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.
- When COVID-19 is prevalent, 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.
- **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.
- **Outpatient management of mild CAP in healthy adults*:** empiric **monotherapy** with amoxicillin *OR* doxycycline.
  *Healthy adults: those *without* comorbidities and/or risk factors for antibiotic resistant pathogens

CHOOSE ONE OF THE FOLLOWING:

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

- **Risk factors for infection with drug resistant Strep. pneumoniae (DRSP), include** age > 65 years, beta-lactam therapy within the past 3 months, exposure to a child in a day care center, comorbidities such as asthma, COPD, diabetes mellitus, immunosuppression, and alcohol use.
- **Outpatient management of mild CAP in patients *with* comorbidities and/or risk factors for DRSP *without* allergy to penicillins and cephalosporins (pen & ceph):** use **combination therapy** of a beta-lactam *and* azithromycin (moderate quality evidence) *OR* a beta-lactam *and* doxycycline (low quality evidence).

CHOOSE ONE OF THE FOLLOWING:

Class	Agent	Dosing
Beta-lactam	Amoxicillin-clavulanate	875 mg/125mg (immediate release) PO twice a day x 5 days ($51) OR 2g (extended release) PO twice a day x 5 days ($153)
Beta-lactam	Cefpodoxime	200 mg PO twice a day x 5 days ($85)
Beta-lactam	Cefuroxime	500 mg PO twice a day x 5 days ($80-111)

COMBINE WITH ONE OF THE FOLLOWING:

Agent	Dosing
Azithromycin	500 mg PO daily x 1 day, then 250 mg PO daily x 4 days ($14)
Doxycycline	100 mg PO twice a day x 5 days

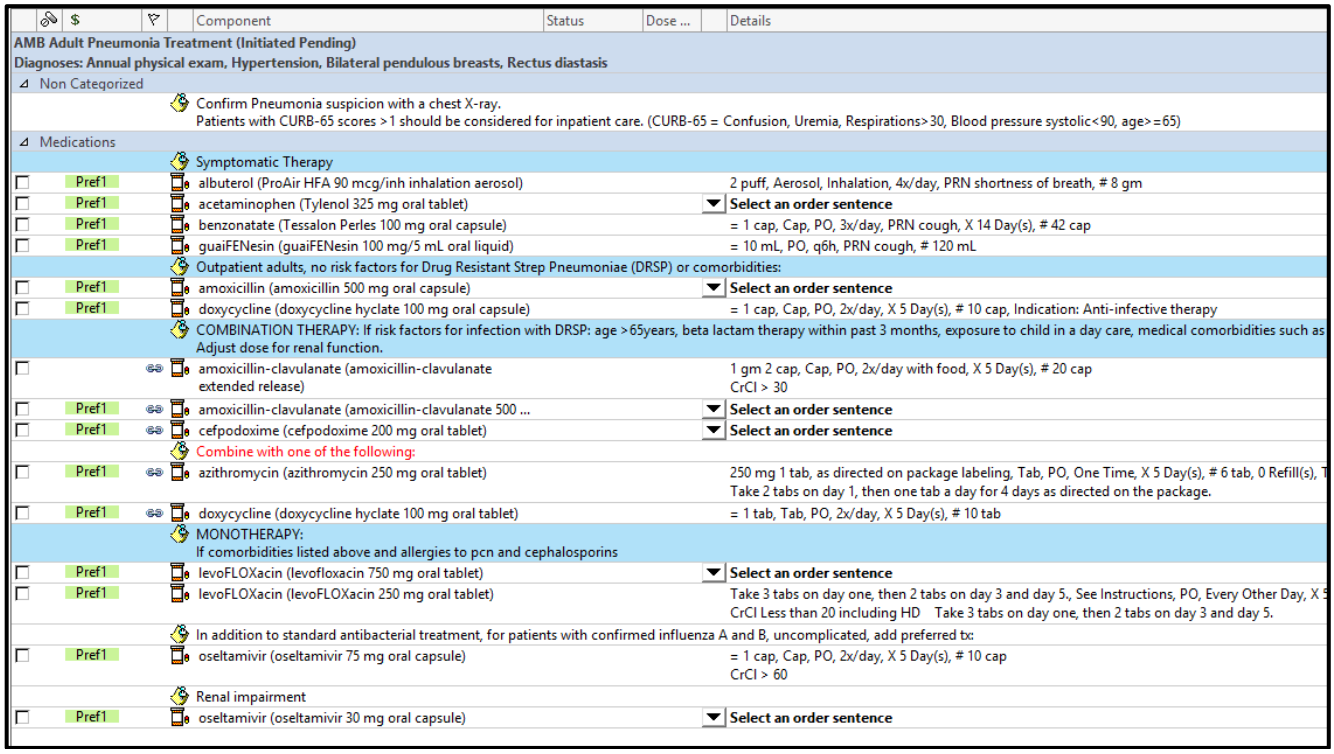
- **Outpatient management of mild CAP in patients with allergies to pen & ceph, and *with* comorbidities and/or risk factors for DRSP:** use **monotherapy with a respiratory fluoroquinolone** (moderate quality evidence). For patients with reported pen or ceph allergies please see Section XI for a beta-lactam hypersensitivity clinical decision tool algorithm, which utilizes the PEN-FAST scale.

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, 09/2023, interim update PCN allergy Clinical Decision Tool 10/23, 9/2024	**September 2024 Full review** 	September 2026

CHOOSE ONE OF THE FOLLOWING:

Agent	Dosing
Moxifloxacin	400 mg PO daily x 5 days ($136)
Levofloxacin	750 mg PO daily x 5 days ($180)

- **Patient Education** is available (Community-Acquired Pneumonia, Adult & Community-Acquired Pneumonia, Adult, Easy-to-Read)
- This **MedConnect Order Set, "AMB Adult Pneumonia Treatment,"** includes the above recommendations and can be used to assist in ordering appropriate therapies, including supportive therapies**:**



Component	Status	Dose ...	Details
AMB Adult Pneumonia Treatment (Initiated Pending)			
Diagnoses: Annual physical exam, Hypertension, Bilateral pendulous breasts, Rectus diastasis			
Non Categorized			
Confirm Pneumonia suspicion with a chest X-ray. Patients with CURB-65 scores >1 should be considered for inpatient care. (CURB-65 = Confusion, Uremia, Respirations>30, Blood pressure systolic<90, age>=65)			
Medications			
Symptomatic Therapy			
Pref1 albuterol (ProAir HFA 90 mcg/inh inhalation aerosol)			2 puff, Aerosol, Inhalation, 4x/day, PRN shortness of breath, # 8 gm
Pref1 acetaminophen (Tylenol 325 mg oral tablet)			**Select an order sentence**
Pref1 benzonatate (Tessalon Perles 100 mg oral capsule)			= 1 cap, Cap, PO, 3x/day, PRN cough, X 14 Day(s), # 42 cap
Pref1 guaiFENesin (guaiFENesin 100 mg/5 mL oral liquid)			= 10 mL, PO, q6h, PRN cough, # 120 mL
Outpatient adults, no risk factors for Drug Resistant Strep Pneumoniae (DRSP) or comorbidities:			
Pref1 amoxicillin (amoxicillin 500 mg oral capsule)			**Select an order sentence**
Pref1 doxycycline (doxycycline hyclate 100 mg oral capsule)			= 1 cap, Cap, PO, 2x/day, X 5 Day(s), # 10 cap, Indication: Anti-infective therapy
COMBINATION THERAPY: If risk factors for infection with DRSP: age >65years, beta lactam therapy within past 3 months, exposure to child in a day care, medical comorbidities such as Adjust dose for renal function.			
amoxicillin-clavulanate (amoxicillin-clavulanate extended release)			1 gm 2 cap, Cap, PO, 2x/day with food, X 5 Day(s), # 20 cap CrCl > 30
Pref1 amoxicillin-clavulanate (amoxicillin-clavulanate 500 ...			**Select an order sentence**
Pref1 cefpodoxime (cefpodoxime 200 mg oral tablet)			**Select an order sentence**
Combine with one of the following:			
Pref1 azithromycin (azithromycin 250 mg oral tablet)			250 mg 1 tab, as directed on package labeling, Tab, PO, One Time, X 5 Day(s), # 6 tab, 0 Refill(s), T Take 2 tabs on day 1, then one tab a day for 4 days as directed on the package.
Pref1 doxycycline (doxycycline hyclate 100 mg oral tablet)			= 1 tab, Tab, PO, 2x/day, X 5 Day(s), # 10 tab
MONOTHERAPY: If comorbidities listed above and allergies to pcn and cephalosporins			
Pref1 levoFLOXacin (levofloxacin 750 mg oral tablet)			**Select an order sentence**
Pref1 levoFLOXacin (levoFLOXacin 250 mg oral tablet)			Take 3 tabs on day one, then 2 tabs on day 3 and day 5., See Instructions, PO, Every Other Day, X 5 CrCl Less than 20 including HD Take 3 tabs on day one, then 2 tabs on day 3 and day 5.
In addition to standard antibacterial treatment, for patients with confirmed influenza A and B, uncomplicated, add preferred tx:			
Pref1 oseltamivir (oseltamivir 75 mg oral capsule)			= 1 cap, Cap, PO, 2x/day, X 5 Day(s), # 10 cap CrCl > 60
Renal impairment			
Pref1 oseltamivir (oseltamivir 30 mg oral capsule)			**Select an order sentence**

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, 09/2023, interim update PCN allergy Clinical Decision Tool 10/23, 9/2024	**September 2024 Full review**	September 2026

Introduction:
Community Acquired Pneumonia (CAP) remains one of the leading causes of death in the United States. It is the most common infectious cause 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. As result, it may be appropriate to discuss end-of-life issues and complete MOLST forms for high-risk patients. 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

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]

Presenting signs and symptoms include:

- 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)

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

III. 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

IV. 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, Group A Strep, Klebsiella, and Staph Aureus);* and atypical bacteria *(Chlamydia pneumoniae, Mycoplasma pneumoniae*, *Legionella* species).

The most common bacterial etiology is Strep pneumoniae, although its incidence is on the decline. This decline is attributed to the widespread use of the pneumonia vaccine.

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,

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, 09/2023, interim update PCN allergy Clinical Decision Tool 10/23, 9/2024	**September 2024 Full review**	September 2026

immunosuppressive illness or therapy, and exposure to a child in a day care center. Recent treatment with antimicrobials is 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 these organisms and further work-up may be necessary.

V. 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 is no immediate access to labs:

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

CRB-65
*C*onfusion
*R*espiratory rate ≥ 30 breaths/minute
*Bl*ood 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.

VI. 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, hepatization of the lung, 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. Studies have shown sensitivity of approximately 80-90 per cent and specificity of approximately 70-90 per cent. However, interobserver variability can affect diagnostic accuracy, and it is recommended to use lung ultrasound when a chest radiograph is unlikely to be a good quality study.

iv. 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. **When COVID-19 is prevalent in the community**, 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 and to limit antibiotic overuse.

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
- 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. 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.

ii. Blood cultures **are** indicated for patients with severe CAP.

iii. Broad respiratory panels should only be ordered if the results will affect management.

iv. Despite sophisticated testing methods, a causal pathogen can be identified in only half of cases of CAP.

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.

VII. Drug Therapy:

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

CHOOSE ONE OF THE FOLLOWING:

Agent	Dosing	Evidence
Amoxicillin	1 gram three times a day x 5 days ($15)	Moderate quality
Doxycycline	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 as outlined for higher risk patients.

B. **Risk factors for infection with drug resistant Strep. pneumoniae (DRSP), include** age > 65 years, beta-lactam therapy within the past 3 months, exposure to a child in a day care center, comorbidities such as asthma, COPD, diabetes mellitus, alcohol use, and immunosuppressive illness or therapy. Recent treatment with antimicrobials is likely the most significant risk factor.**

C. **For patients *with* comorbidities and/or risk factors for DRSP *without* allergy to penicillins and cephalosporins (pen & ceph):** it is recommended to use **combination therapy** of a beta-lactam *and* azithromycin*** (moderate quality evidence) *OR* a beta-lactam *and* doxycycline (low quality evidence).

CHOOSE ONE OF THE FOLLOWING:

Class	Agent	Dosing
Beta-lactam	Amoxicillin-clavulanate	875 mg/125mg (immediate release) PO twice a day x 5 days ($51) OR 2g (extended release) PO twice a day x 5 days ($153)
Beta-lactam	Cefpodoxime	200 mg PO twice a day x 5 days ($85)
Beta-lactam	Cefuroxime	500 mg PO twice a day x 5 days ($80-111)

COMBINE WITH ONE OF THE FOLLOWING:

Agent	Dosing
Azithromycin***	500 mg PO daily x 1 day, then 250 mg PO daily x 4 days ($14)
Doxycycline	100mg PO twice a day x 5 days

D. **For patients with allergies to pen & ceph, and *with* comorbidities and/or risk factors for DRSP:** we recommend **monotherapy with a respiratory fluoroquinolone**‡ (moderate quality evidence). For patients with reported pen or ceph allergies please see Section XI for a beta-lactam hypersensitivity clinical decision tool algorithm, which utilizes the PEN-FAST scale.

CHOOSE ONE OF THE FOLLOWING:

Agent	Dosing
Moxifloxacin‡	400 mg PO daily x 5 days ($136)
Levofloxacin‡	750 mg PO daily x 5 days ($180)

* Rule out PCP in immunosuppressed patients, consult infectious disease physician
** Use agent from a different class than previous antibiotic
***Macrolides (azithromycin) can cause QT prolongation. Risk factors include advanced age, hypokalemia, hypomagnesemia, clinically significant bradycardia, and the use of other QT-prolonging agents.
‡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.

VIII. 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. Extending treatment beyond 7 days does not add any benefit.

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.

IX. CAP Treatment in Pregnancy:

A. Amoxicillin, amoxicillin-clavulanate, cefpodoxime, cefuroxime, and azithromycin are considered to be safe for use in pregnancy. Doxycycline, moxifloxacin and levofloxacin are not considered to be safe.

X. Other treatment considerations:

A. Offer Influenza vaccination (October-March) and COVID vaccination (year-round) to all un-vaccinated patients. Offer Pneumococcal vaccinations to at-risk patients.

B. Encourage patients who smoke to stop smoking.

XI. 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 is not 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.

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, 09/2023, interim update PCN allergy Clinical Decision Tool 10/23, 9/2024	**September 2024 Full review**	September 2026

- 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.

XII. MedConnect Resources:

- **Order Set "AMB Adult Pneumonia Treatment,"** includes the above recommendations and can be used to assist in ordering appropriate therapies, including supportive therapies**.**
- **Patient Education** is available (Community-Acquired Pneumonia, Adult & Community-Acquired Pneumonia, Adult, Easy-to-Read)

XIII. Assessment of Penicillin Allergy / Beta-Lactam Hypersensitivity, an algorithm for assessing and managing reported beta-lactam hypersensitivities **PEN-FAST**[8]

A. Background: Approximately 90% of patients who report a penicillin allergy are not actually allergic to penicillin.[1] Sometimes, an intolerance or benign reaction is reported as an allergy.[2,3] For others, allergic reactions can fade with time. Up to 80% of patients with a true, IgE-mediated allergy, become tolerant after 10 years.[4] Unfortunately, documentation of reaction type is often incomplete.[2,3] Thus, an accurate assessment of the patient's reported penicillin allergy can be difficult to make.

B. **Cross Reactivity:** An allergy to one beta-lactam does not necessarily preclude the use of other beta-lactams. Cross-reactivity between penicillin and cephalosporins occurs only in about 2% of patients, (significantly less than the 8-10% reported with the initial introduction of cephalosporins.)[5,6] Much of the cross-reactivity between penicillins and cephalosporins was documented at a point when cephalosporins were frequently contaminated with penicillin.[6]

C. **The PEN-FAST clinical decision support tool:** allows clinicians to quickly evaluate penicillin allergy risk and severity, thereby encouraging the safe use of beta-lactam antibiotics and identifying patients considered to be at low risk for an oral beta-lactam challenge**.** [6,7,8]

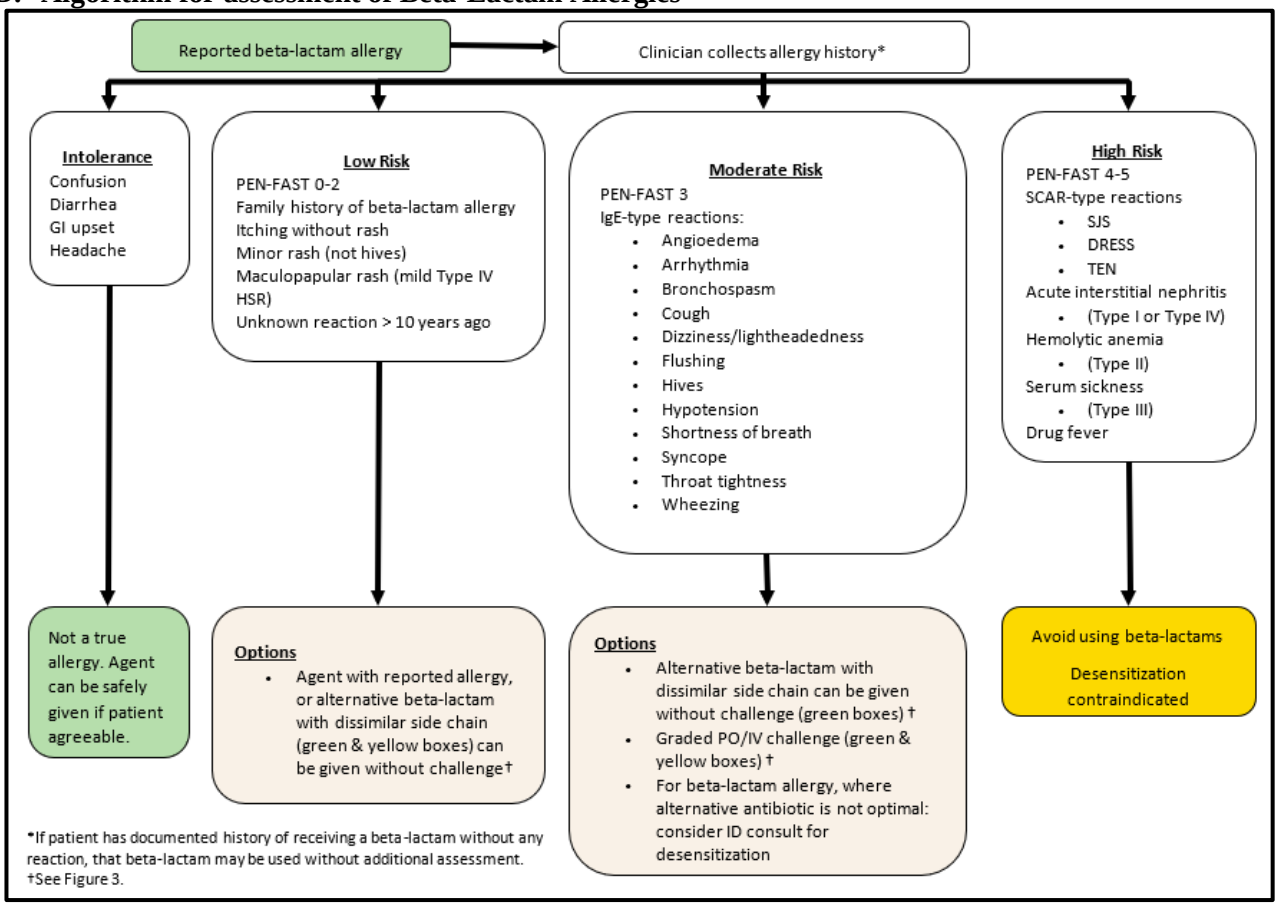
PEN-FAST (Link to PEN-FAST calculator: (PEN-FAST Penicillin Allergy Risk Tool)

PEN	Penicillin allergy reported by patient	Yes	Proceed with assessment
F	Five years or less since reaction	Yes, or unknown	2 points
A	Anaphylaxis or angioedema	Yes	2 points
S	Severe cutaneous adverse reaction*	Yes	
T	Treatment required for reaction	Yes, or unknown	1 point

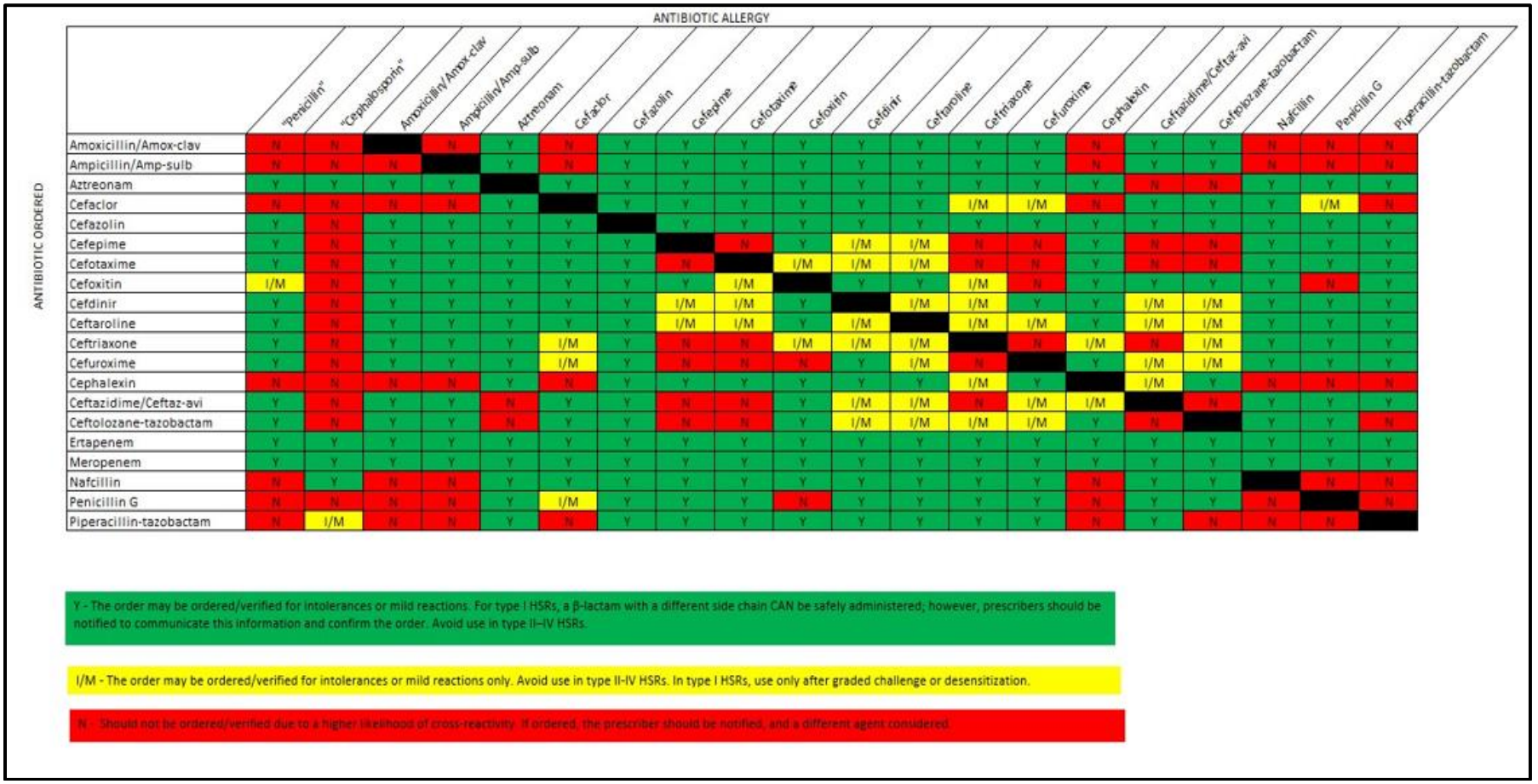
* Stevens-Johnson syndrome (SJS), toxic epidermal necrolysis (TEN), drug reaction with eosinophilia and systemic symptoms (DRESS), acute generalized exanthematous pustulosis (AGEP). Patients with acute interstitial nephritis (AIN), drug induced liver injury, serum sickness, and isolated drug fever were excluded.

0: Very low risk of positive penicillin allergy test (<1%)
1-2: Low risk of positive penicillin allergy test (5%)
3: Moderate risk of positive penicillin allergy test
(20%) 4-5: High risk of positive penicillin allergy
test (50%)

D. Algorithm for assessment of Beta-Lactam Allergies



E. Beta-Lactam Cross Reactivity chart (adapted from Collins 2021)



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, 09/2023	September 2022	September 2024

F. References for Assessment of Pen Allergy / Beta-Lactam Hypersensitivity

1. Joint Task Force on Practice Parameters; American Academy of Allergy, Asthma, and Immunology; American College of Allergy, Asthma, and Immunology; Joint Council of Allergy, Asthma, and Immunology. Drug allergy: an updated practice parameter. *Ann Allergy Asthma Immunol*. 2010;105(4):259-273. doi: 10.1016/j.anai.2010.08.002
2. Moskow JM, Cook N, Champion-Lippmann C, Amofah SA, Garcia AS. Identifying opportunities in EHR to improve the quality of antibiotic allergy data. *J Am Med Inform Assoc*. 2016;23(e1): e108-e112. doi:10.1093/jamia/ocv139
3. Albin S, Agarwal S. Prevalence, and characteristics of reported penicillin allergy in an urban outpatient adult population. *Allergy Asthma Proc*. 2014;35(6):489-494. doi:10.2500/aap.2014.35.3791
4. Trubiano JA, Adkinson NF, Phillips EJ. Penicillin Allergy Is Not Necessarily Forever. *JAMA*. 2017;318(1):82-83. doi:10.1001/jama.2017.6510
5. Blumenthal KG, Shenoy ES, Varughese CA, Hurwitz S, Hooper DC, Banerji A. Impact of a clinical guideline for prescribing antibiotics to inpatients reporting penicillin or cephalosporin allergy. *Ann Allergy Asthma Immunol*. 2015;115(4):294-300.e2. doi: 10.1016/j.anai.2015.05.011
6. Zagursky RJ, Pichichero ME. Cross-reactivity in β-Lactam Allergy [published correction appears in J Allergy Clin Immunol Pract. 2022 Feb;10(2):651]. *J Allergy Clin Immunol Pract*. 2018;6(1):72-81. e1. doi: 10.1016/j.jaip.2017.08.027
7. Collins CD, Bookal RS, Malani AN, Leo HL, Shankar T, Scheidel C, West N. Antibiotic use in patients with β-lactam allergies and pneumonia: impact of an antibiotic side chain-based cross-reactivity chart combined with enhanced allergy assessment. *Open Forum Infect Dis.* 2021;9(1). doi:10.1093/ofid/ofab544
8. Trubiano JA, Vogrin S, Chua KYL, Bourke J, Yun J, Douglas A, Stone CA, Yu R, Groenendijk L, Holmes NE, Phillips EJ. Development and Validation of a Penicillin Allergy Clinical Decision Rule. *JAMA Intern Med*. 2020;180(5):745752.

XIV. References

1. Jenkins, Timothy C., et al. "Risk Factors for Drug-resistant Streptococcus pneumoniae and Antibiotic Prescribing Practices in Outpatient Community-acquired Pneumonia." *Academic Emergency Medicine* 19.6 (2012): 703-706.
2. Metlay, Joshua et al. Diagnosis and Treatment of Adults with Community-Acquired Pneumonia. An Official Clinical Practice Guideline of the American Thoracic Society and Infectious Diseases Society of America. Am J Respir Crit Care Med 2019; 200: e45-e67.
3. Mandell LA, Winderink RG, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults. Clin Infect Dis. 2007; 44(suppl 2): S27-72. 2019 Press Release. https://www.thoracic.org/about/newsroom/press-releases/journal/2019/ats-idsa-publishes-clinical-guideline-on-community-acquired-pneumonia.php
4. Madeddu G, Fois AG, Pirina P, Mura MS. Pneumococcal pneumonia: clinical features, diagnosis, and management in HIV-infected and HIV-noninfected patients. Curr Opin Pulm Med. 2009; 15:236-42.
5. Bartlett JB. Pneumonia, Community-Acquired. Hopkins-Abx Guide. Updated 1/15.
6. Nuermberger, E. Pneumonia, bacterial. Johns Hopkins HIV Guide. Updated 2015.
7. Bartlett JB. Pneumonia, Acute [HIV]. Hopkins-Abx Guide. Updated 1/15
8. File TM. Treatment of community-acquired pneumonia in patients in the outpatient setting, *UpToDate* (Wolters Kluwer). May 2019.
9. Bartlett, John. Diagnostic approach to community-acquired pneumonia in adults, *UpToDate* (Wolters Kluwer) January 2019.
10. The Sanford Guide to Antimicrobial Therapy 2014; 44th Edition
11. Schuetz P, et al. Procalcitonin to initiate or discontinue antibiotics in acute respiratory tract infections. Cochrane Database Syst Rev, 2012.
12. http://www.choosingwisely.org/clinician-lists/#keyword=respiratory_pathogens&topic-

area=Infectious_Disease
13. Marchello, Christian et al. Signs and Symptoms That Rule out Community-Acquired Pneumonia in Outpatient Adults: A Systematic Review and Meta-Analysis. J Am Board Fam Med 2019; 32: 234-247).
14. https://www.thoracic.org/about/newsroom/press-releases/journal/2021/potential-overuse-of-antibiotics-found-in-patients-with-severe-covid-19-pneumonia.php Potential Overuse of Antibiotics Found in Patients with Severe COVID-19 Pneumonia
15. https://www.thoracic.org/about/newsroom/press-releases/journal/2021/new-clinical-practice-guideline-on-community-acquired-pneumonia.php New Clinical Practice Guideline on Community Acquired Pneumonia; Addresses Testing for Non-Influenza Viral Pathogens
16. Chavez MA, S. N. (2014 Dec; 15). *Lung ultrasound for the diagnosis of pneumonia in adults: a systematic review and meta-analysis.* Respiratory research.
17. Klompas, MichaelClinical Evaluationand Diagnostic Testing for Community-Acquied Pneumonia in Adults *Up to Date* (Wolters Kluwer). Updated April 2024.

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.

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, 09/2023	**September 2022**	September 2024

APPENDIX 1: Conditions and their associated CAP pathogens

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)

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
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.)

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