Articles

Diagnosis and Antibiotic Treatment of Community-Acquired Pneumonia

JONATHAN E. RODNICK, MD, *and* JAMES K. GUDE, MD, *San Francisco, California*

Only a few pathogens cause most community-acquired pneumonias. In outpatients, treatment is empiric, based on the results of chest films, leukocyte counts, and Gram's stains (if available). Antibiotics must always cover pneumococci and should cover *Mycoplasma pneumoniae* in young adults and during epidemic periods. A follow-up chest film in smokers and those older than 40 years is strongly recommended. In inpatients, the evaluation and treatment are tailored to individual cases. A search for a wider range of causes, using invasive tests if necessary, is undertaken, and all likely pathogens should be covered with the initial antibiotic therapy.

(Rodnick JE, Gude JK: Diagnosis and antibiotic treatment of community-acquired pneumonia. West J Med 1991 Apr; 154:405-409)

Community-acquired pneumonia is an acute lower respiratory tract infection developing in nonhospitalized persons who have new focal findings on chest examination and an abnormal chest roentgenogram. It is estimated that in the United States each year, pneumonia develops in as many as 3 million persons, of whom about 500,000 are admitted to a hospital and about 50,000 die.[1] Assuming that there are about 150,000 physicians in primary care in this country—family practice, general internal medicine, and pediatrics—each full-time primary care physician could, conceivably, care for an average of 20 patients with pneumonia a year, of whom 2 to 5 might be admitted to a hospital. In more than 500,000 visits to family and general practitioners in Virginia, pneumonia was found to be the 25th most common problem seen and the reason for 0.8% of all the visits.[2] Although community-acquired pneumonia is a common office problem, there has been little published about its incidence in the United States and few controlled clinical trials of the treatment of it on an outpatient basis.

Etiology

Six recent studies have looked at the infectious causes of community-acquired pneumonia. Four of these were done on inpatients in the United Kingdom,[3] France,[4] Sweden,[5] and the United States.[6] Two studies were done on outpatients—in England[7] and Sweden.[8] Results of these studies are presented in Tables 1 and 2. The following generalizations are drawn:

- The spectrum of pathogens is similar for both inpatients and outpatients.
- *Streptococcus pneumoniae* is by far the most common cause in either setting. The percentage of patients with pneumococci in these reports may be underestimated. All studies tested for the pneumococcal antigen in sputum, which has a greater sensitivity but lower specificity than cultures.
- The incidence of infection with *Mycoplasma* and *Chlamydia* species may also be underestimated. *Mycoplasma pneumoniae* can be cultured, but more commonly it is diagnosed by a change in antibody titer, which can have false-negatives. None of these studies used sputum culture techniques for *Chlamydia* species, which are not routinely available. On the average, about 10% of cases of pneumonia in young adults are associated with *Chlamydia pneumoniae* (previously called the TWAR agent).[8]
- The incidence of viral pneumonia also may be underestimated. Percentages reported here are from positive sputum cultures or antibody titer rises due to influenza A and B only.
- All studies, despite using a wide spectrum of tests, were still not able to find the cause in a third of inpatient pneumonias and close to half of all outpatient pneumonias.

A probable order of frequency of the cause of community-acquired pneumonia in otherwise healthy young and middle-aged adults is *S pneumoniae, M pneumoniae, Haemophilus influenzae,* other causes of influenza, *C pneumoniae,* and *Branhamella catarrhalis. B catarrhalis* is a Neisseriaceae-like organism that is a seasonal pathogen, primarily causing pneumonia in those with underlying chronic lung disease.[10] In elderly, alcoholic, or debilitated patients, bacterial infections are more common, and pathogens such as *Mycobacterium tuberculosis,* the anaerobes, and gram-negative pathogens, as well as *Staphylococcus aureus,* must be considered—especially in times of influenza epidemics. Aspiration (anaerobic) pneumonia is usually seen in patients with major trauma, coma, stroke, or intoxication. In young children, *H influenzae* is a more common cause, but it still ranks after *S pneumoniae;* also, *S aureus* and respiratory syncytial virus are frequently seen in this age group.[11] Mycoplasmal and chlamydial infections and influenza occur in epidemics. Epidemics of *M pneumoniae* infection have been reported on a three- to seven-year cycle.[12] *M pneumoniae* is probably the most common cause of pneumonia in young adults but is rare in the elderly.[13]

In patients with the acquired immunodeficiency syndrome, the order of etiologic frequency (from most common to least common) of community-acquired pneumonia is *Pneumocystis carinii,* pyogenic bacteria (especially pneumococci), *Mycobacterium avium* complex, fungi (especially *Cryptococcus neoformans*), *M tuberculosis,* and cytomegalovirus. This ranking is based on data from Community Hospital of Sonoma County, Santa Rosa, California, where

From the Department of Family and Community Medicine, University of California, San Francisco, School of Medicine.
Reprint requests to Jonathan E. Rodnick, MD, Dept of Family and Community Medicine, UCSF School of Medicine, Box 0900, San Francisco, CA 94143.

ABBREVIATIONS USED IN TEXT

AFB = acid-fast bacilli
PPD = purified protein derivative

P carinii pneumonia was the most commonly diagnosed community-acquired pneumonia on the family practice-internal medicine service during the first six months of 1990.

Office Evaluation of Pneumonia

The signs and symptoms of pneumonia are well recognized. In the British Thoracic Society study of 453 patients with pneumonia, cough was present in 88%, dyspnea in 71%, sputum production in 69%, chest pain in 64%, hemoptysis in 17%, and confusion in 17%.[3] It is important to remember that pneumonia in the elderly can often present with confusion and a low-grade fever. Another not infrequent presentation of pneumonia in the very young and very old is upper quadrant abdominal pain, even with guarding and ileus. An upper respiratory tract infection precedes pneumonia only about a third of the time. Characteristic signs, symptoms, and findings of the two pneumonic "syndromes"—bacterial and atypical—are presented in Table 3. The rales and wheezes heard in the chest are nonspecific—they can also be heard in patients with bronchitis and those with congestive heart failure. The more specific signs, such as bronchial breath sounds, egophony, and dullness to percussion, are often heard later in the course, so may not help in the initial diagnosis. Normal findings on a chest examination exclude pneumonia 95% of the time.

For outpatients, only three diagnostic tests are used—a chest roentgenogram, leukocyte count, and Gram's stain of sputum specimens.

A chest x-ray film aids clinicians in three ways. First, it may help distinguish whether a pneumonia is bacterial or viral. Focal alveolar or lobar infiltrates on chest roentgenograms suggest bacterial infections. Diffuse interstitial infiltrates are suggestive of a viral, mycoplasmal, or chlamydial infection. Radiologists are able to distinguish bacterial from viral pneumonia correctly in more than two thirds of patients.[14]

Second, a chest film can determine if a pleural effusion is present. About a third of patients admitted to a hospital with pneumonia have a pleural effusion. If the effusion is small (it does not layer out to more than 2 cm on a lateral decubital film) and if a patient's condition does not appear toxic and responds well to antibiotic therapy, thoracentesis may not be needed. If, however, there is a larger effusion or if the infection is severe, thoracentesis is mandatory to exclude empyema.[15] The most common cause of empyema is an anaerobic infection; such an empyema occurs more frequently in patients with alcoholism or with impaired consciousness.

Third, follow-up chest films are needed to see if the infiltrate clears completely. More than 50% of chest films show pneumonia clearing within six weeks, and 75% show resolution within three months.[3] Follow-up films should be done within three to six months for all patients who smoke or who are older than 40. If an abnormality has not cleared on follow-up films, the patient should be evaluated for a possible cancer. In one study, half of patients with persistent abnormalities on follow-up chest films were found to have cancer.[12]

To help identify those patients who need hospital care, a leukocyte count should be done—<4 or $>30 \times 10^9$ per liter ($<4{,}000$ or $>30{,}000$ per μl). This also may aid in differentiating between pneumonia of viral or of bacterial cause. There is no clear dividing line between viral and bacterial pneumonias, although total counts of greater than 15×10^9 per liter (15,000 per μl) suggest a bacterial cause. The differential cell count is not a reliable indicator.

Last, if the patient has a productive cough, a Gram's stain should be done of sputum specimens. Patients with a productive cough are more likely to have a bacterial infection. A Gram's stain should be searched for areas where there are greater than 10 neutrophils per high-power field and few squamous epithelial cells, and the predominant bacteria in these areas should be identified. Unfortunately, a Gram's

TABLE 1.—*Causes of Community-Acquired Pneumonia in Patients Admitted to Hospital**

Study (Country), Year	Patients, No.	Streptococcus pneumoniae, %	Mycoplasma pneumoniae, %	Viral, %	Haemophilus influenzae, %	Staphylococcus aureus, %	Legionella Species, %	Chlamydia Species, %	Gram-negative, %†	Other, %	No Pathogen Identified, %
British Thoracic Society Research Committee (England), 1987[3]	453	42	18	7	6	1	2	3	2	3	33
Levy et al (France), 1988[4]	116	26	4	4	12	3	4	1	8	17‡	35
Holmberg (Sweden), 1987[5]	147	47	10	10	10	1	1	1	2	13	29
Fang et al (US), 1990[6]§	359	15	2	0	11	3	7	6	6	14	33

*Percentages will total >100% because some patients have more than one cause.
†Includes *Branhamella catarrhalis*.
‡Includes *Mycobacterium tuberculosis*.
§In the patients of Fang et al,[6] 3% had *Pneumocystis carinii* as the cause of their community-acquired pneumonia.

TABLE 2.—*Causes of Community-Acquired Pneumonia in Outpatients**

Study (Country), Year	Patients, No.	Streptococcus pneumoniae, %	Mycoplasma pneumoniae, %	Viral, %	Haemophilus influenzae, %	Staphylococcus aureus, %	Chlamydia Species, %	Gram-negative, %†	Other, %	No Pathogen Identified, %
Woodhead et al (England), 1987[7]	236	36	1	13	10	1	1	1	3	45
Berntsson et al (Sweden), 1986[8]	54	9	37	12	12	0	4	0	0	51

*Percentages will total >100% because some patients have more than one cause.
†Includes *Branhamella catarrhalis*.

stain has low sensitivity. For pneumococcal pneumonia, its sensitivity ranges from 15% to 60%.[16] When positive, however, it has a high predictive value of 80% to 90%.[3] Therefore, if a predominant organism is found, it is likely the cause of the pneumonia.

Because sputum is expectorated through the upper airway, which has many bacteria, sputum cultures are not usually helpful in patients with community-acquired pneumonia who are not admitted to a hospital. If the patient does not have a productive cough, no further diagnostic studies are warranted as an outpatient. The risks of doing a transtracheal aspirate generally outweigh the benefits.[17]

Evaluation in Hospital

Factors noted in the literature to be associated with increased mortality from pneumonia are presented in Table 4.[1,3,18,19] In patients with these risk factors, hospital admission should be strongly considered and a more detailed workup for the pathogens should be undertaken. The following tests should be considered:

TABLE 3.—*Characteristic Findings in Community-Acquired Pneumonia**

Characteristic	*'Typical Pneumonia'*	*'Atypical Pneumonia'*
Onset	Often sudden	Usually gradual
Myalgia, headache, photophobia	Not prominent	Often prominent
Rigors	Common	Rare
Toxicity	Marked	Mild to moderate
Cough	Productive, purulent, or bloody sputum	Nonproductive paroxysms or only scant mucoid sputum
Pleuritic pain	Common	Rare
Fever	>38.9°C (102°F)	<38.9°C (102°F)
Physical findings	Dullness with bronchial or tubular breath sounds	Often minimal
Roentgenographic findings	Localized; correlate with physical findings	Involvement in excess of physical findings
Leukocyte count	>15 x 10^9/liter†	<15 x 10^9/liter
Pathogen	Bacteria, *Legionella pneumophila*	*Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, viruses

*Table courtesy of Mary Anne G. Johnson, MD, Dept of Family and Clinical Medicine, University of California, San Francisco.
†Leukopenia may be seen in overwhelming infection.

TABLE 4.—*Factors Associated With Increased Mortality From Pneumonia**

Advanced age
Male sex
Confusion
Underlying conditions, such as alcoholism, congestive heart failure, diabetes mellitus, cancer, or immunodeficiency (especially due to HIV)
Fever—temperature >38.3°C
Tachypnea—respiratory rate >30/minute
Hypotension—diastolic pressure <60 mm of mercury
Hypoxemia—O_2 saturation <88%
Leukopenia—<4 x 10^9/liter
Pronounced leukocytosis—>30 x 10^9/liter
Bacteremia
Bilateral or multilobe densities or large pleural effusion on chest film
Staphylococcal or gram-negative infection
Steroids, cytotoxic drugs, or other immunosuppressive therapy

HIV = human immunodeficiency virus

*From Fine et al,[1] the British Thoracic Society Research Committee,[3] Siegel,[18] and Marrie et al.[19]

• *Culture of two to three blood specimens.* Blood cultures are positive in 25% to 40% of patients with pneumococcal pneumonia.[3,4] Blood culture has lower sensitivity in other types of bacterial pneumonia.

• Legionella *culture or antibody titer.* Sputum culture for *Legionella pneumophila* is done with a selective medium and acid washing. Antibody titers can be measured only for *L pneumophila* serotype 1. An immunofluorescent titer of greater than 1:256 or a fourfold or greater rise in paired serum specimens is considered positive. Because of the time delay in getting culture or serologic results, the treatment of legionellosis, mycoplasmal or chlamydial infection, or viral pneumonia should usually be started on clinical suspicion.

• *Mycoplasmal titer.* Cold agglutinins are widely used but have low sensitivity and specificity, especially early in the course.[13] They are not advised. A fourfold rise in specific mycoplasmal complement fixation titers in paired serum specimens or a single immunoglobulin M titer of greater than 1:4 is diagnostic.

• *Chlamydial titers.* Unfortunately, no specific test or culture is available for *C pneumoniae.* Psittacosis or chlamydial pneumonia in newborns due to genital strains is diagnosed by a fourfold or greater rise in complement fixation or immunofluorescent titers or a single convalescent titer of greater than 1:64.

• *Viral culture or antibody titers.* Influenza virus types A and B can be cultured relatively easily. Alternatively, a fourfold rise in antibody titers is highly suggestive. Most laboratories will not look for the 180 or so other viruses capable of causing respiratory infections. The exception is respiratory syncytial virus, which causes bronchiolitis in children. The

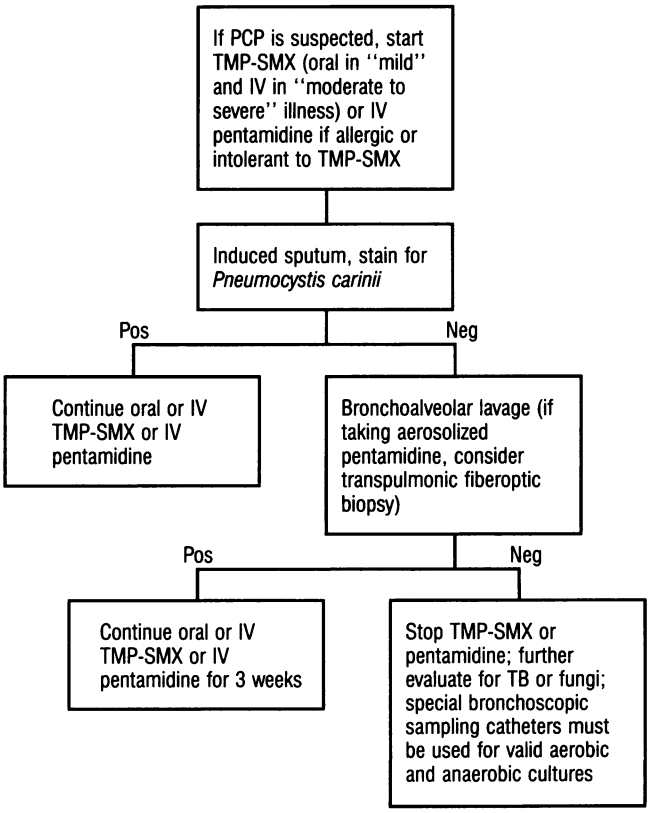

Figure 1.—The schema shows the approach to evaluating and treating suspected *Pneumocystis carinii* pneumonia (PCP) in patients positive for the human immunodeficiency virus antibody. IV = intravenous, TB = tuberculosis, TMP-SMX = trimethoprim and sulfamethoxazole

TABLE 5.—*Use of Gram's Stain of the Sputum to Select Initial Antibiotics for Outpatient Treatment of Pneumonia*

Gram's Stain Results	*Pneumonia Suspected*	*Initial Antibiotic Drug (Alternative)*
Few WBCs, no predominant organism	Viral or mycoplasmal or chlamydial	Erythromycin (tetracycline)
WBCs and gram-positive lancet-shaped diplococci	Pneumococcal	Penicillin (erythromycin)
WBCs and small gram-negative rods	*Haemophilus influenzae*	Amoxicillin; amoxicillin-clavulanate if β-lactamase strains prevalent
WBCs and large grape-like gram-positive cocci	Staphylococcal	Admit for IV nafcillin therapy (vancomycin)
WBCs and gram-negative rods	Gram-negative	Admit for IV aminoglycoside or cephalosporin therapy
WBCs and mixed pleomorphic flora	Unclear type	TMP-SMX and metronidazole or amoxicillin-clavulanate

IV = intravenous, TMP-SMX = trimethoprim and sulfamethoxazole, WBCs = leukocytes

enzyme-linked immunosorbent assay or immunofluorescent test for antigen in the sputum is also diagnostic.

• *Purified protein derivative (PPD) skin test and acid-fast bacilli (AFB) sputum smear.* A 5-TU (intermediate strength) PPD and sputum AFB smear and culture are recommended for patients with suggestive upper lobe infiltrates or other signs or symptoms suggesting tuberculosis.

• P carinii *smear.* Where indicated, an induced sputum specimen (sensitivity 20% to 50%) or, if normal, a bronchoalveolar lavage specimen (sensitivity 90%) should be examined for *P carinii.* The choice of stain depends on the laboratory's experience. Figure 1 outlines an approach to the evaluation of pneumonia in high-risk patients who are positive for human immunodeficiency virus antibodies.

• *Sputum bacterial culture.* This is often done more by habit than intention. If a patient is sick enough to be admitted to a hospital, however, a positive culture, despite its false-positives and false-negatives, may confirm a bacterial cause in those patients who have negative blood cultures, and the antibiotic sensitivities may be helpful. The culture results inspire more confidence if they correlate with a good Gram's stain.

• *Invasive diagnostic techniques.* Some invasive procedures, such as transbronchial needle biopsies, are used in sick patients who do not respond to empiric antibiotic therapy, but they yield a diagnosis only about 50% of the time.[17] A discussion of these techniques is beyond the scope of this article.

Treatment

Three questions must be answered. First, does a patient have pneumonia? This is usually determined by the results of a physical examination and chest roentgenogram. Second, should the patient be admitted to a hospital? This is addressed in the previous section. Third, what is the best antibiotic therapy to use?

If a patient is a "normal host," produces little or no sputum so a Gram's stain cannot be done, and is not being admitted to a hospital, the antibiotic drug of choice is erythromycin. The dosage for adults is 250 to 500 mg four times a day. Erythromycin covers pneumococci as well as *M pneumoniae* and *C pneumoniae.* Erythromycin frequently causes gastrointestinal side effects—nausea, vomiting, and diarrhea. These are dose related and are at least as common with the enteric-coated tablets as with the stearate or ethylsuccinate forms.[20] Even intravenous erythromycin causes gastrointestinal discomfort. In children, erythromycin estolate has a lower incidence of side effects, but its use should be avoided in adults because of the risk of cholestatic jaundice. Giving erythromycin with food or using small, frequent doses of a suspension may decrease the gastrointestinal side effects.

TABLE 6.—*Outpatient Drug Costs of Oral Antibiotics**

Drug, Dose, No.	*Cost, $*
Amoxicillin, 500 mg, 40	12.06
Amoxicillin-clavulanate potassium, 500 mg, 30	62.05
Ampicillin, 500 mg, 40	10.19
Cefaclor, 500 mg, 30	82.15
Cefixime, 400 mg, 10	45.26
Cefuroxime, 500 mg, 30	125.66
Ciprofloxacin hydrochloride, 750 mg, 20	84.35
Erythromycin, 500 mg, 40	13.76
Penicillin, 500 mg, 40	7.85
Trimethoprim-sulfamethoxazole, 160 mg-800 mg, 20	9.38

*Average retail costs in six community pharmacies, November 1989.

An alternative to erythromycin is tetracycline or doxycycline, but some pneumococci are resistant. Penicillin is not active against *Chlamydia* species or *M pneumoniae,* nor is ampicillin. The combination of trimethoprim and sulfamethoxazole provides adequate coverage for the three common bacterial pathogens—*S pneumoniae, H influenzae,* and *B catarrhalis*—but does not cover *M pneumoniae* or *C pneumoniae.* The newer and more expensive oral cephalosporins, such as cefaclor or cefuroxime, cover a similar respiratory pathogen spectrum as does trimethoprim-sulfamethoxazole. Ciprofloxacin has some activity against *M pneumoniae,* but high doses are needed to be bactericidal for pneumococci. It is not recommended as the initial drug of choice for respiratory tract infections.

If the patient is a "normal host" and produces a purulent sputum specimen, the sputum Gram's stain can help guide the antibiotic selection. The use of the Gram's stain for initial antibiotic selection is depicted in Table 5. If the Gram's stain shows pneumococci, an intramuscular injection of penicillin G procaine followed by penicillin V potassium, 500 mg four times a day (erythromycin or trimethoprim-sulfamethoxazole in penicillin-allergic patients), is an appropriate choice. If the Gram's stain suggests *H influenzae* or *B catarrhalis,* ampicillin, 500 mg four times a day, or amoxicillin, 500 mg three times a day, is a reasonable choice. If, however, the patient is from an area where β-lactamase-producing *H influenzae* is prevalent, a combination of amoxicillin and clavulanate potassium, 500 mg four times a day, is more appropriate. If the patient is allergic to penicillin, double-strength trimethoprim-sulfamethoxazole (160 mg and 800 mg) or an oral second- or third-generation cephalosporin (cefaclor, cefixime, or cefuroxime) has an effective antibacterial spectrum. The costs of a ten-day course of some typical oral antibiotic regimens are given in Table 6.

If a patient is admitted to hospital, the choice of antibiotic should obviously depend on the organism suspected. For a sick nursing-home patient or one with alcoholism in whom there is also concern about a gram-negative, anaerobic, or

staphylococcal infection, initial treatment with a parenteral combination drug, amoxicillin and sulbactam sodium, is a reasonable single-agent choice. If the primary concern is a staphylococcal infection, nafcillin or vancomycin is the agent of choice. If there is a possible pseudomonal infection (unusual in community-acquired pneumonia), gentamicin and ceftazidime are good initial choices. If the primary concern is anaerobic aspiration pneumonia, clindamycin is the best choice. In the case of an unclear cause where aspiration is a possibility, the use of trimethoprim-sulfamethoxazole and metronidazole or amoxicillin-clavulanate offers a wider initial empiric coverage.

The criteria for hospital discharge include the resolution of fever, an ability to take medicine orally, no need for supplemental oxygen, no progression of a chest film infiltrate, a decrease in the leukocyte count, and the presence of social and family support. Following the discharge of patients from a hospital, 75% return to normal activities within six weeks. The cost of treating an uncomplicated case of pneumonia in the hospital is in the range of $5,000, whereas treating a patient at home with oral antibiotics costs about $250 for physician visits, chest roentgenograms, and antibiotics. The diagnosis-related group 089 for uncomplicated pneumonia was based on allowing 7½ days of hospital treatment.

Prevention

The influenza vaccine is protective at a 70% to 80% level for the current covered strains. (The 1990-1991 vaccine included A/Taiwan, A/Shanghai, and B/Yamagata hemagglutinin antigen.) Unfortunately, less than 20% of patients older than 65 or others at high risk (residents of long-term-care facilities or those with chronic cardiac, renal, or hematologic illness) are immunized each year. If an actual influenza outbreak is relatively certain, amantadine is also 70% to 90% protective.[21] The usual dose is 200 mg a day, but in the elderly, 100 mg a day is recommended to decrease the side effects of insomnia, dizziness, and personality changes. The use of the pneumococcal vaccine is more controversial. It probably reduces the chances of pneumococcal pneumonia by 60% to 80% in healthy elderly persons, but this may be lower in those with underlying conditions.[22] The pneumococcal vaccine is recommended for any adult with a chronic illness. Last, a recent recommendation is to give the Haemophilus b vaccine to children beginning at 2 months to protect against meningitis. This vaccine is unlikely to do much to decrease the incidence of *H influenzae* respiratory infections, however, because pneumonia is usually caused by nontypeable serotypes.

REFERENCES

1. Fine MJ, Smith DN, Singer DE: Hospitalization decision in patients with community-acquired pneumonia: A prospective cohort study. Am J Med 1990; 89:713-721

2. Marsland DW, Wood M, Mayo F: Content of family practice—Parts I and II. J Fam Pract 1976; 3:37-68

3. British Thoracic Society Research Committee: Community-acquired pneumonia in adults in British hospitals in 1982-1983: A survey of aetiology, mortality, prognostic factors and outcomes. Q J Med 1987; 62:195-220

4. Levy M, Dromer F, Brion N, Leturdu F, Carbon C: Community-acquired pneumonia—Importance of initial noninvasive bacteriologic and radiographic investigations. Chest 1988; 92:43-48

5. Holmberg H: Aetiology of community-acquired pneumonia in hospital treated patients. Scand J Infect Dis 1987; 19:491-501

6. Fang GD, Fine M, Orloff J, et al: New and emerging etiologies for community-acquired pneumonia with implications for therapy. Medicine (Baltimore) 1990; 69:307-316

7. Woodhead MA, Macfarlane JT, McCracken JS, Rose DH, Finch RG: Prospective study of the aetiology and outcome of pneumonia in the community. Lancet 1987; 1:671-674

8. Berntsson E, Lagergård T, Strannegård O, Trollfors B: Etiology of community-acquired pneumonia in out-patients. Eur J Clin Microbiol 1986; 5:446-447

9. Grayston JT: *Chlamydia pneumoniae*, strain TWAR. Chest 1989; 95:664-668

10. Wright PW, Avery WG: *Branhamella catarrhalis* infections. Am Fam Physician 1989; 39:125-128

11. Denny FW, Clyde WA: Acute lower respiratory tract infections in nonhospitalized children. J Pediatr 1986; 108:635-646

12. Macfarlane J: Community-acquired pneumonia. Br J Dis Chest 1987; 81:116-127

13. Mansel JK, Rosenow EC 3rd, Smith TF, Martin JW Jr: *Mycoplasma pneumoniae* pneumonia. Chest 1989; 95:639-646

14. Tew J, Calenoff L, Berlin BS: Bacterial or nonbacterial pneumonia—Accuracy of radiographic diagnosis. Radiology 1977; 124:607-612

15. Sahn SA, Light RW: The sun should never set on a parapneumonic effusion. Chest 1989; 95:945-947

16. Rein MF, Gwaltney JM, O'Brien WM, Jennings RH, Mandell GL: The accuracy of Gram's stain in identifying pneumococci in sputum. JAMA 1978; 239:2671-2673

17. Stulbarg MS: Problems in diagnosing pneumonia—Medical Staff Conference, University of California, San Francisco. West J Med 1984; 140:594-601

18. Siegel D: Management of community-acquired pneumonia in outpatients. West J Med 1985; 142:45-48

19. Marrie TJ, Durant H, Yates L: Community-acquired pneumonia requiring hospitalization: 5-year prospective study. Rev Infect Dis 1989; 11:586-599

20. Latare PA, Setness PA: Using erythromycin. Postgrad Med 1989; 86:55-59, 63

21. LaForce FM: Community-acquired lower respiratory tract infections—Prevention and cost control strategies. Am J Med 1985; 78(Suppl 6B):52-57

22. Broome CV, Facklam RR, Fraser DW: Pneumococcal disease after pneumococcal vaccination: An alternative method to estimate the efficacy of pneumococcal vaccine. N Engl J Med 1980; 303:549-552

* * *

This article is one of a series on topics in primary care in which common diagnostic or therapeutic problems encountered in primary care practice are presented. Physicians interested in contributing to the series are encouraged to contact the Special Editors.

STEPHEN M. McPHEE, MD
TERRIE MENDELSON, MD
Special Editors