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Community Acquired Pneumonia in Adults - Antibiotic Stewardship
Clinical Practice Guideline

These guidelines are provided to assist physicians and other clinicians in making decisions regarding the care of their patients. They are not a substitute for individual judgment brought to each clinical situation by the patient's primary care provider-in collaboration with the patient. As with all clinical reference resources, they reflect the best understanding of the science of medicine at the time of publication but should be used with the clear understanding that continued research may result in new knowledge and recommendations.

Key Points

- Chest x-ray (CXR) or lung ultrasound should be obtained to confirm Community Acquired Pneumonia (CAP)
- Patients should be screened by pulse oximetry to rule out hypoxemia
- During the COVID-19 pandemic, all patients with CAP should be tested for COVID-19
- CURB-65 or CRB-65 may be used to assess for admission versus outpatient treatment
- **Risk factors for infection with drug resistant S. pneumoniae (DRSP), include:** age > 65 years, beta-lactam therapy within the past 3 months, alcoholism, multiple comorbidities, malignancy, immunosuppressive illness or therapy, exposure to a child in a day care center
- **Duration of therapy**: antibiotics are used for a minimum of 5 days. Ensure patients are afebrile for at least 48 hours and clinically improving before discontinuing antibiotics.
- **ATS/IDSA recommended empiric monotherapy for mild CAP for healthy adults *without* comorbidities and/or risk factors for antibiotic resistant pathogens (choose 1):**

Agent (class)	Dosing	Evidence
Amoxicillin (penicillin)	1 gram three times a day x 5 days ($15)	Moderate quality
Doxycycline (tetracycline)	100 mg PO twice daily x 5 days ($4-65)	Low quality

- **ATS/IDSA recommended empiric drug therapy for patients *with* comorbidities and/or risk factors for DRSP (choose 1):**
    1. Monotherapy with a respiratory fluoroquinolone (moderate quality evidence)
    2. Combination therapy: a Beta-lactam *and a* macrolide (moderate quality evidence)
    3. Combination therapy: a Beta-lactam *and* doxycycline (low quality evidence)

Class	Agent	Dosing
Beta-lactams	Amoxicillin-clavulanate OR Cefpodoxime	500 mg/125 mg PO three times a day x 5 days ($57) OR 875 mg/125 mg PO twice a day x 5 days ($51) OR 2g (extended release) PO twice a day x 5 days ($153) 200 mg PO twice a day x 5 days ($85) OR 500 mg PO twice a day x 5 days ($80-111)
Macrolides	Azithromycin OR Clarithromycin	500 mg PO daily x 1 day, then 250 mg PO daily x 4 days ($14) 500 mg PO twice a day x 5 days ($60) OR 1 g (extended-release) PO daily x 5 days ($90)
Tetracycline	Doxycycline	100 mg twice a day x 5 days
Respiratory fluoroquinolones	Moxifloxacin OR Levofloxacin	400 mg PO daily x 5 days ($136) 750 mg PO daily x 5 days ($180)

Initial Approval Date and Reviews:	Most Recent Revision and Approval Date:	Next Scheduled Review Date:
Effective 9/1/2015, 9/2017, focused update January 2019, 9/2019, 9/2021. 09/2022	September 2022	September 2023

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Introduction: Community Acquired Pneumonia (CAP) remains one of the leading causes of death in the United States. According to one estimate, almost 1 million episodes of CAP occur in adults age 65 and older each year in the United States. There is considerable variability in rates of hospitalization, in part because there are several different severity rating tools. Physicians often overestimate severity and hospitalize patients at low risk for death. Points where evaluation and management differ for HIV-infected patients are noted in this document.

I. Initial Presentation

- Cough with or without sputum
- Hemoptysis
- Gastrointestinal symptoms
- Pleuritic chest pain
- Myalgias
- Rales, rhonchi, wheezing
- Dyspnea
- Malaise, fatigue
- Anorexia
- Temperature > 38^{o}C (100.4^{o}F)
- Egophony, bronchial breath sounds, dullness to percussion
- Atypical symptoms in older patients (confusion, delirium)

About 80% of patients will have a fever. Tachypnea (RR > 24) may be the most sensitive sign in the elderly.

Patients with an acute respiratory infection who have normal vital signs and a normal pulmonary exam are very unlikely to have CAP. [11]

II. Risk factors associated with a complicated course of CAP

A. Coexisting illness/conditions:

- Age > 65 years
- Use of antibiotics within past 3 months
- Malnutrition
- COPD
- Suspicion of aspiration
- Immunosuppression/HIV
- Diabetes Mellitus
- Altered mental status
- Asplenia
- Chronic renal failure, liver disease and/or heart disease
- Hospitalization within the past year for CAP
- Malignancies

B. Indicators of severe CAP on presentation:

- Respiratory rate ≥ 30/min
- Temperature < 36^{o}C (96.8^{o}F)
- Diastolic blood pressure < 60 mmHg
- Confusion/disorientation
- Systolic blood pressure < 90 mmHg
- Oxygen saturation < 92% or a significant change from baseline

III. Primary Pathogens

A. Common etiologies of outpatient CAP include respiratory viruses (SARS-CoV-2, other coronaviruses, Influenza A and B, adenovirus, respiratory syncytial virus, and parainfluenza); typical bacteria (*Streptococcus pneumoniae, Mycoplasma pneumoniae, Haemophilus influenza);* and atypical bacteria *(Chlamydia pneumoniae, Mycoplasma pneumoniae*, *Legionella* species).

B. Drug-resistant *S. pneumoniae* (DRSP): Risk factors for infection with b-lactam–resistant *S. pneumoniae* include age > 65 years, beta-lactam therapy within the previous 3 months, alcoholism,

multiple comorbidities, immunosuppressive illness or therapy, and exposure to a child in a day care center. Recent treatment with antimicrobials is likely the most significant risk factor. Recent therapy or repeated courses of therapy with beta-lactams, macrolides, or fluoroquinolones are risk factors for pneumococcal resistance to the same class of antibiotic.

C. Additional conditions and their specific associated pathogens are listed in **APPENDIX 1.** Note that empiric therapy for CAP does not cover all of these organisms and further work-up may be necessary.

IV. Severity of Illness Scoring and Prognostic Models

Patients should be assessed for admission versus outpatient treatment using a severity scale. The two most commonly used are the Pneumonia Severity Index (PSI) and the CURB-65. The PSI has been more widely studied and validated but is cumbersome. If working in a setting with labs and radiology readily available see **APPENDIX 2** for the Pneumonia Severity Index (PSI), otherwise see below.

A. CURB-65 and CRB-65 Score

One point is assigned for the presence of each of the following to help decide on appropriate treatment setting. CRB-65 is used when there's no immediate access to labs:

CURB-65
*C*onfusion
*U*remia (BUN greater than 20 mg/dL)*
*R*espiratory rate ≥ 30 breaths/minute
*B*lood pressure (systolic < 90 or diastolic ≤ 60)
65 - Age ≥ *65*

CRB-65
*C*onfusion
*R*espiratory rate ≥ 30 breaths/minute
*B*lood pressure (systolic < 90 or diastolic ≤ 60)
65 - Age ≥ *65*

CURB-65 Score	Treatment Setting
0-1	Outpatient
2	Inpatient
3-5	Inpatient-ICU

CRB-65 Score	Treatment Setting
0	Outpatient
1-4	Consider Inpatient

B. Scoring systems are not intended to replace clinical judgment. Other considerations may influence a clinician's decision to admit a patient. Concern for pathogens associated with rapidly progressive pneumonia (COVID-19, SARS, MERS, avian influenza, post-influenza bacterial pneumonia, Legionella) and psycho-social conditions (homelessness, substance abuse, mental illness, inability to pay for or adhere to medications) may necessitate hospitalization.

C. HIV-infected patients, particularly those with advanced disease (CD4 < 200 cells/mm^3), typically require blood cultures to rule out bacteremia as well as sputum and urinary antigen testing, which may necessitate hospitalization.

V. Management

A. **Chest x-ray (CXR) or lung ultrasound** should be performed to confirm the diagnosis of CAP. CXR findings of CAP include lobar consolidations, interstitial infiltrates, and/or cavitations. Ultrasound findings of pneumonia include subpleural consolidations, localized area of B-lines, and/or air bronchograms.
   i. CXR can help exclude other diseases (i.e., CHF), suggest other diagnoses (i.e., tumor), and assess for severity of illness by locating infiltrates in more than one lobe.
   ii. A negative CXR does not rule out pneumonia. False negative CXRs may be seen in very early pneumonia, neutropenia, dehydration, or *Pneumocystis Jirovecii* pneumonia.
   iii. Point-of-care lung ultrasound can help differentiate CAP vs. CHF vs. COPD exacerbation.
   iv. Lung ultrasound is more sensitive than CXR for diagnosing pneumonia.[15]
   v. CT scans are not routinely recommended due to high cost and no direct evidence to suggest they improve outcomes.

B. Patients should be screened by **pulse oximetry** to rule out hypoxemia.

C. **During the COVID-19 pandemic**, all patients with suspected or diagnosed CAP should be tested for COVID-19. Similarly consider testing for influenza during influenza season to allow for directed therapy.

D. **Assess severity of illness** using for example CURB-65 or CRB-65, to determine the most appropriate treatment setting

E. **Additional clinical indications for admission** and more extensive diagnostic testing* include:

- Failure of outpatient antibiotic therapy
- Cavitary infiltrates
- Leukopenia
- Active alcohol abuse
- Severe chronic liver disease
- Unable to take PO due to nausea, vomiting or allergies
- Asplenia (functional or anatomic)
- Recent travel (within the past 2 weeks)
- Pleural effusion
- Severe structural lung disease

***See APPENDIX 3** for the recommended diagnostic testing to perform for each of the above clinical indications.

F. **Treat with empiric antibiotics for at least 5 days, see below (Drug Therapy)**
   i. Use of procalcitonin is not recommended to determine need for initial antibacterial therapy.[1]

G. **Other testing**
   i. During flu season, testing for influenza is advised. Testing with an influenza NAA test is preferred over a rapid test (i.e., antigen test)
   ii. Routine microbiologic testing (i.e., sputum culture) is not indicated for patients with mild CAP being managed as outpatients, as most of these patients respond well to empiric therapy.
   iii. Blood cultures **are** indicated for patients with severe CAP.
   iv. Broad respiratory panels should only be ordered if the results will affect management.

H. **HIV patients** experience a high proportion of bacteremia due to pneumococcal pneumonia (up to 20%), therefore blood cultures should be performed in all HIV patients with CAP.
   i. Rule-out *Pneumocystis jiroveci pneumonia* (formerly known as *Pneumocystis carinii pneumonia* (PCP)) in HIV patients with CD4 count less than or equal to 200 cells/mm^3, with absence of infiltrate on CXR, non-productive cough, and high clinical suspicion of pneumonia.

ii. Rule out pulmonary tuberculosis (TB) in HIV patients (any CD4 count) presenting with a cough> 2 weeks, fever, night sweats, weight loss, hemoptysis, shortness of breath, chest pain; consult infectious disease physician/discuss care with patient's primary HIV provider.

VI. Drug Therapy:

A. **ATS/IDSA empiric drug therapy for outpatient management of mild CAP for healthy adults *without* comorbidities and/or risk factors for antibiotic resistant pathogens,** (including HIV patients with CD4 count > 200 cells/mm3) **(choose 1)**:

Agent (class)	Dosing	Evidence
Amoxicillin (penicillin)	1 gram three times a day x 5 days ($15)	Moderate quality
Doxycycline (tetracycline)	100 mg PO twice daily x 5 days ($4-65)	Low quality

Note: The prevalence of macrolide resistance in the US is high enough that macrolides cannot be recommended as empiric monotherapy. For patients in whom amoxicillin and doxycycline are contraindicated, use one of the below regimens usually used for higher risk patients.

B. **ATS/IDSA empiric drug therapy for outpatient management of mild CAP for patients *with* comorbidities and/or risk factors for antibiotic resistant pathogens[§].** Including patients with co-morbidities such as chronic heart, lung, liver, or renal disease; diabetes mellitus; alcoholism; malignancy; asplenia; immunosuppressing conditions (including HIV with CD4 count ≤ 200 cells/mm^3) or use of immunosuppressant drugs[*]; use of antimicrobials within the previous 3 months[**]; or other risks for DRSP infection[§]. **(Choose 1):**

1. **Monotherapy with a respiratory fluoroquinolone (moderate quality evidence)**
2. **Combination therapy: a Beta-lactam *and a* macrolide (moderate quality evidence)**
3. **Combination therapy: a Beta-lactam *and* doxycycline (low quality evidence)**

Class	Agent	Dosing
Beta-lactams	Amoxicillin-clavulanate OR Cefpodoxime	500 mg/125 mg PO three times a day x 5 days ($57) OR 875 mg/125 mg PO twice a day x 5 days ($51) OR 2g (extended release) PO twice a day x 5 days ($153) 200 mg PO twice a day x 5 days ($85) OR 500 mg PO twice a day x 5 days ($80-111)
Macrolides[***]	Azithromycin OR Clarithromycin	500 mg PO daily x 1 day, then 250 mg PO daily x 4 days ($14) 500 mg PO twice a day x 5 days ($60) OR 1 g (extended release) PO daily x 5 days ($90)
Tetracycline	Doxycycline	100 mg twice a day x 5 days
Respiratory fluoroquinolones‡	Moxifloxacin OR Levofloxacin	400 mg PO daily x 5 days ($136) 750 mg PO daily x 5 days ($180)

Note: anaerobic infections are uncommon causes of CAP. For patients in whom a concern exists for aspiration who can be treated in an ambulatory setting, amoxicillin or amoxicillin-clavulanate is recommended.

C. **Alternate monotherapy option** (for patients unable to tolerate beta-lactams or fluoroquinolones):

Agent (class)	Dosing	Evidence
Lefamulin¥	600 mg every 12 hours, for a minimum of 5 days	Low quality

* Rule out PCP in immunosuppressed patients, consult infectious disease physician
** Use agent from a different class than previous antibiotic
§ Risk factors for DRSP infections: age > 65 years, beta-lactam therapy within the previous 3 months, alcoholism, multiple comorbidities, immunosuppressive illness or therapy, and exposure to a child in a day care center.
‡ Fluoroquinolone Warnings/ Precautions: Fluoroquinolone use may cause peripheral neuropathy or QT prolongation. Risk factors include advanced age, hypokalemia, hypomagnesemia, clinically significant bradycardia, and the use of other agents that prolong the QT interval. Tendon inflammation and/or rupture have also been reported. Risk may be increased with concurrent corticosteroids, organ transplant recipients, and in patients >60 years of age. In patients with myasthenia gravis, use may exacerbate muscle weakness. Patients should promptly report any symptoms and the drug should be discontinued.
***Macrolides can cause QT prolongation. Risk factors include advanced age, hypokalemia, hypomagnesemia, clinically significant bradycardia, and the use of other QT-prolonging agents.
¥ Lefamulin is not preferred for patients with structural lung disease because it does not have activity against Enterobacteriaceae. Avoid Lefamulin in patients with moderate or severe hepatic dysfunction, known long QT syndrome, or in those taking QT-prolonging agents, pregnant, or breastfeeding.

D. **Anti-influenza treatment** is recommended to be prescribed for adults with CAP who test positive for influenza in the outpatient setting, independent of duration of illness before diagnosis. Standard antibacterial treatment should be prescribed along with anti-influenza treatment for adults with clinical and radiographic evidence of CAP who test positive for influenza in the outpatient setting.

VII. Duration of treatment and follow up:

A. Most patients with CAP should be treated for a minimum of 5 days. Ensure patients are afebrile for at least 48 hours and clinically improving before discontinuing antibiotics.
B. A follow up call or visit (in-person or telehealth) is recommended 48 -72 hours after initiation of treatment to determine response to treatment and to adjust the plan if needed.
C. Cough, fatigue, and infiltrates on CXR may persist for several weeks and are not indications to prolong antibiotic therapy or re-treat as long as initial response to therapy has occurred.
D. Routine follow up CXR is **not** recommended for patients whose clinical symptoms improve. Follow-up CXRs are indicated in selected patients, i.e., age > 50 years, cigarette smokers. The recommended time interval for follow up CXR is 7-12 weeks after diagnosis of CAP since radiographic abnormalities clear more slowly than clinical manifestations.
E. Procalcitonin levels may help guide the timing of antibiotic discontinuation, leading to reduced antibiotic use, however MedStar does not have a protocol for its use at this time.

VIII. Other treatment considerations:

A. Vaccination is an effective and important component of pneumonia prevention. Offer Influenza vaccination (October-March) and COVID vaccination (year-round) to all un-vaccinated patients.

B. Offer Pneumococcal vaccinations to at-risk patients. See link below for the updated pneumococcal vaccination guidance.
https://www.cdc.gov/vaccines/vpd/pneumo/downloads/pneumo-vaccine-timing.pdf

C. Encourage patients who smoke tobacco or marijuana, to stop smoking.

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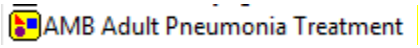
IX. MedConnect Resources: Powerplan (AMB Adult Pneumonia Treatment) exists in MedConnect to facilitate ordering appropriate antibiotics and symptomatic therapy.



Patient Education is available (Community-Acquired Pneumonia, Adult & Community-Acquired Pneumonia, Adult, Easy-to-Read)

X. Patient Education: Patient information can be obtained through the MedConnect or via Medline Health topics at http://www.nlm.nih.gov/medlineplus/pneumonia.html

Please review the below information with your patients.

- Bacterial pneumonia is treated with antibiotics.
- Most cases of pneumonia can be treated without hospitalization.
- The need for hospitalization depends on:
  - The extent of the illness
  - Whether you live alone and how well you can take care of yourself
  - How old you are
  - Whether you live in a nursing home and what health care is available there
  - Whether pneumonia is a complication of another disease
- Pneumonia isn't usually contagious and can normally be cured with five days of antibiotics. Recovery may take longer for adults over age 60, and people with other illnesses.
- Patients should follow these self-care treatment guidelines:
  - Rest in bed until fever disappears and pain and shortness of breath decrease
  - Drink about 2 to 3 quarts of water, tea, or other fluid. The extra fluid will help you cough up lung secretions more easily.
  - Cough up lung secretions as much as possible
  - Use a cool-mist humidifier to increase moisture in the air
  - Use cough medicine only if your cough is dry and your provider agrees
  - Use a heating pad on a low setting to reduce chest pain
  - Use over-the-counter drugs such as acetaminophen to relieve minor discomfort
- Seek medical attention if:
  - Symptoms do not improve in 72 hours
  - Coughing up blood
  - Become confused
  - Chest pain is not relieved by heat or prescribed medication
  - Begin to have nausea, vomiting, or diarrhea
  - Skin, fingernails, or toenails turn blue
  - Temperature >102°F (39°C)
  - Shortness of breath increases
  - Any new symptoms appear

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VII. References

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15. Chavez MA, S. N. (2014 Dec; 15). *Lung ultrasound for the diagnosis of pneumonia in adults: a systematic review and meta-analysis.* Respiratory research.

Outpatient Management of Patients with Community Acquired Pneumonia Guideline initiated 1996. Clinical Guidelines are reviewed every 2 years by a committee. Updates to guidelines occur more frequently as needed when new scientific evidence or national standards are published.

APPENDIX 1: Conditions and their associated CAP pathogens

Initial Approval Date and Reviews:	**Most Recent Revision and Approval Date:**	**Next Scheduled Review Date:**
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Condition	Commonly encountered pathogens
Alcohol use disorder	*S. pneumoniae*, oral anaerobes, *Klebsiella pneumoniae*, *Acinetobacter* species, *Mycobacterium tuberculosis*
COPD and/or smoking	*H. influenzae*, *Pseudomonas aeruginosa*, *Legionella* species, *S. pneumoniae*, *Moraxella catarrhalis*, *Chlamydia pneumoniae*
Aspiration*	Gram-negative enteric pathogens, oral anaerobes
Lung abscess	CA-MRSA, oral anaerobes, endemic fungal pneumonia, *M. tuberculosis*, atypical mycobacteria
Exposure to bat or bird droppings	*Histoplasma capsulatum*
Exposure to birds	*Chlamydia psittaci* (if poultry: avian influenza)
Exposure to rabbits	*Francisella tularensis*
Exposure to farm animals or parturient cats	*Coxiella burnetti* (Q fever)
HIV infection (early)	*S. pneumoniae*, *H. influenzae*, *M. tuberculosis*
HIV infection (late)	*S. pneumoniae*, *H. influenzae*, *M. tuberculosis*, *Pneumocystis jirovecii*, *Cryptococcus*, *Histoplasma*, *Aspergillus*, *atypical mycobacteria (especially Mycobacterium kansasii)*, *P. aeruginosa*
Hotel or cruise ship stay in previous 2 weeks	*Legionella* species
Travel to or residence in southwestern United States	*Coccidioides* species, *Hantavirus*
Travel to or residence in Southeast and East Asia	*Burkholderia pseudomallei*, avian influenza, SARS coronavirus
Travel to or residence in the Middle East	*MERS-CoV*
Influenza active in community	Influenza, *S. pneumoniae*, *Staphylococcus aureus*, *H. influenzae*
Cough >2 weeks with whoop or post-tussive vomiting	*Bordetella pertussis*
Structural lung disease (e.g., bronchiectasis)	*P. aeruginosa*, *Burkholderia cepacia*, *S. aureus*
Injection drug use	*S. aureus*, anaerobes, *M. tuberculosis*, *S. pneumoniae*
Endobronchial obstruction	Anaerobes, *S. pneumoniae*, *H. influenzae*, *S. aureus*
In context of bioterrorism	*Bacillus anthracis* (anthrax), *Yersinia pestis* (plague), *Francisella tularensis* (tularemia)

**Anaerobic coverage is clearly indicated only in the classic aspiration pleuropulmonary syndrome in patients with a history of loss of consciousness as a result of alcohol/drug overdose or after seizures in patients with concomitant gingival disease or esophageal motility disorders*

APPENDIX 2: Pneumonia Severity Index (PSI)

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This is a prediction model that assigns points based on age, coexisting disease and initial presentation. The PSI risk class, which correlates directly with mortality rate, ranges from I to V. Risk class I has the lowest mortality rate while risk class V has the highest. The PSI risk class determination is a two-step process.

Step 1: Determine if the patient is in risk category I based on the history and physical examination. If the patient is <50 years of age, has no history of co-morbidity and the physical exam reveals normal mental status, pulse <125, RR<30, SBP>90 and temperature >35°C but ≤ 40°C, then the patient is risk category I and no further workup is required.

Step 2: If the patient is not a risk category I, blood tests (chemistry and ABG) and a CXR are utilized to determine the patient's risk category (II-V). Utilizing the mortality rates, risk class I and II can generally be treated as outpatients, risk class III can be treated with a short hospitalization, and risk class IV and V require hospitalization.

Note that the PSI scoring system has not been formally validated for HIV-infected patients and does not include specific variables related to HIV infection (such as CD4 count). Studies that have utilized the PSI score in HIV patients have shown its utility, particularly in patients with high CD4 counts. However, up to 20% of HIV infected patients have bacteremia despite low PSI scores.

PSI Scoring System:

Demographic Factor	**Score**
Age: Men	Age in years
Women	Age – 10
Nursing Home Resident	Age + 10
Coexisting Illnesses	
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	+20
Systolic Blood Pressure <90 mmHg	+20
Temperature < 35 or > 40° C	+15
Pulse > 125/min	+10
Laboratory and Radiographic Findings	
Arterial pH < 7.35	+30
BUN > 30 mg/dl	+20
Sodium <130 mEq/L	+20
Glucose >250 mg/dl	+10
Hematocrit < 30%	+10

Partial pressure of arterial oxygen < 60mmHg or O2 sat<90%	+10
Pleural effusion	+10
TOTAL SCORE	

Treatment setting decision based on PSI score/ risk category:

Patient Score	Risk Category	Treatment Setting
Age < 50, no coexisting illness, negative physical exam findings.	I	Outpatient
51- 70	II	Outpatient
71-90	III	Overnight admission
91-130	IV	Hospital Unit
>130	V	ICU

Fine MJ et al. *Prediction Rule to Identify Low-Risk Patients with Community-Acquired Pneumonia.* N Engl. J. Med., 1997; 336 (4): (243-247)

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APPENDIX 3: Clinical indications for additional diagnostic testing

Indication	Blood Culture	Sputum Culture	Legionella Urine Antigen Test	Pneumococcal Urine Antigen Test	Other
Failure of outpatient antibiotic therapy		✓	✓	✓	
Cavitary infiltrates	✓	✓			Fungal & Tuberculosis cultures; consider evaluation for malignancy if appropriate
Leukopenia	✓			✓	
Active alcohol abuse	✓	✓	✓	✓	
Severe chronic liver disease	✓			✓	
Asplenia (functional or anatomic)	✓			✓	
Recent travel (within past 2 weeks)			✓		Common respiratory pathogens in area of travel
Pleural effusion	✓	✓	✓	✓	Thoracentesis and pleural fluid cultures
Severe structural lung disease		✓			Common respiratory pathogens in area of travel