

## *Community Acquired Pneumonia*

*Jill S. Roncarati, PA-C  
John Bernardo, MD*

**T**he term community-acquired pneumonia (CAP) refers to a common lower respiratory infection diagnosed by a combination of some or all of the following: clinical signs and symptoms; an infiltrate seen on chest radiography; and abnormal laboratory values. CAP occurs outside of the hospital or within 48 hours after hospital admission in a patient who has not been recently hospitalized and is not living in a long-term care facility. Pneumonia acquired while hospitalized or while living in an inpatient setting is referred to as “nosocomial pneumonia”.

### **Prevalence and Distribution**

More than 4 million adults are diagnosed with community-acquired pneumonia in the USA each year, resulting in close to 1.5 million hospitalizations. According to the Infectious Disease Society of America (IDSA), pneumonia is the sixth leading cause of death in the USA, with greater than 14% mortality among hospitalized patients. Pneumonia affects men and women equally; however, those with predisposing conditions such as dysphagia, esophageal disease, or altered consciousness have a greater chance of succumbing to the illness. Higher risk groups include: homeless persons who are 35-55 years old; persons with co-morbid diseases such as asthma, COPD, tuberculosis, and a history of smoking; and individuals who abuse drugs and/or alcohol.

### **Mode of Transmission**

CAP usually occurs when bacteria from the upper respiratory system or undigested material in the stomach are aspirated into the lung. Infection can also occur by the inhalation of aerosolized material or by the seeding of microorganisms in the lungs through hematogenous spread, the least common route. Persons suffering from the co-morbid diseases described above usually are more likely to have contracted CAP through aspiration.

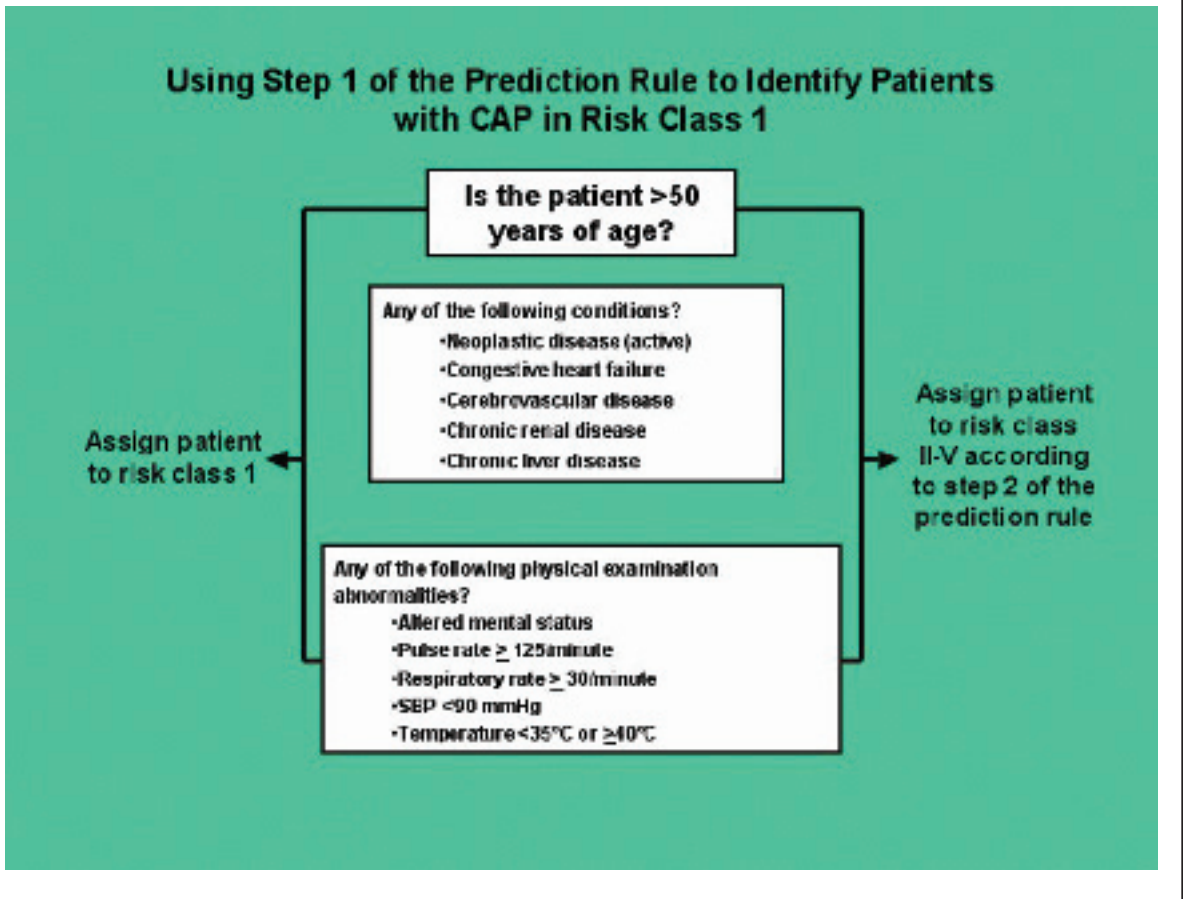
### **Symptoms and Diagnosis**

The most common signs and symptoms are cough (with or without sputum production), fever, chills, tachypnea (rapid breathing), tachycardia (a rapid heart rate), pleuritic chest pain (chest pain that worsens or “catches” with inhalation), dyspnea

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*Dr. Stephen Hwang of BHCHP finds a creative approach to speaking with this deaf man during a clinic visit at St. Francis House Day Shelter. Photo by Stephen Savoia*

Table 1:



PORT Pneumonia Severity Index, Step 1. Prediction rule to identify those patients with CAP in Risk Class 1. Courtesy of UpToDate. www.uptodate.com

(sensation of difficult breathing), altered mental status, dehydration, and hemoptysis (coughing up blood). Clinical findings include a temperature greater than 100°F (>37.8°C), heart rate over 100, respiratory rate greater than 25, room air oxygen saturation <90%, and an exam showing rhonchi or focal rales on auscultation of the lungs, decreased breath sounds, and bronchophony.

If pneumonia is suspected, the IDSA recommends a chest x-ray along with several laboratory tests: complete blood count with a differential, serum creatinine, blood urea nitrogen, glucose, electrolytes, and liver function tests. Vital signs along with oxygen saturation by oximetry or by blood gas analysis should always be assessed. Two blood cultures and Gram's staining of sputum, with a culture and sensitivity evaluation, also should be ordered before antibiotics are given. Other tests to be considered may include HIV screening, PPD skin testing for tuberculosis, and Legionella or influenza (viral) cultures. Since tuberculosis can also present like community-acquired pneumonia in those who are at-risk for TB, the PPD status of the patient should be verified. If past results are either unknown or negative, a PPD should be planted in

persons at-risk for TB. If the PPD has been positive in the past, the chest x-ray and sputum samples should be evaluated for active TB. Sputum should be tested for acid fast bacilli (AFB) by smear and culture on three separate sputum samples, taken at least 8 hours apart, to help rule out tuberculosis.

Although the chest x-ray is accepted as the "gold standard," the sensitivity and specificity have not been well-studied. For example, in a patient with dehydration or early in the disease process, an infiltrate (i.e. pneumonia) may not be recognized by the chest radiograph. Thus, an alternative standard, based on a combination of clinical symptoms and findings, chest radiography results, laboratory data, and clinical response to anti-microbial treatment, may be better. However, chest radiography usually is useful to help assess severity of the disease process and the response to therapy over time.

Gram's stain of the sputum, usually available within hours, can contribute useful information. The Gram's stain should be inspected for the presence of neutrophils and for the identification of the predominant bacteria. A large number of squamous epithelial cells (>25/hpf) suggests the sample is saliva rather than sputum and should be

discarded. According to a study of homeless persons in Boston in 2001 conducted by the authors of this chapter, the three most common microorganisms that cause community-acquired pneumonia in adults are *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Staphylococcus aureus*. With aspiration pneumonia, the responsible microorganism is often an anaerobe or a combination of anaerobes and the above aerobic organisms. The primary anaerobes found to cause aspiration pneumonia in adults are *Peptostreptococcus*, *Fusobacterium nucleatum*, *Prevotella*, and *Bacteroides* species. If an anaerobic infection is suspected, a transtracheal aspiration from the lower airways may be obtained for culture and sensitivity studies. This will avoid contamination of the sample by anaerobes that inhabit the oral cavity.

The decision to hospitalize a patient with pneumonia can be difficult. To help clinicians with this dilemma, a Pneumonia Severity Index (PSI) has been derived by the Pneumonia Patient Outcome Research Team (PORT) after a very lengthy prospective cohort study involving almost 15,000 adults who presented to emergency rooms with radiographic evidence of pneumonia. Based on the risk of death within 30 days of presenting to the emergency room, the PSI is a 2-step process that stratifies patients into 5 risk classes. The PSI is a very useful clinical tool that utilizes the decision-making processes that clinicians typically use during a clinic visit.

The first step is to identify patients with pneumonia on chest x-ray who are at very low risk (Class 1): under the age of 50 and without any of 11 demographic variables, co-morbid conditions, physical findings, or laboratory results. These persons can be treated as outpatients with close follow-up, but do not usually require hospitalization. Please see Table 1.

The second step in the PSI assigns the remaining patients to classes 2 through 5, based upon a total point score. This score involves adding the age in years (age minus 10 points for females) to the points for each risk factor that is present. The risk factors and points are detailed in Table 2, which is adapted from the IDSA. The point assignments for Classes 2-5 are depicted in Table 3.

Patients in Class 1 and 2 do not usually require hospitalization and can be followed as outpatients. Those in Class 3 require a brief hospital stay, while those in Class 4 and 5 almost always require hospitalization, and sometimes even admission to an Intensive Care Unit.

**Table 2: Risk Factors and Assigned Points**

Risk Factors	Points
<b>Demographic factors</b>	
Age for men	Age (years)
Age for women	Age (years) – 10
Nursing home resident	+10
<b>Coexisting illnesses</b>	
Neoplastic disease (active)	+30
Chronic liver disease	+20
Congestive heart failure	+10
Cerebrovascular disease	+10
Chronic renal disease	+10
<b>Physical examination findings</b>	
Altered mental status	+20
Respiratory rate ≥ 30/minute	+20
Systolic blood pressure < 90 mmHg	+20
Temperature < 35°C or ≥40°C	+15
Pulse ≥ 125 beats/minute	+10
<b>Laboratory and radiographic findings</b>	
Arterial pH <7.35	+30
Blood urea nitrogen ≥ 30 mg/dL (11 mmol/L)	+20
Sodium < 130 mmol/L	+20
Glucose ≥ 250 mg/dL	+10
Hematocrit <30 percent	+10
Partial pressure of arterial oxygen < 60 mmHg*	+10
Pleural effusion	+10

\*or an oxygen saturation of <90 percent on pulse oximetry

PORT Pneumonia Severity Index, Step 2. The risk factors with assigned points used to determine the total score for Risk Classes 2 to 5.

### Treatment and Complications

Treatment consists of oral or intravenous antibiotics, hydration, and over-the-counter analgesics such as acetaminophen (Tylenol™) for minor arthralgias, myalgias, and fever. Antibiotics are ideally prescribed according to which microorganism is causing the infection. Efforts should be made to determine the type of microorganism in order to decrease antibiotic resistance, avoid unnecessary exposure to medication side effects, and

**Table 3**

CLASS	POINT ASSIGNMENT
Class 2	≤70
Class 3	71-90
Class 4	91-130
Class 5	>130

PSI Risk Classes.

The close proximity of the dormitory beds in most adult shelters facilitates the spread of many airborne infections, including TB and influenza.  
Photo by James O'Connell MD



prevent worsening of disease by using an antibiotic not active against the infecting bacteria.

The initial choice of antibiotic is made empirically. After 24-48 hours, when microbiology laboratory tests are complete (such as sputum Gram's staining and culture results), an antibiotic sensitive to the bacteria causing CAP should be confirmed and prescribed. Performing such laboratory tests is often impossible or the test results are equivocal; in such cases, empirical treatment is continued. According to the IDSA, certain conditions can predict certain pathogens. The most pertinent correlations can be found in Table 4 from the IDSA.

The IDSA also recommends the following classes of antibiotics agents, in no particular order, for the empirical treatment of outpatients: a macrolide, doxycycline (Vibramycin™), or a fluoroquinolone, as these classes of medications have the greatest activity against *Streptococcus pneumoniae*, *Mycoplasma pneumoniae*, and *Chlamydia pneumoniae*. Please refer to the Medication List at the end of this chapter for the most commonly used medications in these classes of antibiotics. Special consideration should be taken to different regional sensitivity to these medications. For elderly patients

or those who will have difficulty with medications that are dosed several times per day, a once-a-day fluoroquinolone or macrolide may be a good option. However, a fluoroquinolone should not be used in individuals at-risk for tuberculosis. While this class of drugs has excellent activity against the *M. tuberculosis* bacteria, their use as a single agent may lead to fluoroquinolone drug resistance if the person actually has tuberculosis pneumonia (see chapter on Tuberculosis). Furthermore, these drugs may cause clinical improvement in TB patients and mask the underlying disease. In this situation, the TB remains incompletely treated, and the patient is permitted to remain in the community or shelter and become a public health risk for TB transmission.

### Prevention and Control

A *Streptococcus pneumoniae* vaccine active against the 23 most prevalent types is available and should be administered to all people over 65 years of age, those over 2 years of age with chronic pulmonary disease, those at risk for aspiration pneumonia (such as chronic alcohol and drug abusers), and those with HIV. This vaccine needs to be administered every 5 years. Influenza vaccine should also be given yearly to those at risk for pneumonia. Drug and alcohol treatment programs should always be encouraged to provide vaccinations to their clients.

### Special Considerations for Homeless Populations

In homeless persons with pneumonia, aspiration should be suspected in those who use drugs or alcohol as well as those with known upper gastrointestinal conditions. An antibiotic effective against anaerobes should be used, such as penicillin V (Pen-Vee K™), metronidazole (Flagyl™), or clindamycin (Cleocin™). Treatment regimens can

**Table 4**

Medical Condition	Most Common Pathogen
Chronic obstructive pulmonary disease (COPD) or smoking	<i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> , <i>Moraxella catarrhalis</i> , and <i>Legionella</i> species
Alcoholism	<i>Streptococcus pneumoniae</i> and anaerobes
Poor dental hygiene	Anaerobes
HIV infection in the early stages.	<i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> , and <i>Mycobacterium tuberculosis</i>
HIV infection in the later stages	All pathogens from the early stages as well as <i>P. carinii</i> , <i>Cryptococcus</i> , and <i>Histoplasma</i> species
Influenza in community	Influenza, <i>Streptococcus pneumoniae</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i> , and <i>Haemophilus influenzae</i>
Aspiration or airway obstruction	Anaerobes, <i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> , and <i>Staphylococcus aureus</i>
Intravenous drug abuse	<i>Staphylococcus aureus</i> , anaerobes, <i>Mycobacterium tuberculosis</i> , and <i>Streptococcus pneumoniae</i>

be difficult to complete for homeless persons, especially with complicated drug regimens that require dosing every 4 or 6 hours or when there is no safe place to store medicines. Medications taken once a day, such as fluoroquinolones or macrolides, may encourage successful completion of an antibiotic course. In some cases, the cost of prescribed antibiotics and accessibility to medications for persons without health insurance should be considered.

The availability of a safe place to convalesce can be as important as taking medications as prescribed. Homeless persons with pneumonia often are not ill enough to be admitted to the hospital but are much too sick and vulnerable for the shelter system or the streets. Shelters often close their doors during the daytime, sending guests to the streets until the doors re-open again in the late afternoon or evening. If a homeless person is ill, navigating this system can prolong or worsen the illness. Requesting or advocating for a homeless patient with pneumonia to be admitted to the hospital is thus worthwhile. An alternative to hospitalization is a day care unit or a medical respite unit, such as the Barbara McInnis House, a 92-bed facility in Boston, Massachusetts. These facilities may provide nursing care and other

resources to help patients adhere to treatment plans and recover in a safe environment.

### Summary

A constellation of clinical signs and symptoms should lead the clinician to a diagnosis of pneumonia in the appropriate setting. Clinical findings may be noted even before changes appear on chest x-ray. An effort to perform diagnostic microbiologic laboratory studies should be made as soon as the diagnosis is suspected. Antibiotics are usually started empirically at the outset based on the clinical presentation and then changed if necessary when the diagnostic tests become available. If the patient is homeless, ease of administration of treatment regimes (such as once a day dosing), cost of medications, health insurance status, and having a place to convalesce should be considered. Immunizations such as the influenza vaccination and Pneumovax should be considered as a prevention measure. Where TB is a risk, the PPD status should be verified. If the patient is not connected with a primary care provider or already has primary care, follow up care should be arranged. ■■

Community Acquired Pneumonia Medication List		
Generic	Name Brand	Cost
acetaminophen	Tylenol	\$
clindamycin	Cleocin	\$\$
doxycycline	Adoxa, Doryx, Monodox, Vibramycin	\$
<b>Fluroquinolones</b>		
ciprofloxacin	Cipro, Cipro XR	\$\$\$
levofloxacin	Levaquin	\$\$\$
<b>Macrolides</b>		
azithromycin	Zithromax	\$\$
clarithromycin	Biaxin	\$\$\$\$
erythromycin	Eryc, E-mycin	\$
metronidazole	Flagyl, Florazole ER	\$
penicillin V	Pen-Vee K, Veetids	\$

### References

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