonia.[9,17] The positive predictive value of abnormal breath sounds in patients with acute respiratory illness is only 55%.[11] The degree of interobserver variability in these findings is also high.

Crackles (rales) are the most common finding on auscultation in patients with community-acquired pneumonia.[18] However, rales are also common in pulmonary embolism. Half of all patients with angiographically confirmed PE may demonstrate rales on physical exams.[12,19]

The examination of the chest includes four steps: inspection, palpation, percussion, and auscultation. The assessment of symmetry between the hemithoraces is an essential aspect of nearly all of these tests.

Inspection of the chest may reveal asymmetric chest wall expansion due to splinting. The most important aspect of palpation involves tactile fremitus. This is accomplished by palpating the two hemithoraces while the patient is speaking to detect asymmetry in the "voice buzz." The chest is percussed evenly on both sides to elicit dullness that accompanies consolidation, pleural fluid, atelectasis, or large intrathoracic masses.

Auscultation should be done with the patient sitting upright and breathing at normal tidal volumes. Bronchial or tubular breath sounds are normally heard only over the trachea, but they are heard in the periphery in cases of consolidation. The enhanced transmission of sound encountered with consolidation or effusions will increase the clarity of the patients whispered voice (whispered pectoriloquy), or the change in tone of the patient's voice from "e" to "a" (egophony—traditionally associated with effusions). Adventitious breath sounds include discontinuous sounds, crackles, and continuous sounds with a

musical quality—either high-pitched wheezes or lower-pitched rhonchi.

Alternative Techniques

Auscultatory percussion is a relatively new technique developed to enhance the sensitivity of the chest exam. The examiner lightly percusses the sternum with his or her finger while auscultating the hemithorax posteriorly. A decrease in the intensity of the conducted sound is attributed to pleural fluid, lung consolidation, or lung masses. While some authors claim auscultatory percussion enhances the detection of pulmonary abnormalities,[12,13] others feel the technique offers nothing over conventional percussion.[14,15]

Listening to the chest while the patient is lying on his or her side may increase the accuracy of the auscultatory examination. In one study, the most valuable examination maneuvers in detecting pneumonia were unilateral rales and rales in the lateral decubitus position.[17]

Other Aspects Of The Physical Examination

Determine the patient's state of hydration. This may involve skin turgor, mucous membranes, or urine output.

It is also important to identify signs of underlying disease. Comorbid illnesses may result in malnourishment evidenced by muscular atrophy and temporal wasting. Infection with HIV may reveal generalized lymphadenopathy, thrush, hairy leukoplakia, or Kaposi's sarcoma.

Examination of the upper extremities may show indurated and scarred veins, "track marks" in the antecubital fossa from injection drug use, or clubbing of the fingernails from chronic lung disease, such as bronchiectasis, cystic fibrosis, or cancer.

The oral examination in a patient with cough and fever may be as important as the lung exam. The presence of oral thrush significantly increases the likelihood of PCP.[20-22] In one study, oral mucosal lesions suggestive of HIV infection were present in 80% of patients with unknown HIV status and probable PCP.[23]

Diagnostic Studies

Chest Radiograph

The chest radiograph is the most useful test to establish the diagnosis of community-acquired pneumonia. *The American Thoracic Society and the Infectious Diseases Society of America guidelines recommend a chest x-ray in all patients suspected of pneumonia.*[1,16]

A chest x-ray helps predict severity of disease, as multilobar infiltrates and pleural effusions are associated with increased mortality.[24] A chest x-ray is useful to rule out other conditions that mimic pneumonia.

Although a chest x-ray cannot determine the etiology of a community-acquired pneumonia, certain classic radiographic findings may suggest a specific etiology, such as the diffuse bilateral infiltrates of *Pneumocystis carinii* pneumonia or the upper-lobe cavitary lesions of *Mycobacterium tuberculosis*. A cavity with an air-fluid level is essentially diagnostic of a lung abscess caused by anaerobes.

Limitations Of Chest Radiography

Regrettably, the chest x-ray is not a perfect screening tool, and patients may have a normal radiograph in the face of pneumonia.[19] Some authorities believe this is more likely to occur in patients with dehydration and those with profound neutropenia. However, the scientific evidence for this is meager.

Despite all that is written about classic radiographic features of pneumonias caused by various bacterial pathogens, radiographic findings are nonspecific.[17] Finding an infiltrate on the chest x-ray does not ensure the diagnosis of pneumonia. False-positive chest x-ray findings may be due to unilateral pulmonary edema, neoplasms, atelectasis, hypersensitivity pneumonitis, pulmonary embolism, and sarcoidosis. Even radiologists cannot reliably distinguish bacterial from viral pneumonias on chest x-ray.[20] More importantly, it is also impossible to distinguish pulmonary embolism from pneumonia on chest film.[19]

There is considerable interobserver variability in the roentgenographic diagnosis of pneumonia—a variability that does not improve with increasing medical experience. In one study comparing physicians of differing experience, agreement with a "gold standard" (3 radiologists) was poor. Dense lobar or segmental opacities were uniformly recognized as pneumonia, while patchy opacities and diffuse alveolar disease were frequently missed as signs of pneumonia, or misinterpreted.[25]

Who Needs A Chest X-ray?

Since the minority of patients who present to the ED with a chief complaint of cough will have pneumonia, ordering chest x-rays for all patients with respiratory symptoms is wasteful.[10] Factors that predict pneumonia on chest x-ray are temperature greater than 37.8˚C, heart rate greater than 100 beats/min, rales, locally decreased breath sounds, and the absence of asthma.[11] Dementia is also associated with radiographic pneumonia. The absence of any abnormality in the patient's temperature, pulse, or respiratory rate significantly reduces the odds of a positive film.[18]

Laboratory Testing

Many patients with community-acquired pneumonia need no diagnostic tests beyond a history and physical examination, chest x-ray, and pulse oximetry. Today, physicians are ordering fewer tests to determine the etiology of pneumonia, especially in those well enough to be treated at home. In one recent study, only 29.7% of outpatients had any microbiologic tests performed, and in only 5.7% was a discrete organism found.[26] Despite (or because of) the paucity of tests, these patients had excellent outcomes.

Extensive testing often adds expense and little benefit. Hospitalized patients who undergo extensive diagnostic testing (including blood gas analysis, blood, sputum, CSF, urine cultures, and bronchoscopy) have no better outcomes than those who undergo minimal diagnostic procedures.[27] Controlling for severity of illness, an aggressive diagnostic

strategy merely adds costs and increases length of stay without improving care.

When using the PORT scoring algorithm, patients in risk class I need no laboratory testing (except possibly pulse oximetry). However, others may benefit from laboratory testing to determine the safety of outpatient management. The PORT study found the following laboratory variables to be important in predicting mortality:

pH < 7.35
BUN > 10.7 mmol/L (30 mg/dL)
Sodium < 130 mEq/L
Glucose > 13.9 mmol/L (250 mg/dL)
Hematocrit < 30%
pO_2 < 60 mmHg

The PORT algorithm *suggests* these tests to determine risk stratification for patients who have significant risk factors on history and physical examination. Still, the study never tested the hypothesis that selective testing of these laboratory parameters *based on clinical judgment* is safe and effective.

Measurements Of Oxygenation

Hypoxia is associated with increased morbidity and mortality in patients with community-acquired pneumonia. Measuring the patient's oxygen saturation using pulse oximetry may greatly influence medical decision-making. In one study, the failure to adequately assess oxygenation was responsible for 22% of preventable deaths associated with pneumonia.[28] *The PORT authors suggested that admitting all patients with an oxygen saturation of less than 90% on room air would provide an additional margin of safety to their decision algorithm.*[2]

An arterial blood gas (ABG) is helpful in certain patients with low oxygen saturation. This includes patients hospitalized with underlying pulmonary disease, such as COPD, to evaluate for possible CO_2 retention. Patients with an altered mental status may demonstrate CO_2 retention or an acid-base disorder on blood gas analysis. The ABG is also helpful in patients suspected of having PCP, because the decision to add steroids to the antibiotic regimen is based on the PaO_2 being less than 70 mmHg or an A-a gradient of 35 or greater.

While the pO_2 and pCO_2 are important parameters, the base deficit may be equally or even more important in the evaluation of a patient with community-acquired pneumonia. A significantly negative base deficit provides an early warning of occult shock. This metabolic acidosis may portend a more complicated hospital course consistent with sepsis, intoxication, or a metabolic disorder.

Microbiologic Testing

There is no need to routinely search for a pathogen in the patient with community-acquired pneumonia who is well enough to be treated at home. However, the need for microbiologic testing in the patient who requires hospitalization remains controversial. Possible microbiology tests include sputum tests (Gram's stain, culture, antigen testing, and polymerase chain reaction [PCR] tests), blood assays (blood cultures, antigen tests, and serology), and urine testing (cultures and antigens). Transtracheal aspiration and bronchoscopic sputum samples are selective alternatives to expectorated sputum. These techniques are impractical for routine use due to their invasive nature, the need for technical expertise, and expense. Indications are limited to patients with fulminant disease or disease unresponsive to empiric antimicrobial therapy. There is no need for an emergency physician ever to perform a diagnostic transtracheal aspiration.

One prospective study (n=122) examined the value of blood cultures, sputum analysis, and serologic tests in patients with community-acquired pneumonia. A definitive etiologic agent was identified in only 26% of patients. Because the results of these tests affected antibiotic therapy in only 8% of patients, the authors concluded that these tests should *not* be routine; rather, they should be ordered based on severity of illness.[4] Other studies reinforce the precept that routine microbial investigation, such as sputum investigation, blood cultures, and bronchoscopy, provide little value for patients hospitalized for community-acquired pneumonia.[29]

While the literature on the need for microbiologic testing is mixed, the physician must keep a central caveat in mind: *Diagnostic testing should never delay antibiotic treatment of the acutely ill patient.* The severely ill patient requires early antibiotics, *not* extensive culturing. In such cases, rapidly obtain blood cultures and administer antibiotics. Even the IDSA supports this position in their clinical guideline.[1]

Sputum Gram's Stain

Gram's stains are unnecessary in the patient who will be treated at home. For the patient ill enough to require hospitalization, the ATS and IDSA disagree on the role of the sputum Gram's stain. *The ATS does not recommend routine Gram's staining of sputum,* citing the lack of correlation with sputum cultures and the fact that mortality is unchanged whether or not the etiology is established.[7]

On the other hand, the IDSA guidelines state that for hospitalized patients with community-acquired pneumonia, establishing the etiologic agent offers a more precise and possibly more cost-effective use of antibiotics. The IDSA recommends that sputum be obtained from a deep cough before antibiotic treatment and that it be rapidly transported and processed (within 2 hours). They agree that antibiotics should not be delayed for specimen collection in the patient who is acutely ill. Adequate samples should contain less than 25 squamous epithelial cells per low power field.[1] Direct staining of sputum may be useful to diagnose pulmonary infections caused by *Mycobacterium tuberculosis* and endemic fungi.

Limitations Of Sputum Gram's Stains

The disadvantages of the Gram's stain are related to poor sensitivity and specificity. If the Gram's stain is inaccurate, the patient may be treated with the wrong antibiotic. The ATS believes that the empiric treatment of likely

pathogens is more effective than basing antibiotic choices on this unreliable test.

Gram's staining is an art (some say a lost art) that depends upon the skill of the person performing and interpreting the stain. In one study, Gram's stain interpretation by house staff showed a 43% false-positive rate for *Streptococcus pneumoniae* and a 73% false-negative rate for *Haemophilus influenzae*.[30]

The results of sputum Gram's stains and sputum cultures often conflict. The positive predictive values for common Gram's stain morphotypes and their corresponding cultures vary tremendously, from 7.1% to 90.6%.[31] In several studies, Gram's stain could not reliably predict the presence of gram-negative rods, including *Haemophilus influenzae*.[32,33] Gram's stains are also unable to identify intracellular pathogens, such as *Legionella* sp., *Mycoplasma pneumoniae,* and *Chlamydia pneumoniae*.

While obtaining a sputum specimen poses little risk to the patient (unless a transtracheal aspirate is attempted), induction of a sputum sample poses a real danger to everyone in the ED—staff, patients, and visitors. If the patient is infected with TB, sputum induction with saline irritants will aerosolize the tuberculous bacilli. While some curmudgeons suggest that nebulized sputums be obtained in the administrative offices of HMOs, a more appropriate venue is a negative pressure room.

Sputum Cultures

Numerous studies indicate that sputum cultures are neither sensitive nor specific. Contamination with oral microbes and previous antibiotic therapy further limits their utility. Prior antibiotic therapy is associated with false-positive cultures for *Staphylococcus aureus* and gram-negative bacilli.[34]

Sputum cultures may be helpful in certain cases. Sputum cultures with antibiotic sensitivity testing may be useful in patients who have failed prior antibiotics, and perhaps in those suspected of having a penicillin-resistant *Streptococcus pneumoniae*. Cultures are also important in the diagnosis of *Mycobacterium tuberculosis* and endemic fungi. Polymerase chain reaction (PCR) technology applied to sputum may detect *Mycobacterium tuberculosis* in a matter of hours; however, it is not routinely available.

Blood Cultures

Drawn for a variety of febrile conditions, blood cultures taken in the ED rarely yield positive results. Overall, only 1.6% of blood cultures taken in the ED impact patient care.[35] They are a "Pavlovian" response to fever, with a true positive rate averaging 20% and a false-positive rate of about 50%.[35] Neither the ATS nor the IDSA recommends blood cultures in patients who do not require hospitalization.

However, both the ATS and IDSA recommend blood cultures for all hospitalized patients. Blood should be cultured from two separate sites before the administration of antibiotics.

Limitations Of Blood Cultures

The gold standard for diagnosis of community-acquired pneumonia is recovery of an organism from blood culture. Yet only 11% of hospitalized patients with community-acquired pneumonia have positive blood cultures.[21] The detection of a specific pathogen does not improve the mortality rate in hospitalized patients with community-acquired pneumonia.[4,22]

Blood cultures rarely change management of hospitalized patients with pneumonia. In one study, positive blood cultures were obtained in 6.6% of hospitalized patients with pneumonia; in 25 other patients (4.8%), positive cultures were felt to be contaminated. *A positive blood culture led to therapeutic alteration in just over 1% of patients who were cultured.* The authors concluded that the clinical utility of blood cultures is limited and the cost-effectiveness is questionable.[36] Other studies support this position.[37,38]

The role of blood cultures in the treatment of antibiotic-resistant organisms is unclear. The incidence of penicillin-resistant *Streptococcus pneumoniae* has steadily increased over the past decade, and current community rates vary from 20-40% in the United States. However, the in vitro antibiotic resistance may not correlate with the clinical efficacy of an antibiotic (see the section on antibiotics later in this article).

Other Tests

Surely a CBC should be drawn in patients with pneumonia, right? Interestingly, the white count was *not* associated with mortality in the PORT study.[6] While the hemoglobin or hematocrit is of concern, the leukocyte count should not be used in decision making (except possibly in patients undergoing cancer chemotherapy).

It is the chest film, not routine blood tests, that provides the diagnosis of community-acquired pneumonia. Severity of illness, usually apparent on clinical examination, may correlate with abnormal laboratory values. Hyponatremia occurs more frequently in community-acquired pneumonia due to *Legionella* sp. than other pathogens.[25]

The IDSA recommends routine HIV screening for the hospitalized patient if the prevalence of HIV infection is moderate within a community.[24] In general, the emergency physician should avoid testing for HIV. These tests are governed by strict regulations. Some states demand formal pretest and post-test counseling—requirements that are difficult to meet in the ED.

In 1993, the American Thoracic Society recommended that serologic tests not be routine, due to their low yield in community-acquired pneumonia. Acute and convalescent titers are usually necessary for interpretation. On occasion, a urinary antigen assay for *Legionella pneumophilia* is helpful, as it is both rapid and reasonably sensitive (70%) for this disease. However, a negative result does not exclude the diagnosis.[39]

Thoracentesis

A significant number of patients with pneumonia will develop a pleural effusion. These parapneumonic effusions are associated with increased morbidity and

mortality. Both the ATS and IDSA recommend thoracentesis in patients with pneumonia and a significant pleural effusion. While the definition of "significant" may vary, some authorities suggest thoracentesis for effusions that measure more than 10 mm on a lateral decubitus film.[40] Either the emergency medicine or admitting physician may perform thoracentesis, which can be accomplished hours after antibiotic administration.

The most important laboratory parameters of pleural fluid are pH, LDH, and glucose measurement, as these discriminate between complicated vs. uncomplicated effusions.[41] Patients with purulent fluid or those with a pH less than 7.2 require chest tube drainage. Other tests include white blood cell count and differential, Gram's stain, acid-fast stain, and bacterial, fungal, and mycobacterial cultures.

Disposition

Who goes home? Who stays? Decisions regarding disposition depend upon a variety of factors. The most important considerations involve clinical factors such as patient stability, comorbid disease, and ability to take oral medications.[42] Other considerations include psychosocial issues such as patient preferences, reliability of the patient and family, and resources available at home. Home resources include both family and home healthcare provided by visiting professionals.

The PORT Scoring System

Currently, between 3% and 22% (average, 12%) of all patients hospitalized for pneumonia can probably be treated as outpatients.[43] There is a tremendous variability in the admission rates for patients with community-acquired pneumonia. This variability often has less to do with the medical condition of the patient than the practice style of the physician. What if there was an objective means to predict the need for hospitalization? It could identify high-risk patients and target them for aggressive therapy. It could distinguish low-risk patients and allow them to be treated at home, saving significant resources.

The PORT cohort study provides physicians with a prediction rule that quantifies the risk of an adverse medical outcome in patients with community-acquired pneumonia. This allows the physician to select the most appropriate site of treatment. The rule was derived and validated with 52,000 adult inpatients with community-acquired pneumonia, and validated a second time with 2287 adults, both inpatients and outpatients.[2] The investigators designed a two-step algorithm to stratify patients with community-acquired pneumonia into five risk classes that correlate with mortality (see "PORT Recommendations" on page 13). Other researchers have shown that the use of the PORT rules may increase the number of patients with community-acquired pneumonia who may be safely discharged.[44] The IDSA endorses the PORT study's recommendations for outpatient treatment of risk classes I and II, brief hospitalization for risk class III, and traditional hospitalization for risk classes IV and V.[1]

To use the PORT algorithm, follow the decision tree in Part 1 (see page 13). If the patient is younger than 50 and has no high-risk historical factors or physical findings, he or she is assigned to risk class I and requires no further testing apart from pulse oximetry. If the patient is older than 50 or has any high-risk factors, the physician may use the scoring sheet (see Part 2) to compute the score. Calculating this score does require the use of several laboratory variables.

Exceptions To The PORT Rules

There are important limitations to the PORT prediction rule. In addition to the scoring criteria, three additional factors were almost universally associated with hospitalization in the PORT study: the inability to maintain oral intake, the lack of patient home care support, and the presence of hypoxemia.[42]

The authors of the PORT study emphasize that the algorithm "must be applied in conjunction with physician judgment."[2] Several important considerations are omitted in the prediction rule: intractable nausea and vomiting, psychiatric illnesses, drug and/or alcohol abuse, homelessness, and poor social support. Such patients may receive a low risk class assignment on objective scoring, yet they may still require inpatient therapy.

Alcoholism deserves special consideration. One large trial specifically examined the impact of alcoholism on pneumonia and found an increase in both morbidity and the need for medical interventions.[45] Other studies have found different risk factors associated with either a complicated course or increased risk of death from community-acquired pneumonia. (See **Table 4**.)

Another limitation of the PORT prediction rule is the exclusion of what the authors term "rare conditions." These include patients with immunosuppression and neuromuscular diseases. Assigning a greater risk for diabetic and immunosuppressed patients seems obvious, but this is absent in the PORT prediction rule. The PORT authors also failed to include measurement of oxygen saturation early in their algorithm. For example, if a previously healthy 40-year-old with normal vital signs and normal mental status had a PaO_2 of 55 mmHg, he would be assigned to risk class I. However, the presence of hypoxia, as outlined in the second step of the prediction rule, would dictate admission and treatment with supplemental oxygen. The authors recognized this oversight and in the body of the paper suggested early measurement of oxygen saturation in patients with community-acquired pneumonia, recommending hospitalization for those with hypoxia.

Finally, because the prediction rule uses dichotomous variables (normal vs abnormal), certain patients have greater risk than the rule predicts. Consider a previously healthy 30-year-old with a systolic blood pressure of 60 mmHg and a heart rate of 130 beats/min

and no other abnormalities listed in the algorithm. The prediction rule would assign this patient to risk class II, suggesting outpatient therapy. Hopefully no emergency physician would discharge a patient in septic shock.

Alternatives To Admission

ED discharge to a home IV therapy program is a safe and effective alternative to hospitalization for carefully selected patients, provided appropriate safeguards are in place.[46,47]

If antibiotics are administered by a visiting nurse, and 24-hour telephone consultation is available, such a program can safely avoid hospitalization and significantly reduce costs associated with community-acquired pneumonia.[48]

ED Management

Supportive Treatment

Supportive treatment of patients with community-acquired pneumonia begins with ensuring adequate oxygenation and perfusion.

Oxygen

Supplemental oxygen should be given to all patients with hypoxia (O_2 saturation < 90%). The oxygen should be titrated to reach a saturation of *at least* 90%—levels of 92-94% provide an additional margin of safety.

Table 4. Risk Factors Associated With Increased Mortality In Patients With Community-Acquired Pneumonia (Studies Other Than The PORT Cohort).[1,7]

Historical Factors
Age over 65
Comorbid illness
Pre-existing lung disease
Diabetes mellitus
Chronic renal failure
Congestive heart failure
Chronic liver disease
Pre-existing neurologic disorder
Asplenia
Alcoholism
Immunosuppression

Physical Findings
Respiratory rate > 30 breaths/minute
Diastolic blood pressure < 60 mmHg or systolic blood pressure < 90 mmHg
Temperature > 101˚F
Extrapulmonary infection
Altered mental status

Laboratory Values
WBC < 4 x 109/L or > 30 x 109/L
Hematocrit < 30% or Hg < 9 g/dL
Evidence of organ dysfunction (metabolic acidosis, increased PT/PTT)
PaO_2 < 60 mmHg or $PaCO_2$ > 50 mmHg on room air
Creatinine > 1.2 mg/dL or BUN > 20 mg/dL

Intubation, CPAP, Or BiPAP

The decision to intubate and mechanically ventilate a patient is based mostly on clinical parameters. Absolute indications to intubate are: respiratory arrest, hemodynamic instability, hypercapnia with worsening acidosis, inability to protect the airway, and decreasing mental status. Relative indications include: PaO_2 less than 70 mmHg with an FiO_2 greater than 40%, pCO_2 greater than 50 mmHg (in a patient with previously normal pCO_2), A-a gradient greater than 400 mmHg with an FiO_2 of 100%, and subjective fatigue with increasing hypercapnia.[26] Noninvasive ventilatory techniques such as BiPAP have been studied in patients with community-acquired pneumonia.[49,50] However, more research is necessary.

Fluid Therapy

Failure to adequately manage fluids may lead to death in patients with pneumonia. In one study, 20% of preventable in-hospital deaths in patients with pneumonia were secondary to poor fluid management.[28]

Intravenous fluids should be the first intervention in patients with septic shock; two large-bore intravenous catheters may be required. Hypotensive patients may require 1-2 liters of crystalloid. Urinary catheters will assist in monitoring response to fluid resuscitation and organ perfusion. If patients remain hypotensive despite adequate crystalloids, vasopressors may be necessary to raise the mean arterial blood pressure to at least 75 mmHg.

Antibiotic Treatment

In the ED, it is nearly impossible to identify the etiologic agent of the patient's pneumonia, effectively rendering all therapy empiric. The choice of antibiotic should be based upon the most commonly isolated pathogens in patients with community-acquired pneumonia. For this reason, antibiotics must be effective against *Pneumococcus* and other "typical" bacterial pathogens, as well as the "atypical" organisms, such as *Mycoplasma, Legionella,* and *Chlamydia.* Antibiotic selection must account for local geographic resistance patterns.[1] Additional factors that influence antibiotic selection are cost, compliance, patient allergies, and possible drug interactions.

Both the ATS and IDSA guidelines (see "Clinical Pathway: IDSA Recommendations For Empiric Antibiotic Therapy" on page 14) are based upon the severity of illness; in other words, whether the patient requires treatment at home, in a general medical ward, or in an intensive care unit. The ATS also suggests that the physician consider the patient's age in the presence of comorbid illness. Recent reviews of both guidelines criticize the lack of coverage for atypical organisms in hospitalized patients.[51]

Macrolides

The macrolides are important drugs in the treatment of pneumonia. These antibiotics cover both "typical and atypical" organisms responsible for community-acquired pneumonia. The extended-spectrum macrolides, such as

azithromycin and clarithromycin, have enhanced activity against *H. influenzae.* Because in vitro studies demonstrate that erythromycin has limited activity against *H. influenzae,* some authorities suggest that patients predisposed to *H. influenzae* infections (such as smokers and those with COPD) be treated with one of these newer agents. However, a recent study showed excellent results in patients (age 60 or younger) with pneumonia who were treated with erythromycin.[52]

As with any popular antibiotic administered without good indications, liberal prescribing habits (giving antibiotics for viral syndromes or for simple bronchitis in young adults) have increased antibiotic resistance. The new-generation macrolides have suffered from their own marketing success; in some geographic locales, 30% or more of *Pneumococcus* in now resistant to the macrolides.[1] However, it remains unknown whether the in vitro resistance correlates with clinical failures.

Quinolones

Older quinolones such as ciprofloxacin are ineffective against *Pneumococcus.* However, the newer fluoroquinolones, such as levofloxacin, sparfloxacin, and grepafloxacin, are active against both penicillin-resistant and penicillin-susceptible strains of *S. pneumoniae,* as well as other common respiratory pathogens. They achieve high pulmonary tissue concentrations with oral dosing, and can be administered once daily.[53] The FDA has severely restricted the use of trovafloxacin because of the potential for life-threatening hepatic failure. Its use should be reserved in cases where the following conditions are met:

1. The patient is hospitalized with a life-threatening infection.
2. The patient receives the initial therapy in an inpatient healthcare facility (i.e., hospital or long-term nursing care facility); and
3. The treating physician believes that, even given the new safety information, the benefit of the product for the patient outweighs the potential risk.

Beta-lactam Antibiotics

Once a mainstay of treatment, the beta-lactams have fallen on hard times. The large gap in their coverage includes *Mycoplasma, Legionella,* and *Chlamydia,* all important causes of community-acquired pneumonia. This breach in their spectrum, along with the growing incidence of penicillin and cephalosporin resistance, is chipping at their primacy in the hospitalized patient. However, they remain an important class of antibiotics in the treatment of pneumonia, especially in patients who are critically ill.

Tetracyclines

The trendy practitioner, enamored of the latest pharmaceutical, often ignores this humble class of antibiotics. However, doxycycline in particular is an effective and inexpensive alternative to the costly new-generation quinolones and extended-spectrum macrolides.[54]

Antibiotic Resistance

The incidence of streptococcal pneumonia resistance to penicillin varies between communities, but it has increased markedly over the past decade across the nation. High-level penicillin resistance confers resistance to some macrolides, cephalosporins, and tetracycline.

The impact of in vitro resistance patterns and clinical effectiveness of antibiotics is surprisingly unclear. In one large study, in vitro resistance patterns had no impact on outcome in patients treated with beta-lactam antibiotics. Those with penicillin-resistant *Pneumococcus* who were treated with penicillin-G or ampicillin had similar outcomes to patients treated with ceftriaxone or cefotaxime.[6]

Similar results were found in patients with cephalosporin-resistant pneumococci who were treated with cephalosporins. In this study, the most important correlate of mortality was not the antibiotic chosen, but the clinical presentation of the patient; a blood pressure less than 90 mmHg was the most significant predictor of death.[6]

Outpatient Therapy

For most patients with a community-acquired pneumonia, treatment with a macrolide, new-generation quinolone, or doxycycline will suffice. The duration of treatment remains unclear. The American Thoracic Society guidelines state that pneumococcal pneumonia should be treated for 7 to 10 days; *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* for 10 to 14 days; and Legionnaires' disease in immunocompetent patients should be treated for 14 days and in immunosuppressed patients should be treated for 21 days.[7] However, because the etiology is rarely discovered in outpatients with community-acquired pneumonia, many emergency physicians treat empirically for 10 to 14 days depending upon the severity of illness and comorbidity. The use of azithromycin can shorten the treatment course to five days, due to its long half-life and high tissue levels.

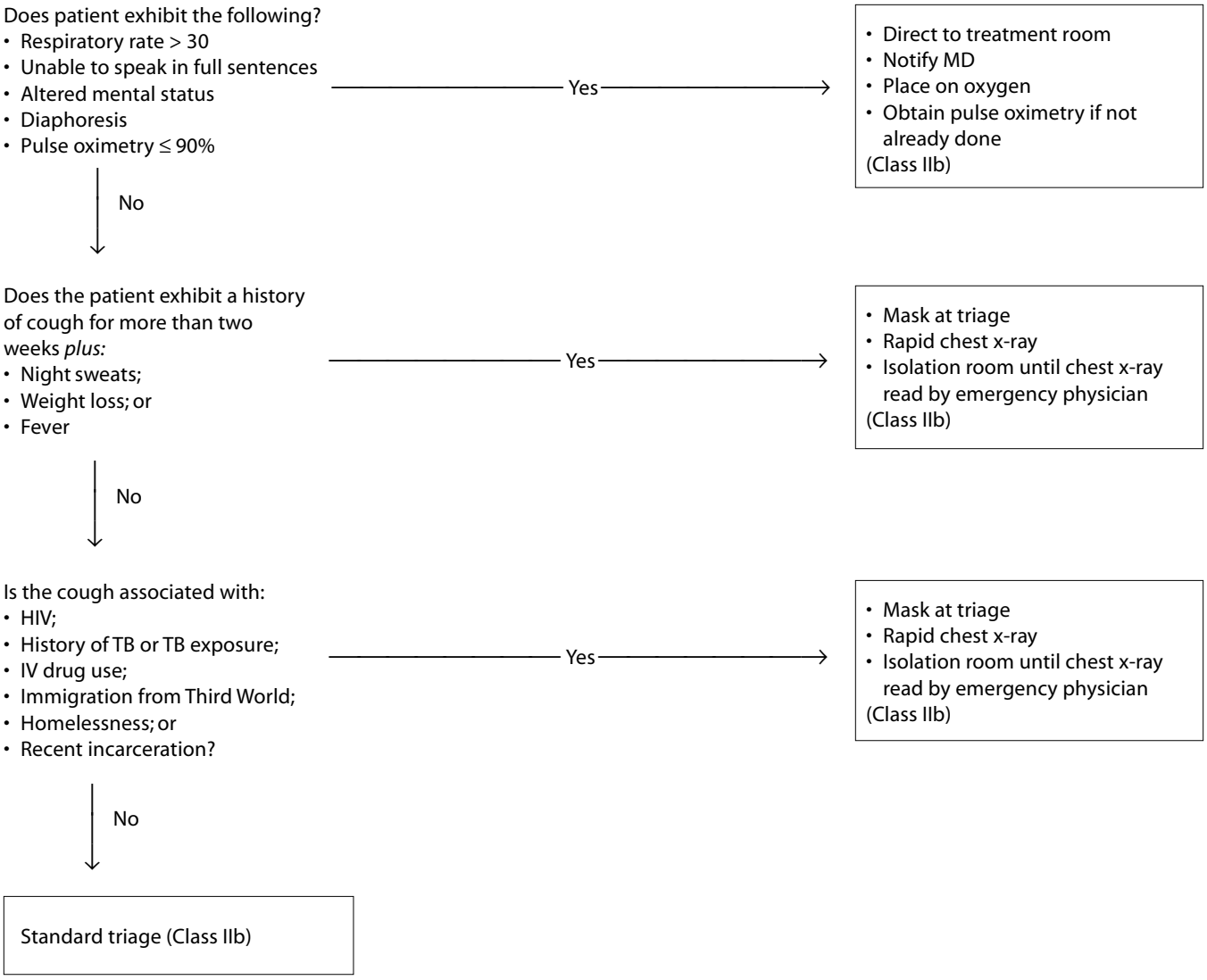
There is recent literature to support a three-day course of azithromycin in the treatment of certain patients with community-acquired pneumonia.[55,56] These trials involved higher than usual dosages of the drug (azithromycin was administered at a single dose of 1000 mg on day 1, and 500 mg for two days in one study and 500 mg per day for three days in the other). *This differs from the FDA-approved regimen* of 500 mg on the first day, followed by 250 mg for four additional days.

This off-label dosing may allow the physician to administer a loading dose of antibiotics in the ED and discharge the patient with two pills to take over the ensuing two days. Physicians must follow state and federal regulations regarding dispensing of medication.

Regardless of your choice of antibiotic, be sure to provide appropriate instructions upon discharge of the patient. Sample discharge instructions are included on page 21.

Continued on page 16

Clinical Pathway: Triage For Patients With Cough And Fever



The **evidence for recommendations** is graded using the following scale. For complete definitions, see back page. **Class I:** Definitely recommended. Definitive, excellent evidence provides support. **Class II a:** Acceptable and useful. Very good evidence provides support. **Class II b:** Acceptable and useful. Fair-to-good evidence provides support. **Class III:** Not acceptable, not useful, may be harmful. **Indeterminate:** Continuing area of research.

This clinical pathway is intended to supplement, rather than substitute, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

Clinical Pathway: The Management Of Patients With Community-Acquired Pneumonia

This algorithm assumes prior stabilization of the critically ill patient

Measure oxygen saturation using pulse oximetry (Class IIa)

↓

Is the O_2 saturation less than 90%? — Yes → Place on oxygen. Arrange for admission. (Class IIa)

↓ No

Use the PORT algorithm to assign a risk class to the patient. (Class IIa)

↓

Does the PORT score suggest inpatient therapy? — Yes → Place on oxygen. Arrange for admission. (Class IIa)

↓ No

Are any of the following factors present?
- Vomiting
- Homelessness
- Alcoholism
- Compliance issues
- No family or social support
- No money for antibiotics

— Yes → Place on oxygen. Arrange for admission. (Class IIa)

↓ No

Arrange for follow-up. Provide instructions for early return to the ED. Discharge home. (Class IIa)

The **evidence for recommendations** is graded using the following scale. For complete definitions, see back page. **Class I:** Definitely recommended. Definitive, excellent evidence provides support. **Class IIa:** Acceptable and useful. Very good evidence provides support. **Class IIb:** Acceptable and useful. Fair-to-good evidence provides support. **Class III:** Not acceptable, not useful, may be harmful. **Indeterminate:** Continuing area of research.

This clinical pathway is intended to supplement, rather than substitute, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

PORT Recommendations

Part 1. Admission Decision Tree For Community-Acquired Pneumonia.

Is the patient over 50 years of age?
- Yes → Assign patient to risk class II-V based on prediction model scoring system. (Class IIa)
- No ↓

Does the patient have a history of any of the following comorbid conditions?
- Neoplastic disease
- Congestive heart failure
- Cerebrovascular disease
- Renal disease
- Liver disease

→ Yes → Assign patient to risk class II-V based on prediction model scoring system. (Class IIa)

No ↓

Does the patient have any of the following abnormalities on physical examination?
- Altered mental status
- Pulse: 125/minute or more
- Respiratory rate: 30/minute or more
- Systolic blood pressure: less than 90 mmHg
- Temperature: < 35˚C or ≥ 40˚C

→ Yes → Assign patient to risk class II-V based on prediction model scoring system. (Class IIa)

No ↓

Assign patient to risk class I (Class IIa)

The **evidence for recommendations** is graded using the following scale. For complete definitions, see back page. **Class I:** Definitely recommended. Definitive, excellent evidence provides support. **Class II a:** Acceptable and useful. Very good evidence provides support. **Class II b:** Acceptable and useful. Fair-to-good evidence provides support. **Class III:** Not acceptable, not useful, may be harmful. **Indeterminate:** Continuing area of research.

Part 2. Scoring System for Prediction Model.

Patient Characteristic	Points Assigned
Demographic factors	
Age: Males	Age (in years)
Age: Females	Age (in years) –10
Nursing home resident	+10
Comorbid diseases	
Neoplastic disease	+30
Liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Renal disease	+10
Physical examination findings	
Altered mental status	+20
Respiratory rate 30/minute or more	+20
Systolic blood pressure < 90 mmHg	+20
Temperature < 35˚C or ≥ 40˚C	+15
Pulse 125/minute or more	+10
Laboratory findings	
pH < 7.35	+30
BUN > 10.7 mmol/L (30 mg/dL)	+20
Sodium < 130 mEq/L	+20
Glucose > 13.9 mmol/L (250 mg/dL)	+10
Hematocrit < 30%	+10
pO_2 < 60 mmHg	+10
Pleural effusion	+10

1. A risk score (total point score) for a given patient is obtained by summing the patient's age in years (age -10 for females) and the points for each applicable patient characteristic.
2. Oxygen saturation < 90% was also considered abnormal.

Part 3. Stratification Of Risk Score For Prediction Model.

Risk	Risk Class	Based on
Low	I	Algorithm
Low	II	70 or fewer total points
Low	III	71-90 total points
Moderate	IV	91-130 total points
High	V	> 130 total points

This prediction model for prognosis in patients with community-acquired pneumonia may be used to help guide the initial decision on site of care. However, its use may not be appropriate for all patients with this illness and therefore should be applied in conjunction with physician judgment.

Fine MJ, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia [see comments]. *N Engl J Med* 1997;336(4):243-250.

Clinical Pathway: IDSA Recommendations For Empiric Antibiotic Therapy

Outpatient therapy →

- Macrolide (erythromycin, clarithromycin, or azithromycin) **or**
- Fluoroquinolone (levofloxacin, sparfloxacin, grepafloxacin) **or**
- Doxycycline

(Class IIb)

Inpatient therapy: General medical ward →

- Fluoroquinolone (levofloxacin, sparfloxacin, grepafloxacin) **or**
- Beta-lactam/beta-lactamase inhibitor (ampicillin/sulbactam, ticarcillin/clavulanate or piperacillin/tazobactam) ± macrolide

(Class IIb)

Inpatient therapy: Intensive care unit →

- Macrolide (erythromycin, clarithromycin or azithromycin) **plus**
- Cefotaxime or ceftriaxone or beta-lactam/beta-lactamase inhibitor

or

- Fluoroquinolone (levofloxacin, sparfloxacin, grepafloxacin) **plus**
- Cefotaxime or ceftriaxone or beta-lactam/beta-lactamase inhibitor

(Class IIb)

Source: Bartlett JG, Breiman RF, Mandell LA, et al. Community-acquired pneumonia in adults: Guidelines for management. *Clin Infect Dis* 1998;26:811-38.

The **evidence for recommendations** is graded using the following scale. For complete definitions, see back page. **Class I:** Definitely recommended. Definitive, excellent evidence provides support. **Class IIa:** Acceptable and useful. Very good evidence provides support. **Class IIb:** Acceptable and useful. Fair-to-good evidence provides support. **Class III:** Not acceptable, not useful, may be harmful. **Indeterminate:** Continuing area of research.

This clinical pathway is intended to supplement, rather than substitute, professional judgment and may be changed depending upon a patient's individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

Table 5. Antibiotics For Pneumonia.

Antibiotic	Dosage	Pros	Cons
Macrolides:			
Erythromycin	Many preparations. EES—400 mg QID. Erythromycin Base: 215 mg-500 mg QID IV: 15-20 mg/kL; up to 4g q day. Given q6h.	Inexpensive. Broad coverage.	Significant GI intolerance. Inadequate against many strains of *H. influenzae.* May not be optimal in patients at high risk for *H. influenzae,* such as smokers and those with COPD.
Clarithromycin (Biaxin)	500 mg bid for 10-14 days.	Better *H. influenzae* coverage than erythromycin.	Expense. In vitro resistance of *Pneumococcus* > 30% in some areas.
Azithromycin (Zithromax)	500 mg on day 1, then 250 mg q d on days 2-5.	Better *H. influenzae* coverage than erythromycin. Once a day dosage. Long-acting (can limit therapy of pneumonia to 5 days).	Expense. In vitro resistance of *Pneumococcus* > 30% in some areas.
Fluoroquinolones:			
Levofloxacin (Levaquin)	250-500 mg q d PO or IV for 10-14 days.	Long acting. Enhanced activity against both typical and atypical organisms.	Expense.
Sparfloxacin	400 mg PO times 1, then 200 mg q d for 10-14 days.	Same as levofloxacin.	Expense. Occasional reports of torsades de pointes in patients with drugs. Known to prolong QT interval. Phototoxic reactions.
Grepafloxacin	400-600 mg PO q d for 10-14 days.	Long acting. Extended coverage.	Expense. Prolongation of QT interval.
Trovafloxacin			Not indicated for outpatient use. Associated with fatal hepatotoxicity. (See text.)
Doxycycline	100 mg bid IV or PO for 10-14 days.	Extended coverage. Inexpensive.	Avoid during pregnancy. Phototoxicity.
Tetracycline	500 mg qid or 500 mg-1g q12h IV. 500 mg PO qid for 10-14 days.	Inexpensive.	GI side effects. Contraindicated in pregnancy. *Note:* Fatal hepatotoxicity with IV doses over 2 g/day.
Trimethoprim/ Sulfamethoxazole	Double strength. 1 tablet bid coverage for pneumonia. For PCP, 2 tablets q8h x 21 days.	Broad spectrum. Inexpensive.	Frequent adverse reactions, especially rash. Stevens-Johnson syndrome. Serum sickness. Neurotoxicity. Adverse reactions 10% or more patients. GI and skin reactions possible, especially in HIV-positive patients.
Cephalosporins	Numerous cephalosporins. Follow drug manufacturer's recommended guidelines.	Well-tolerated. Good activity against *Pneumococcus.*	No coverage of atypical organisms. Avoid in patients with anaphylaxis or allergy to penicillin. Second-, third-, and fourth-generation cephalosporins are expensive.
Beta-lactam/beta-lactamase inhibitors:			
Amoxicillin/ clavulanate	825 mg/125 mg bid	Excellent coverage for gram-positive and many gram-negative organisms.	Expense. Does not cover atypical organisms. Avoid in patients with penicillin allergies.
Ampicillin/Sulbactam	1.5-3.0 g IV q6h	Excellent coverage of gram-positive, gram-negative, and anaerobic organisms.	Expense. Does not cover atypical organisms.

Source: Gilbert DN, Moellering RC, Sande MA. *Sanford Guide to Antimicrobial Therapy.* 29th ed. Antimicrobial Therapy, Inc.; Hyde Park, VT: 1999.

Continued from page 10

Antibiotic Treatment: General Medical Ward

The antibiotic recommendations for the patient hospitalized with community-acquired pneumonia include a broad coverage reflecting the increasing likelihood of gram-negative bacilli, polymicrobial infections including anaerobes, and *Legionella* sp. (see **Table 5** on page 15). While neither the ATS nor IDSA guidelines mandate coverage of atypical organisms, other authorities believe that these pathogens must be treated empirically, at least during the initial phase of therapy. These authorities conclude that macrolides or extended-spectrum fluoroquinolones are essential to empiric treatment of the hospitalized patient.[57]

Antimicrobial therapy should be administered promptly after the diagnosis is made, especially in patients requiring hospitalization. One large study of more than 14,000 patients demonstrated that the initiation of antibiotics within eight hours can decrease 30-day mortality of elderly pneumonia patients.[37] Antibiotics given within four hours may further decrease mortality.[58] Approximately one-quarter of patients with pneumonia may wait more than eight hours before receiving antimicrobials.[37]

Intravenous vs. Oral Antibiotics

There is a tendency for physicians to administer intravenous antibiotics to patients who require hospital admis-

Cost-Effective Strategies For Managing Patients With Pneumonia

1. Discharge low-risk patients.

The most cost-effective intervention in emergency practice is to discharge the patient. The PORT algorithm can safely decrease the number of patients admitted with community-acquired pneumonia.

Risk Management Caveat: Use of the PORT score alone may lead to inappropriate discharge of a patient. Determine whether the patient is able to take oral medications, is likely to be compliant, and has a home and caretakers. Alcoholics and substance abusers are likely to fail outpatient therapy.

2. Consider home IV therapy.

Home therapy is an effective alternative to hospitalization for patients who are moderately ill.

Risk Management Caveat: Patients with very high PORT scores or hypotension are inappropriate candidates for home therapy. The patient's family and physician should agree to home therapy, and the program should have a proven track record in the community. Early follow-up with the private attending or consulting internist is essential.

3. Consider inexpensive antibiotics (see table).

The use of more costly agents does not translate into improved clinical outcome. One study found that the use of "cheap" antibiotics is not associated with a higher 30-day mortality, increased hospital admission (of outpatients), or re-admissions.[72] Doxycycline and erythromycin are both very effective and cheap alternatives to the expensive new-generation quinolones and extended-spectrum macrolides.

Risk Management Caveat: The acutely ill patient requires broad-spectrum antibiotics. This is especially true in patients who require intensive care.

4. Decrease microbiology testing.

Patients well enough to be treated at home need no cultures or sputum studies. Even in hospitalized patients, cultures rarely impact patient management.

Risk Management Caveat: Both the ATS and IDSA recommend blood cultures on patients hospitalized for pneumonia.

5. Decrease laboratory testing.

The use of the PORT algorithm can obviate the need for laboratory testing in many patients with pneumonia. In patients who have high-risk findings, the algorithm can limit the number and type of testing. A CBC is not necessary for patients with pneumonia. (Excuse me, some angry infectious disease specialists are pounding at my door.)

Risk Management Caveat: Pulse oximetry is an important diagnostic test for any patient with pneumonia. Patients who are seriously ill also require evaluation of at least pH, sodium, glucose, and hematocrit.

Table. Cost Comparison Of Antibiotics For Course Of Therapy For Pneumonia.

(Costs based on average wholesale price at Medical Center of Louisiana as of August 1999)

PO Antibiotics (10-day course of therapy)		**Cost**
Erythromycin ethyl succinate (EES) 400 mg PO QID		$9.29
Doxycycline 100 mg PO BID	($5.96 - $41.29)	$26.79
Azithromycin (5-day course; 500 mg on day 1; 250 mg on days 2-5)		$38.00
Clarithromycin 500 mg PO BID		$68.39
Levofloxacin 500 mg PO q d		$80.59
IV Antibiotics (seven-day course of therapy)		**Cost**
Azithromycin 500 mg IV q d		$161.70
Ampicillin sulbactam 1.5 mg IV q6h		$207.84
Doxycycline 100 mg IV BID		$233.80
Clindamycin 900 mg IV q8h		$247.80
Cefuroxime 1.5 mg IV q8h		$268.48
Levofloxacin 500 mg IV q d		$277.20
Ticarcillin 3 g IV q6h		$330.29
Cefepime 2 g IV q12h		$425.04
Ticarcillin/clavulanate 3.1 g IV q6h		$431.20
Piperacillin/tazobactam 3.375 g IV q6h		$453.88
Cefoxitin 2 g IV q6h		$585.21
Metronidazole 500 mg IV q6h		$586.46
Ceftriaxone 2 g IV q d		$594.83
Imipenem-cilastatin 500 mg IV q6h		$806.28

sion. Medical necessity and severity of illness occasionally justify this approach (although it has never been proven that the outcome using IV is better than PO). In addition, some physicians fear the admission will be judged inappropriate if PO antibiotics are administered. ("You could have given them pills at home.")

However, in a well-designed, prospective randomized study, oral antibiotics proved effective for hospitalized patients. There were no significant differences between patients who received oral vs. intravenous antibiotics in clinical outcome or mortality, and oral antibiotics were cheaper, easier to administer, and, surprisingly, resulted in a shorter length of stay.[59] This study excluded patients who were immunocompromised, those allergic to penicillin or cephalosporins, critically ill patients, patients with clinical or laboratory evidence of septicemia, patients unable to tolerate oral medicines, acutely confused patients, patients with multilobar disease seen on chest radiography, and pregnant or lactating women.

Antibiotic Treatment: Intensive Care Unit

Both the ATS and IDSA believe that patients admitted to intensive care require different antibiotic selection than patients admitted to a general medical ward.

The IDSA recommendations are modified to account for patients with structural lung disease. Choices include an antipseudomonal penicillin (ticarcillin/clavulanate or piperacillin), imipenem/cilastatin or cefepime plus a macrolide, or a fluoroquinolone plus an aminoglycoside. In penicillin-allergic patients, a fluoroquinolone with or without clindamycin is the recommended therapy. If the patient is suspected of aspiration, the recommendations include a fluoroquinolone plus clindamycin or metron-

Key Points In Dealing With Pneumonia

General

- Pneumonia is the sixth leading cause of death in the U.S., with mortality in hospitalized patients ranging from 2% to 30%.
- *Pneumococcus* remains the number-one agent of bacterial pneumonia in both children and adults.
- Despite frequent microbiologic investigations, at least one-third of all patients with community-acquired pneumonia never have a definitive pathogen identified.

History And Physical

- Historical characteristics are not definitive in distinguishing "typical" from "atypical" pneumonias.
- Confusion tends to be a significant symptom of pneumonia in the elderly.
- Think HIV. Look in the mouth, and ask the patients about HIV risk factors.

Chest X-rays

- The American Thoracic Society and the Infectious Diseases Society of America guidelines recommend a chest x-ray in all patients suspected of having pneumonia.
- Physician judgment is more accurate in determining a need for a chest film in suspected pneumonia that any current scoring system.
- The presence of dementia increases the likelihood ratio of a chest film positive for pneumonia, while a history of asthma decreases it.
- The chest x-ray cannot distinguish the etiology of the organism. Possible exceptions include lung abscess and classic TB.

Diagnostic Testing

- Screening with pulse oximetry to measure arterial oxygen saturation is important in patients with community-acquired pneumonia.
- In most patients, the only important aspect of the CBC is the hemoglobin and hematocrit. The WBC count is rarely important (except in patients receiving chemotherapy).
- Diagnostic testing should never delay antibiotic treatment of the acutely ill patient.
- Scientifically valid literature supporting the use of sputum Gram's stains and cultures on outpatients does not exist. The literature supporting their use in hospitalized patients is weak.

Disposition

- Use the PORT algorithm to assess need for hospitalization. (See "PORT Recommendations" on page 13.)
- Admitting all patients with an oxygen saturation of less than 90% on room air provides an additional margin of safety to the PORT algorithm.
- Determine whether the patient can tolerate oral medications. A vomiting patient with pneumonia should be admitted.
- Alcoholism and other substance abuse, patient reliability, compliance with instructions and medications, the home situation, resources to purchase medications, and ability to access the healthcare system are important considerations beyond the PORT score.
- Patients with HIV and pneumonia who are ill enough to require admission should be placed in respiratory isolation pending sputum analysis for acid-fast bacilli to prevent transmission of TB.

Treatment

- Treat early. Delay in antibiotics is associated with increased mortality.
- Treat empirically. Unless you spend your life reading Gram's stains for a living, do not trust them to guide antibiotic therapy.

idazole, or a beta-lactam/beta-lactamase inhibitor alone.

In severe cases of community-acquired pneumonia, the ATS recommends combination therapy with a macrolide and either a third-generation cephalosporin with antipseudomonal activity, or another antipseudomonal agent such as imipenem/cilastatin or ciprofloxacin.

Antibiotic Selection: Special Considerations

On occasion, the chest x-ray or clinical picture may suggest the need for a special approach to antimicrobial selection. The most dramatic instance is the patient with a lung abscess on chest x-ray. Community-acquired acute lung abscesses are most commonly caused by anaerobic organisms. Initial therapy is empiric and should begin with amoxicillin-clavulanate, chloramphenicol, or penicillin plus metronidazole.[60]

Special Considerations

Immunocompromised Hosts

Pulmonary disease is a major source of morbidity and mortality in patients with immunologic defects. In addition to HIV, immune suppression occurs in patients with solid organ and hematologic malignancies, sickle-cell disease, organ and bone marrow transplants, recipients of immunosuppressive medications, asplenia, and patients with connective-tissue disorders.

While pneumonia in such patients may present with fever, tachypnea, and cough, physical findings may be minimal due to a blunted inflammatory reaction. Similarly, these patients may not produce sputum or develop infiltrates on chest radiographs.[30] The post-chemotherapy patient is one exception to the general futility of the CBC, which in this case may detect life-threatening neutropenia.

Immunosuppressed patients with pneumonia should be admitted to the hospital for further evaluation and treatment. Give timely empiric antibiotic therapy, and provide broad coverage against gram-positive, gram-negative, and atypical pathogens. Patients with organ transplants and those with renal failure are at particular risk for *Legionella*.[61]

HIV

The greatest challenge in treating the HIV patient with pneumonia is recognizing the presence of HIV. Physicians frequently fail to ask the patient regarding HIV risk factors (or even if the patient knows his or her HIV status) and may overlook important clues to immune suppression such as oral thrush. As many as 40% of patients with an AIDS-defining illness present to the ED unaware that they are seropositive.[62] For these reasons, it is not surprising that physicians often fail to promptly institute indicated diagnostic and therapeutic interventions for PCP.[63]

Pulmonary infections are common in patients infected with HIV, and HIV is common in patients hospitalized with pneumonia. Pneumonia is the most frequent presenting illness in patients hospitalized with newly diagnosed HIV infection.[18] Because of the emphasis placed upon opportunistic pathogens, many physicians are unaware that *Streptococcus pneumoniae* is the most commonly identified pathogen in HIV patients with bacterial pneumonia.[30] Bacterial pneumonia may be responsible for up to half of all of episodes of pneumonia in the HIV-positive patient.[64]

Patients with CD4 counts below 200 cells/cc are at risk for opportunistic infections, in particular, PCP. Those with higher counts are less likely to present with these unusual pathogens, but they are still predisposed to tuberculosis. Emergency physicians must recognize that CD4 counts are not absolute markers for susceptibility to infection. Patients with oral candidiasis, prolonged fever, and unintentional weight loss may be at high risk for opportunistic infections regardless of the CD4 counts.

PCP is the most common AIDS-defining illness and the most common cause of death in patients with HIV infection. Patients with PCP present with a subacute illness characterized by a dry cough, fever, and dyspnea that progresses over several weeks. Patients have a paucity of physical exam findings; many have clear lungs upon auscultation. Some patients may have been treated unsuccessfully with a macrolide or quinolone in the weeks prior to the current ED visit.

The chest x-ray may demonstrate diffuse bilateral interstitial infiltrates, characterized by a "ground glass" appearance. However, a normal chest x-ray may be seen in approximately 5-10% of patients with PCP.[32] In addition, the chest x-ray cannot distinguish between PCP and bacterial pneumonia. In one study, more than half of all HIV patients with bacterial pneumonia had a predominantly interstitial infiltrate rather than the classic segmental or lobar alveolar consolidation.[64] The presence of oral thrush in conjunction with a characteristic chest film is strong presumptive evidence of PCP.

Exercise desaturation is classic for PCP. Some centers measure the drop in oxygen saturation on pulse oximetry during a standard exercise test to make the diagnosis.[65] An arterial blood gas should be obtained on patients suspected of having PCP to assess respiratory status and to guide therapy. Treatment for PCP is dependent upon the patient's PaO_2 and the A-a gradient. If the PaO_2 is less than 70 or the A-a gradient is greater than 35, then treatment must include prednisone along with the antibiotic.[66] (See **Table 6** on page 20.) Such patients will also require supplemental oxygen.[67]

The serum lactate dehydrogenase (LDH) may be valuable in the diagnosis. Serum LDH levels greater than 220 u/L are associated with PCP.[33] While the definitive diagnosis is made by detection of the organism in sputum, this is problematic in patients with a nonproductive cough. Many hospital centers treat PCP empirically.

Not all patients with suspected PCP require admission. Many centers discharge patients who appear clinically well and have a social situation that supports

Continued on page 20

Ten Excuses That Don't Work In Court

1. "I thought I would let the private attending choose the antibiotics."
What's to choose? Studies show that a delay in antibiotic therapy results in increased mortality in patients with pneumonia. Draw cultures for patients who require hospitalization, then follow standard guidelines for antibiotic treatment. (See **Table 6**.) The private attending can always change the antibiotics later.

2. "Who does a throat exam in a patient who presents with a cough?"
You should. The presence of oral thrush has profound implications in the patient with pneumonia. The possibility of PCP will determine significant management decisions, including admission, respiratory isolation, testing for tuberculosis, and choice of antibiotics. Perform an oral examination on patients with pneumonia. Many patients with HIV do not know that they are seropositive.

3. "I didn't think he needed a pulse ox."
Everyone with pneumonia needs a pulse ox. It's fast, inexpensive, reliable, and it has tremendous management implications. An O_2 saturation of less than 90% is a strong predictor of the need for admission. Think long and hard before discharging a patient with pneumonia with an oxygen saturation less than 90%—then admit the patient.

4. "But he met the PORT criteria for discharge."
Maybe so, but he was an alcoholic who lived underneath a bridge, and the nurse documented that he was vomiting in the ED. Homelessness, alcoholism, and inability to take medications by mouth are all important considerations apart from any other score on the PORT criteria.

5. "But I use cipro to treat everything."
Bad choice. Standard doses of ciprofloxacin are not adequate to treat pneumococcal pneumonia. Other quinolones, however, are helpful, such as levofloxacin and sparfloxacin, which cover both typical and atypical organisms. Trovafloxacin should be reserved for patients requiring inpatient therapy with life-threatening disease and for whom no other alternative agent is appropriate. (To state it more simply, "Don't give trovafloxacin.")

6. "I don't believe in the PORT score—plus, who can remember how to calculate it?"
Believe in death, taxes, and any well-designed study with more than 50,000 patients. You should not commit the PORT scoring system to memory, but keep this copy of *Emergency Medicine Practice* in the ED.

7. "He had a cough, low-grade temp, and infiltrate on chest x-ray—how was I supposed to know he had a pulmonary embolism?"
Well, if you had asked, the patient had just flown back from Europe, where he had consulted a specialist on his prostate cancer. While he was there he fell, broke his hip, and required surgery. In short—risk factors.

Consider pulmonary embolism in patients with an infiltrate on chest x-ray. A rectal temperature of greater than 102˚F makes pulmonary embolism significantly less likely. In other patients, perform a risk factor analysis: Have they been recently immobilized? Did they have a history of DVT or PE, family history of thromboembolic disease, recent trauma or surgery, or a history of cancer? The V/Q scan is inadequate to distinguish between pulmonary embolism and pneumonia. Helical CT may be a better choice. (See also the August 1999 issue of *Emergency Medicine Practice,* "Dyspnea: Fear, Loathing, and Physiology.")

8. "I didn't get a chest x-ray because it was obvious he had pneumonia. Besides, I treated him with antibiotics."
But you didn't see that he had a lung abscess. Or was it the multilobar infiltrate or pleural effusion that you missed? No, it was the classic presentation of PCP.

A chest x-ray is an essential component of the diagnosis of pneumonia, and it carries important management implications. Also, a clear chest x-ray would suggest a competing diagnosis.[39] The film may be near-diagnostic for anaerobic infection (lung abscess) and very suggestive in cases of tuberculosis (apical cavitation, scarring, hilar adenopathy). Patients with multi-lobar disease and significant pleural effusion are at high risk for complications and may require admission based on their PORT score.

9. "He never told me his spleen was removed."
Unfortunately, not every patient is a splendid historian. Immune status will often alter a decision to treat as an outpatient. HIV status, chronic illness, asplenia, diabetes, immunosuppressive therapy, and advanced age are all reasons to consider admission. Asplenia predisposes hosts to encapsulated organisms such as *Streptococcus pneumoniae* and *Haemophilus influenzae*. Look for a laparotomy scar during the physical exam. If a patient states that he or she has never been hospitalized yet has a laparotomy scar, that patient must have had a knife fight with a surgeon.

10. "Yes, I saw her track marks—but levofloxacin is a broad-spectrum antibiotic. I thought the pills would work."
Well, they didn't, and she needs a new heart valve. Fever and pulmonary infiltrates in a patient with history of intravenous drug use equal bacterial endocarditis until proven otherwise. Quickly obtain several sets of blood cultures and begin broad-spectrum gram-positive and gram-negative coverage. Intravenous drug abusers are likely to be HIV positive and are at risk for PCP and TB.

Continued from page 18

outpatient treatment. Early follow-up is essential for such patients.

Patients with HIV and pneumonia who are ill enough to require admission should be placed in respiratory isolation pending sputum analysis for acid-fast bacilli to prevent transmission of TB.

Tuberculosis

There has been a dramatic resurgence of tuberculosis over the past several decades coincident with the AIDS epidemic. Patients infected with HIV are at increased risk for *Mycobacterium tuberculosis* and have a 100-fold increase in relative risk compared to those without HIV infection.[36]

Emergency physicians must remember that immunosuppression may affect the chest x-ray findings of tuberculosis. Patients with mild HIV disease have typical radiographic findings of upper lobe disease, cavitation, and well-formed granulomas. Patients with advanced HIV disease are more likely to have infiltrates in midlung zones, less cavitation, and more hilar/mediastinal adenopathy.[31,36] One multicenter study identified 10 patients out of 128 (8%) who demonstrated normal chest x-ray with sputum culture-confirmed *Mycobacterium tuberculosis*.[36] *Tuberculosis cannot be ruled out in AIDS patients based upon chest x-ray findings alone.*

Polymerase chain reaction (PCR) technology may be applied to sputum samples to detect *Mycobacterium tuberculosis*. A PCR on cultured media has sensitivities that are significantly higher but requires protracted time. Outpatients with HIV, or those suspected of HIV, should receive PPD skin testing with placement of controls.

Nursing-Home Residents

Nursing-home residents are more likely to develop severe pneumonia or pneumonia due to gram-negative organisms than patients living at home. In the PORT algorithm, residence in a nursing home adds 10 points to the risk score.

However, the mere fact that a patient lives in a nursing home when he or she develops pneumonia does not mandate hospitalization. A substantial number of nursing-home patients with pneumonia can be safely returned to the nursing home with oral antibiotics or a combination of ED-administered IM antibiotics followed by PO antibiotics. This strategy may save an estimated $3000-$4000 per episode.[68]

Table 6. Treatment Of *Pneumocystis carinii* Pneumonia*

Trimethoprim/sulfamethoxazole 15 mg/kg/d (based on TMP) PO/IV TID x 21 days
or
Trimethoprim 15 mg/kg/d PO TID + Dapsone 100 mg PO q d x 21 days
Atovaquone 750 mg PO BID x 21 days
Pentamidine 4 mg/kg/d IV x 21 days

* If the PaO_2 is < 70 or the A-a gradient is greater than 35, then treatment must include prednisone.

Clinical Pathways

Many hospitals are developing clinical pathways for pneumonia in an effort to decrease costs and (perhaps) increase the quality of care.[69] An effective hospital clinical pathway *must* include the ED. One hospital used several strategies that involved the ED, including early enrollment of patients into the pathway, antibiotics initiated immediately instead of waiting for sputum collection, and a limited number of antibiotics available on formulary. These strategies, combined with inpatient interventions, reduced the average length of stay from 6.1 days to 5.3 days, decreased the average charges per case by approximately $1000, and increased reimbursement by 11%.[70] In another hospital, institution of a clinical pathway reduced mortality from 10.2% to 6.8%, decreased average length of hospital stay by 1.3 days, and reduced total charges by $945 per patient.[58] (See "Cost-Effective Strategies For Managing Patients With Pneumonia" on page 16 for further instructions.)

Of interest, a recent study showed that the use of the ATS guidelines for the treatment of community-acquired pneumonia did not decrease length of stay or improve outcomes over conventional ED decision making.[71]

Summary

Recent literature provides an evidence-based approach to the patient with community-acquired pneumonia. Using the PORT scoring system combined with an assessment of the patient's social situation allows the emergency physician to make rational decisions regarding disposition. Diagnostic testing may be limited to pulse oximetry and chest radiography in many patients.

The ATS guidelines regarding minimal microbiologic testing are better suited to emergency medicine practice and are based upon stronger literature than the IDSA guidelines. However, the IDSA antibiotic guidelines are simpler to use than the ATS suggestions.

Using the PORT recommendations, perhaps pneumonia can be demoted to the "ensign of the men of death." ▲

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study, will be included in bold type following the reference, where available. In addition, the most informative

references cited in the paper, as determined by the authors, will be noted by an asterisk (*) next to the number of the reference.

1.* Bartlett JG, Breiman RF, Mandell LA, et al. Community-acquired pneumonia in adults: Guidelines for management. *Clin Infect Dis* 1998;26:811-838.
2.* Fine MJ, Auble TE, Yealy DM, et al. A prediction rule to identify low-risk patients with community-acquired pneumonia. *N Engl J Med* 1997;336(4):243-250. **(Prospective; 54,525 patients)**
3. Fine MJ, Smith MA, Carson CA, et al. Prognosis and outcomes of patients with community-acquired pneumonia. *JAMA* 1996;275:134-141.
4.* Woodhead MA, Arrowsmith J, Chamberlain-Webber R, et al. The value of routine microbial investigation in community-acquired pneumonia. *Resp Med* 1991;85:313-317.
5.* Marston BJ, Piouffe JF, File TM Jr., et al. Incidence of community-acquired pneumonia requiring hospitalization. Results of a population-based active surveillance study in Ohio. The Community-Based Pneumonia Incidence Study Group. *Arch Intern Med* 1997;157:1709-1718. **(Prospective; 2776 patients)**
6.* Pallares R, Linares J, Vadillo M, et al. Resistance to penicillin and cephalosporin and mortality from severe pneumococcal pneumonia in Barcelona, Spain. *N Engl J Med* 1995;333(8):474-480. **(Prospective; 504 patients)**
7.* Niederman MS, Bass JB Jr., Campbell GD, et al. Guidelines for the initial management of adults with community-acquired pneumonia: Diagnosis, assessment of severity, and initial antimicrobial therapy. American Thoracic Society. Medical Section of the American Lung Association. *Am Rev Respir Dis* 1993;148:1418-1426. **(Clinical guideline)**
8. Anonymous. Guidelines for the management of community-acquired pneumonia in adults admitted to hospital. The British Thoracic Society. *Br J Hosp Med* 1993;49(5):346-350.
9. Mandell LA, Niederman M. The Canadian Community-Acquired Pneumonia Consensus Conference Group. Antimi-

Tool 1. Sample Discharge Instructions For The Patient With Pneumonia.

You have been diagnosed with pneumonia, an infection of your lungs. Please return to the emergency department or see your doctor right away if you (or your family member) experience any of the following:

1. Worsening shortness of breath.
2. High fever (>102˚F) unrelieved with acetaminophen and ibuprofen.
3. Inability to swallow your medications or keep down liquids.
4. Chest pain unrelieved with acetaminophen.
5. Coughing up blood.
6. Failure to improve after two days of antibiotics.
7. Passing out or dizziness upon standing.
8. Any worsening at all.

Follow-up Instructions

1. Return to the emergency department in _____ hours for recheck.
2. See your doctor if not improving in _____ days.
3. See your doctor in _____ days.

Medications

Take the following medications:

Side Effects

Possible side effects of the medications you have been prescribed include:

Additional Instructions

1. No alcohol.
2. No tobacco.

Remember that the emergency department is open 24 hours a day, every day, and we are always glad to care for you.

crobial treatment of community-acquired pneumonia in adults: A conference report. *Can J Infect Dis* 1993;4:25.
10. Stein PD, Saltzman HA, Web J. Clinical characteristics of patients with acute pulmonary embolism. *Am J Cardiol* 1991;68:1723-1724. **(Prospective; 155 patients in this arm)**
11. Goldberg SN, Palmer EL, Scott JA, et al. Pulmonary embolism: Prediction of the usefulness of initial ventilation-perfusion scanning with chest radiographic findings. *Radiology* 1994;193:801-805. **(Retrospective; 951 patients)**
12. Marrie TJ, Durant H, Yates L. Community-acquired pneumonia requiring hospitalization: 5-year prospective study. *Rev Infect Dis* 1989;11(4):586-599. **(Prospective; 719 patients)**
13. Mundy LM, Auwaerter PG, Ldach D, et al. Community-acquired pneumonia: Impact of immune status. *Am J Respir Crit Care Med* 1995;152(4 Pt 1):1309-1315. **(Cross-sectional, prospective; 385 patients)**
14. Heckerling PS, Tape TG, Wigton RS, et al. Clinical prediction rule for pulmonary infiltrates. *Ann Intern Med* 1990;113(9):664-670. **(Prospective, retrospective; 1436 patients)**
15. Metlay JP, Schulz R, Li YH, et al. Influence of age on symptoms at presentation in patients with community-acquired pneumonia *Arch Intern Med* 1997;157:1453-1459. **(Prospective; 2287 patients)**
16. Kresovich-Wendler K, Levitt MA, Yearly L. An evaluation of clinical predictors to determine need for rectal temperature measurement in the emergency department. *Am J Emerg Med* 1989;7(4):391-394. **(Cross-sectional; 366 patients)**
17. Wipf JE, Lipsky BA, Hirxchmann JV, et al. Diagnosing pneumonia by physical examination: Relevant or relic? *Arch Intern Med* 1999;159:1082-1087.
18. Metlay JP, Kapoor WM, Fine MJ. Does this patient have community-acquired pneumonia? *JAMA* 1997;278(17):1440-1445.
19. Stein PD, Willis PW, DeMets DL. History and physical examination in acute pulmonary embolism in patients without preexisting cardiac or pulmonary disease. *Am J Cardiol* 1981;47:218-223.
20. Selwyn PA, Pumerantz AS, Durante SA, et al. Clinical predictors of *Pneumocystis carinii* pneumonia, bacterial pneumonia and tuberculosis in HIV-infected patients. *AIDS* 1998;12(8):885-893. **(Retrospective; 229 patients)**
21. Kirby AJ, Munoz A, Detels R, et al. Thrush and fever as measures of immunocompetence in HIV-1-infected men. *J Acquir Immune Defic Syndr Hum Retrovirol* 1994;7(12):1242-1249. **(Prospective cohort; 20,632 visits)**
22.* Phair J, Munoz A, Detels R, et al. The risk of *Pneumocystis carinii* pneumonia among men infected with human immunodeficiency virus type 1. Multicenter AIDS Cohort Study Group. *N Engl J Med* 1990;322(3):161-165. **(Prospective cohort; 1665 patients)**
23. Schulten EA, ten Kate RW, van der Waal I. Oral findings in HIV-infected patients attending a department of internal medicine; the contribution of intraoral examination towards the clinical management of HIV disease. *Q J Med* 1990;76(279):741-745. **(Retrospective; 70 patients)**
24. Hasley PB, Albaum MN, Li YH, et al. Do pulmonary radiographic findings at presentation predict mortality in patients with community-acquired pneumonia? *Arch Intern Med* 1996;156:2206-2212. **(Prospective; 1906 patients)**
25. Young M, Marrie TJ. Interobserver variability in the interpretation of chest roentgenograms of patients with possible pneumonia. *Arch Intern Med* 1994;154(23):2729-2732. **(Interobserver comparative study; 71 physicians compared to 3 radiologists)**
26.* Fine MJ, Stone RA, Singer DE, et al. Processes and outcomes of care for patients with community-acquired pneumonia: Results from the pneumonia Patient Outcomes Research Team (PORT) cohort study. *Arch Intern Med* 1999;159(9):970-980. **(Prospective; 944 outpatients, 1343 inpatients)**
27. Josephson MA, Agger WA, Gennett CL, et al. Performance measurement in pneumonia care: Beyond report cards. *Mayo Clin Proc* 1998;73(1):5-9. **(Retrospective; 94 patients)**
28. DuBois RW, Brook RH. Preventable deaths: Who, how often, and why? *Ann Intern Med* 1988;109:582-589. **(Retrospective analysis; 182 patients)**
29. Ewig S, Bauer T, Hasper E, et al. Value of routine microbial investigation in community-acquired pneumonia treated in a tertiary care center. *Respiration* 1996;63(3):164-169. **(Retrospective; 93 patients)**
30. Fine MJ, Orloff JJ, Rihs JD, et al. Evaluation of house staff physicians' preparation and interpretation of sputum Gram's stains for community-acquired pneumonia. *J Gen Intern Med* 1991;6:189-198. **(Prospective, multicenter; 99 patients)**
31. Flournoy DJ. Microbiology. Interpreting the sputum Gram's stain report. *Lab Med* 1998;29(12):763-768. **(Prospective; 2105 sputum specimens)**
32. Minocha A, Moravec CL Jr. Gram's stain and culture of sputum in the routine management of pulmonary infection. *So Med J* 1993;86(11):1225-1228. **(Prospective study; 224 adequate specimens)**
33. Lentino JR, Lucks DA. Nonvalue of sputum culture in the management of lower respiratory tract infections. *J Clin Microbiol* 1987;25:758-762. **(Retrospective; 226 patients, 354 specimens)**
34. Bartlett JG. Diagnosis of bacterial infections of the lung. *Clin Chest Med* 1987;8(1):119-134. **(Review)**
35. Kelly AM. Clinical impact of blood cultures taken in the emergency department. *J Acc Emerg Med* 1998;15(4):254-256. **(Retrospective; 1062 patients)**
36. Chalasani NP, Valdecanas MA, Gopal AK, et al. Clinical utility of blood cultures in adult patients with community-acquired pneumonia without defined underlying risks. *Chest* 1995;108:932-936. **(Retrospective; 517 patients)**
37. Meehan TP, Fine MJ, Krumholz HM, et al. Quality of care, process and outcomes in elderly patients with pneumonia. *JAMA* 1997;278:2080-2084.
38. Woodhead MA, Macfarlane JT, McCracken JS, et al. Prospective study of the aetiology and outcome of pneumonia in the community. *Lancet* 1987;1:671-674. **(Prospective; 236 episodes)**
39. Kashuba AD, Ballow CH. *Legionella* urinary antigen testing: Potential impact on diagnosis and antibiotic therapy. *Diag Microbiol Infect Dis* 1996;24(3):129-139. **(Review)**
40. Sahn SA. Management of complicated parapneumonic effusions. *Am Rev Respir Dis* 1993;148:813-817.
41. Heffner JE, Brown LK, Barbieri DC, et al. Pleural fluid chemical analysis in parapneumonic effusions. A meta-analysis. *Am J Respir Crit Care Med* 1995;151:1700-1708. **(Meta-analysis)**
42.* Fine MJ, Hough LJ, Medsger AR, et al. The hospital admission decision for patients with community-acquired pneumonia. Results from the pneumonia Patient Outcomes Research Team cohort study. *Arch Intern Med* 1997;157(1):36-44. **(Survey; 292 physicians)**
43.* Rosenthal GE, Harper DL, Shah A, et al. A regional evaluation of variation in low-severity hospital admissions. *J Gen Intern Med* 1997;12(7):416-422. **(Retrospective; 43,209 patients [includes patients with CHF and pneumonia])**
44.* Atlas SJ, Benzrer TI, Borowsky LH, et al. Safely increasing the proportion of patients with community-acquired pneumonia treated as outpatients: An interventional trial. *Arch Intern Med* 1998;158(12):1350-1356. **(Prospective; 166 patients compared with 147 historical controls)**
45. Saitz R, Ghali WA, Moskowitz MA. The impact of alcohol-related diagnoses on pneumonia outcomes. *Arch Intern Med* 1997;157:1446-1452. **(Retrospective cohort; 23,198 patients)**
46. Morales JO, Snead H. Efficacy and safety of intravenous cefotaxime for treating pneumonia in outpatients. *Am J Med* 1994;97(Suppl2A):28-33. **(Prospective; 62 patients)**
47. Williams DN. Reducing costs and hospital stay for pneumonia with home intravenous cefotaxime treatment: Results with a computerized ambulatory drug delivery system. *Am J Med* 1994;97(Suppl 2A):50-55. **(Prospective; 100 patients)**
48. Montalto M. An audit of patients admitted for home intravenous therapy directly from the emergency department. *Internat J Clin Pract* 1997;51(7):433-437. **(Prospective; 133 patients)**
49. Antonelli M, Conti G, Rocco M, et al. A comparison of noninvasive positive-pressure ventilation and conventional mechanical ventilation in patients with acute respiratory failure. *N Engl J Med* 1998;339(7):429-435. **(Prospective; 64 patients)**
50. Meduri GU, Turner RE, Abou-Shala N, et al. Noninvasive positive pressure ventilation via face mask. First-line intervention in patients with acute hypercapnic and hypoxemic respiratory failure. *Chest* 1996;109(1):179-193. **(Prospective; 164 patients)**
51. Collin BA, Ramphal R. Pneumonia in the compromised host including cancer patients and transplant patients. *Infect Dis Clin* 1998;12:781-805.
52.* Gleason PP, Kapoor WN, Stone RA, et al. Medical outcomes and antimicrobial costs with the use of the American Thoracic Society guidelines for outpatients with community-acquired

pneumonia. *JAMA* 1997;278(1):32-39. **(Prospective, cohort; 864 patients)**
53. Hooper DC. Expanding uses of fluoroquinolones: Opportunities and challenges. *Ann Intern Med* 1998;129(11): 908-910. **(Editorial)**
54. Ailani RK, Agastya G, et al. Doxycycline is a cost-effective therapy for hospitalized patients with community-acquired pneumonia. *Arch Intern Med* 1999;159:266-270. **(Prospective; 87 patients)**
55. Rizzato G, Montemurro L, Fraioli P, et al. Efficacy of a three day course of azithromycin in moderately severe community-acquired pneumonia. *Eur Respir J* 1995;8:398-402. **(Prospective; 20 patients in azithromycin group)**
56. Uzun O, Hayran M, Akova M, et al. Efficacy of a three day course of azithromycin in the treatment of community-acquired pneumococcal pneumonia. Preliminary report. *J Chemother* 1994;6:53-57. **(Prospective; 25 patients)**
57. File TM. Which antimicrobial should you be using? Community-acquired pneumonia; recent guidelines for therapy. *J Respir Dis* 1999;20(8):534-541.
58. McGarvey RN, Harper JJ. Pneumonia mortality reduction and quality improvement in a community hospital. *Qual Rev Bull* 1993;19(4):124-130.
59. Chan R, Hemeryck L, O'Regan M, et al. Oral versus intravenous antibiotics for community-acquired lower respiratory tract infection in a general hospital; open, randomized, controlled trial [see comments]. *BMJ* 1995;310(6991):1360-1362. **(Prospective, randomized; 541 patients)**
60. Hammond JM, Potgieter PD, Hanslo D, et al. The etiology and antimicrobial susceptibility patterns of microorganisms in acute community-acquired lung abscess. *Chest* 1995;108(4):937-941. **(Prospective; 34 patients)**
61. Marston BJ, Lipman HB, Breiman RF. Surveillance for Legionnaires' disease. Risk factors for morbidity and mortality. *Arch Intern Med* 1994;1254(21):2417-2422. **(Passive surveillance; 3254 patients)**
62. Landau R, Coker R, Vermeulen E, et al. Patients unaware of their HIV status present to inner city accident and emergency department with respiratory complications. *J Acc Emerg Med* 1997;14(5):304-306. **(Retrospective; 133 patients)**
63. Curtis JR, Paauw DS, Wenrich MD, et al. Ability of primary care physicians to diagnose and manage *Pneumocystis carinii* pneumonia. *J Gen Intern Med* 1995;10(7):395-399. **(Clinical scenario; 34 physicians tested)**
64. Magnenat JL, Nicod LP, Auckenthaler R, et al. Mode of presentation and diagnosis of bacterial pneumonia in human immunodeficiency virus-infected patients. *Am Rev Respir Dis* 1991;144(4):917-922. **(Retrospective; 132 episodes)**
65. Chouaid C, Housset B, Lebeau B. Cost analysis of four diagnostic strategies for *Pneumocystis carinii* pneumonia in HIV-infected subjects. *Eur Respir J* 1995;8(9):1554-1558. **(Cost analysis; 210 patients)**
66. Anonymous. Consensus statement on the use of corticosteroids as adjunctive therapy for pneumocystis pneumonia in the acquired immunodeficiency syndrome. The National Institutes of Health-University of California. Expert Panel for Corticosteroids as Adjunctive Therapy for Pneumocystis Pneumonia. *N Engl J Med* 1990;323(21):1500-1504.
67. Smith DE, Forbes A, Davies S, et al. Diagnosis of *Pneumocystis carinii* pneumonia in HIV antibody positive patients by simple outpatient assessments. *Thorax* 1992;47(12):1005-1009. **(Prospective; 318 patients)**
68. Thompson RS, Hall NK, Szpiech M, et al. Treatments and outcomes of nursing-home-acquired pneumonia. *J Am Board Fam Pract* 1997;10(2):82-87. **(Retrospective; 129 patients)**
69. Kight L. Pneumonia pathway cut charges by $2,900 per case. *Hosp Case Man* 1997;5:103-106. **(Cost analysis study)**
70. Borawski DB, Snow MD. Protocols in practice. Pneumonia pathway streamlines care. *Nurs Case Man* 1996;1:180-182.
71. Pope JH, Goerdt PJ, Mancuso M, et al. ED application of American Thoracic Society guidelines for the treatment of community-acquired pneumonia in adults. *Ann Emerg Med* 1997;30(3):422-423. Abstract 186. **(Prospective, observational; 100 patients)**
72. Gilbert K, Gleason PP, Singer DE, et al. Variations in antimicrobial use and cost in more than 2,000 patients with community-acquired pneumonia. *Am J Med* 1998;104(1):17-27. **(Prospective; 2255 patients)**

Physician CME Questions

27. Appropriate empiric therapy for outpatient management of community-acquired pneumonia includes:
a. cephalexin.
b. ampicillin.
c. ciprofloxacin.
d. doxycycline.

28. Pleural effusions associated with community-acquired pneumonia:
a. are associated with increased morbidity.
b. necessitate empiric coverage for gram-negative bacteria.
c. indicate *Mycobacterium tuberculosis* and require respiratory isolation.
d. resolve with NSAIDs.

29. The most commonly occurring pathogen in community-acquired pneumonia is:
a. *Haemophilus influenzae.*
b. *Klebsiella pneumoniae.*
c. *Streptococcus pneumoniae.*
d. *Mycoplasma pneumoniae.*

30. HIV-infected hosts with pulmonary infiltrates require:
a. respiratory isolation.
b. Amphotericin B.
c. steroid therapy.
d. high-dose ampicillin.

31. Appropriate initial diagnostic studies for community-acquired pneumonia include:
a. sputum for acid-fast bacilli stain.
b. sputum culture.
c. pulse oximetry.
d. peak expiratory flow rate.

32. The average mortality of a patient with community-acquired pneumonia is approximately:
a. 2-5%.
b. 15-30%.
c. 40-50%.
d. greater than 50%.

33. Which of the following factors has driven empiric therapy for community-acquired pneumonia?
a. Cost
b. Antibiotic resistance
c. Chest x-ray findings
d. Resurgence of *Mycobacterium tuberculosis*

34. Sputum Gram's stain would be *negative* in which of the following etiologies?
a. *Streptococcus pneumoniae*

b. *Haemophilus influenzae*
c. *Mycoplasma pneumoniae*
d. *Klebsiella pneumoniae*

35. Which of the following fluoroquinolones is *not* a preferred antimicrobial for the treatment of community-acquired pneumonia?
a. Grepafloxacin
b. Levofloxacin
c. Sparfloxacin
d. Trovafloxacin

36. Which of the following is a marker of severe community-acquired pneumonia?
a. Oxygen saturation of 93% on room air
b. Left lower-lobe infiltrate
c. Respiratory rate greater than 25 on room air
d. Impaired host immunity

Class Of Evidence Definitions

Each action in the clinical pathways section of *Emergency Medicine Practice* receives an alpha-numerical score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness
- Must be used in the intended manner for proper clinical indications

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- Study results consistently positive and compelling

Class IIa
- Safe, acceptable
- Clinically useful
- Considered treatments of choice

Level of Evidence:
- Generally higher levels of evidence
- Results are consistently positive

Class IIb
- Safe, acceptable
- Clinically useful
- Considered optional or alternative treatments

Level of Evidence:
- Generally lower or intermediate levels of evidence
- Generally, but not consistently, positive results

Class III:
- Unacceptable
- Not useful clinically
- May be harmful

Level of Evidence:
- No positive high-level data
- Some studies suggest or confirm harm

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

Adapted from: The Emergency Cardiovascular Care Committees of the American Heart Association and representatives from the resuscitation councils of ILCOR: How to Develop Evidence-Based Guidelines for Emergency Cardiac Care: Quality of Evidence and Classes of Recommendations; also: Anonymous. Guidelines for cardiopulmonary resuscitation and emergency cardiac care. Emergency Cardiac Care Committee and Subcommittees, American Heart Association. Part IX. Ensuring effectiveness of community-wide emergency cardiac care. *JAMA* 1992;268(16):2289-2295.

Physician CME Information

This CME enduring material is sponsored by Carolinas HealthCare System and has been planned and implemented in accordance with the Essentials and Standards of the Accreditation Council for Continuing Medical Education. Credit may be obtained by reading each issue and completing the post-tests administered in December and June.

Target Audience: This enduring material is designed for emergency medicine physicians.

Needs Assessment: The need for this educational activity was determined by a survey of medical staff, including the editorial board of this publication; review of morbidity and mortality data from the CDC, AHA, NCHS, and ACEP; and evaluation of prior activities for emergency physicians.

Date of Original Release: This issue of *Emergency Medicine Practice* was published September 1, 1999. This activity is eligible for CME credit through September 1, 2000. The latest review of this material was August 30, 1999.

Discussion of Investigational Information: As part of the newsletter, faculty may be presenting investigational information about pharmaceutical products that is outside Food and Drug Administration approved labeling. Information presented as part of this activity is intended solely as continuing medical education and is not intended to promote off-label use of any pharmaceutical product. *Disclosure of Off-Label Usage:* This issue of *Emergency Medicine Practice* cites recent literature to support a three-day course of azithromycin in the treatment of certain patients with community-acquired pneumonia (see text).

Faculty Disclosure: In compliance with all ACCME Essentials, Standards, and Guidelines, all faculty for this CME activity were asked to complete a full disclosure statement. The information received is as follows: Dr. DeBlieux is on the speaker bureau for Pfizer, Ortho McNeil, and Merck. Dr. Slaven, Dr. Karas, and Dr. Colucciello report no significant financial interest or other relationship with the manufacturer(s) of any commercial product(s) discussed in this educational presentation.

Accreditation: Carolinas HealthCare System is accredited by the Accreditation Council for Continuing Medical Education to sponsor continuing medical education for physicians.

Credit Designation: Carolinas HealthCare System designates this educational activity for up to 2 hours of Category 1 credit toward the AMA Physician's Recognition Award. Each physician should claim only those hours of credit actually spent in the educational activity. *Emergency Medicine Practice* is approved by the American College of Emergency Physicians for 24 hours of ACEP Category 1 credit (per annual subscription).

Earning Credit: Physicians with current and valid licenses in the United States, who read all CME articles during each *Emergency Medicine Practice* six-month testing period, complete the CME Evaluation Form distributed with the December and June issues, and return it according to the published instructions are eligible for up to 2 hours of Category 1 credit toward the AMA Physician's Recognition Award (PRA) for each issue. You must complete both the post-test and CME Evaluation Form to receive credit. Results will be kept confidential. CME certificates will be mailed to each participant scoring higher than 70% at the end of the calendar year.

Publisher: Robert Williford. **Vice President/General Manager**: Connie Austin.
Managing Editor: Heidi Frost. **Copy Editor**: Farion Grove.

Direct all editorial or subscription-related questions to Pinnacle Publishing, Inc.: **1-800-788-1900** or 770-565-1763
Fax: 770-565-8232

Pinnacle Publishing, Inc.
P.O. Box 72255
Marietta, GA 30007-2255

E-mail: **emergmed@pinpub.com**

Pinnacle Web Site: **http://www.pinpub.com**

Emergency Medicine Practice (ISSN 1524-1971) is published monthly (12 times per year) by Pinnacle Publishing, Inc., 1503 Johnson Ferry Road, Suite 100, Marietta, GA 30062.