Treatment of Community-Acquired Bacterial Pneumonia (CABP) – Adult – Inpatient/Emergency Department Clinical Practice Guideline

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Introduction
Community-acquired bacterial pneumonia (CABP) is a leading cause of death from infectious disease across the globe and in combination with influenza, represents one of the top ten leading causes of death in the United States. CABP is associated with significant morbidity, mortality, and increased healthcare costs.\(^1\)\(^2\)

Among patients with radiographic evidence of community-acquired pneumonia (CAP) and available specimens for bacterial and viral testing, pathogens are only detected 38% of the time.\(^3\) Potential causes for this lack of pathogen identification include an inability to obtain lower respiratory tract specimens, initiation of antibiotics before specimen collection and noninfectious causes such as aspiration pneumonitis. In CAP patients with detectable pathology, the identified pathogens are viral, bacterial or both in 23%, 11% and 3% of patients respectively.\(^3\) Human rhinovirus, influenza virus (A and B) and Streptococcus pneumoniae are the most frequently identified pathogens.\(^3\)

The concept HCAP, as defined in the 2005 publication of the ATS/IDSA guideline on the management of hospital-acquired pneumonia (HAP), ventilator-associated pneumonia (VAP), and healthcare-associated pneumonia (HCAP), was developed to assist clinicians with the identification of patients residing in the community who are at risk for pneumonia caused by drug-resistant pathogens (e.g. MRSA and Pseudomonas aeruginosa).\(^4\) However, since the publication of these guidelines, there is a growing body of evidence that shows that most patients defined as having HCAP, by its original definition, are less likely to have pneumonia caused by drug-resistant pathogens. The HCAP criteria has demonstrated a lack of adequate sensitivity and specificity compared to other published predictive scoring tools. Of concern, patients diagnosed with HCAP, who really have CABP without risk factors for drug resistance are more likely to receive inappropriate broad-spectrum antibiotics, which places these patients at an unnecessary risk for adverse drug reactions, superinfections (e.g. C. difficile), and drug resistance.\(^5\)\(^6\)\(^7\)

Although exposure to the healthcare system is potentially a risk factor for pneumonia caused by drug-resistant pathogens, it is crucial to evaluate patient characteristics to determine individualized patient risk factors based on local and institutional data. One such clinical prediction scoring tool is the Drug Resistance in Pneumonia (DRIP) Score, which was more predictive of the risk of pneumonia secondary to drug-resistant pathogens when compared to the traditional HCAP criteria. Utilization of the DRIP score may aid in the identification of patients previously considered to have HCAP, who really have CABP. The use of the DRIP score to identify risk of drug-resistant pathogens in CABP may prevent antibiotic overutilization and subsequently improve patient outcomes.\(^8\)

While the pathophysiology of virtually all bacterial pneumonia is aspiration of oropharyngeal contents, the terms aspiration pneumonia and aspiration pneumonitis are frequently misunderstood by healthcare providers and are explained further in this guideline.\(^9\)

Scope

Intended Users: Physicians, Advanced Practice Providers, Nurses, Pharmacists, and Respiratory Therapists

Objectives:
- To guide prescribers through the treatment of community-acquired bacterial pneumonia after diagnosis
- To increase appropriate use of antimicrobials and decrease patient risk for adverse drug reactions, superinfections, and drug resistance

Target Population: Adult inpatients or patients in the emergency department with planned admission (excluding patients with structural lung disease including cystic fibrosis, emphysema, bronchiectasis) with suspected or confirmed community-acquired bacterial pneumonia

Clinical Questions Considered:
- What microbiologic methods can be employed to guide treatment of patients with CABP?
• How can individual patient risk for drug-resistant pathogens in CABP be assessed?
• What is appropriate empiric CABP treatment for patients with low risk of drug-resistant CABP pathogens?
• What is appropriate empiric CABP treatment for patients with higher risk of drug-resistant CABP pathogens?
• What is appropriate empiric CABP treatment for patients with severe CABP or septic shock?
• What antimicrobials should patients with severe (IgE-mediated) beta-lactam allergies receive for CABP treatment?
• What is the optimal duration of treatment for patients with CABP?
• What are the differences in treatment approach between aspiration pneumonitis and aspiration pneumonia?

Definitions

1. **Community-acquired bacterial pneumonia (CABP or CAP):** Pneumonia occurring prior to admission or up to 5 days after admission, that is typically caused by standard respiratory bacteria.4,11-13
2. **Hospital-acquired pneumonia (HAP):** Pneumonia occurring 5 days or more after hospital admission not associated with mechanical ventilation and not incubating at the time of hospital admission.14
3. **Ventilator-associated pneumonia (VAP):** Pneumonia occurring over 48 hours after endotracheal intubation.14
4. **Aspiration pneumonia:** Pneumonia occurring after the inhalation of colonized oropharyngeal contents with increased risk for an anaerobic burden of microorganisms.15
5. **Aspiration pneumonitis:** Chemical lung injury precipitated by inhalation of sterile gastric contents. Although often confused with CABP, only one quarter of patients with macroaspiration events leading to pneumonitis develop a superimposed bacterial pneumonia (typically 2 to 7 days after the event).16
6. **Severe community-acquired pneumonia:** Pneumonia with a CURB-65 score ≥3, PSI/PORT score >130 or pneumonia requiring treatment in an intensive care unit (ICU).11,17,18
7. **CURB-65 score:** A clinical prediction tool (below) that has been validated to predict mortality in community-acquired pneumonia. Patients with a score ≥3 are at greater risk of severe pneumonia and have a higher risk of mortality.17

<table>
<thead>
<tr>
<th>Clinical Criteria</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confusion</td>
<td>1</td>
</tr>
<tr>
<td>Urea &gt;70 mmol/L or blood urea nitrogen &gt;19 mg/dL</td>
<td>1</td>
</tr>
<tr>
<td>Respiratory rate ≥30 breaths per minute</td>
<td>1</td>
</tr>
<tr>
<td>Systolic blood pressure &lt;90 mmHg or diastolic blood pressure ≤60 mmHg</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥65 years</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total points (CURB-65 score)</strong></td>
<td></td>
</tr>
</tbody>
</table>
6. **Pneumonia severity index (PSI/PORT score):** A clinical prediction tool (below) that has been validated to predict mortality in community-acquired pneumonia. Patients with a score of >130 are deemed "Class V", are at a greater risk of severe pneumonia and have a higher risk of mortality.\(^\text{14}\)

### Step 1: Stratify to Risk Class I vs. Risk Classes II-V

**Presence of:**
- Over 50 years of age  
- Altered mental status  
- Pulse ≥125 beats/minute  
- Respiratory rate >30 breaths/minute  
- Systolic blood pressure <90 mmHg  
- Temperature <35°C or ≥40°C

**History of:**
- Neoplastic disease  
- Congestive heart failure  
- Cerebrovascular disease  
- Renal disease  
- Liver disease

- If any “Yes”, then proceed to Step 2  
- If all “No”, then assign to Risk Class 1

### Step 2: Stratify to Risk Class II, III, IV, or V

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Points Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Male + Age (years)</td>
<td>+ Age (years)</td>
</tr>
<tr>
<td>If Female + Age (years) – 10</td>
<td></td>
</tr>
<tr>
<td>Nursing home resident +10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>Points Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoplastic disease +30</td>
<td></td>
</tr>
<tr>
<td>Liver disease +20</td>
<td></td>
</tr>
<tr>
<td>Congestive heart failure +10</td>
<td></td>
</tr>
<tr>
<td>Cerebrovascular disease +10</td>
<td></td>
</tr>
<tr>
<td>Renal disease +10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Exam Findings</th>
<th>Points Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altered mental status +20</td>
<td></td>
</tr>
<tr>
<td>Pulse ≥125 beats/minute +20</td>
<td></td>
</tr>
<tr>
<td>Respiratory rate &gt;30 breaths/minute +20</td>
<td></td>
</tr>
<tr>
<td>Systolic blood pressure &lt;90 mmHg +15</td>
<td></td>
</tr>
<tr>
<td>Temperature &lt;35°C or ≥40°C +10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lab and Radiographic Findings</th>
<th>Points Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial pH &lt;7.35 +30</td>
<td></td>
</tr>
<tr>
<td>Blood urea nitrogen ≥30 mg/dL +20</td>
<td></td>
</tr>
<tr>
<td>Sodium &lt;130 mmol/L +20</td>
<td></td>
</tr>
<tr>
<td>Glucose ≥250 mg/dL +10</td>
<td></td>
</tr>
<tr>
<td>Hematocrit &lt;30% +10</td>
<td></td>
</tr>
<tr>
<td>Partial pressure of arterial oxygen &lt;60 mmHg +10</td>
<td></td>
</tr>
<tr>
<td>Pleural effusion +10</td>
<td></td>
</tr>
</tbody>
</table>
Recommendations

1. Microbiologic Methods to Guide Treatment of CABP
   1.1. Common pathogens in CAP are respiratory viruses.3,19
   1.1.1. Procalcitonin (PCT) is a tool to differentiate bacterial from viral infections or non-infectious inflammatory states and may be utilized when considering initiation of antimicrobial therapy in CAP,20,21 (UW Health GRADE Moderate quality evidence, conditional recommendation)
   1.1.1.1. In clinically stable patients with suspected lower respiratory tract infection without COPD, antibiotic initiation is discouraged if PCT level is below 0.25 ng/mL20,21 (UW Health GRADE Moderate evidence, strong recommendation)
   1.1.1.2. Procalcitonin use to guide initiation of antibiotic therapy is NOT recommended in the following comontant clinical scenarios:20,21 (UW Health GRADE Moderate quality evidence, strong recommendation)
      - Pulmonary aspiration syndromes
      - Myocardial infarction patients with pulmonary infiltrates and/or decompensated heart failure
      - Pregnancy
      - Neutropenia
      - Transplant recipients with moderate to intense immunosuppression
      - Chronic lung infections
   1.1.1.3. Refer to the UW Health Procalcitonin Monitoring Related to the Diagnosis and Treatment of Respiratory Tract Infections and Emerging Sepsis – Adult – Inpatient Clinical Practice Guideline for further information.
   1.1.2. During seasons of peak viral respiratory illness, as indicated by ongoing surveillance data, influenza and RSV nasopharyngeal swab collection for respiratory PCR testing (HCFLURSV) should be considered as part of the CABP workup.3 (UW Health GRADE Moderate quality evidence, strong recommendation)
   1.1.2.1. In immunocompromised patients, the expanded respiratory viral panel with Bordetella pertussis (RVPBPCR) can be considered. (UW Health GRADE Very Low quality evidence, conditional recommendation)
   1.1.2.2. Refer to the UW Health Treatment and Prevention of Influenza with Antiviral Medications – Adult/Pediatric – Inpatient for further information on influenza diagnosis and management.
   1.2. An expectorated sputum sample is recommended to gram stain and culture prior to administration or within 24 hours of antimicrobial initiation in patients hospitalized with CABP.11 (UW Health GRADE Low quality evidence, strong recommendation)
   1.2.1. If unable to obtain an expectorated sample within 4 hours, it is reasonable to consider collection of induced sputum, especially in patients receiving anti-MRSA or anti-pseudomonal therapy.10 (UW Health GRADE Low quality evidence, conditional recommendation)
   1.2.2. For intubated patients with CABP (patients hospitalized and/or intubated for less than 48 hours), a tracheal aspirate, BAL, or mini-BAL sample should be obtained.11,22 (UW Health GRADE Very Low quality evidence, strong recommendation)
   1.3. It is reasonable to consider collecting blood culture samples (Policy 2.5.6: Blood Cultures for Adult Patients) and send for culture in patients hospitalized with CABP.11,23,24 (UW Health GRADE Very Low quality evidence, conditional recommendation)
   1.3.1. All patients hospitalized with severe CABP should have blood cultures performed.11,25,26 (UW Health GRADE Very Low quality evidence, strong recommendation)
   1.3.2. If blood cultures are to be collected, they should be collected before antibiotics are administered but should not delay therapy in patients with severe disease (e.g. septic shock).11,27,28 (UW Health GRADE Low quality evidence, strong recommendation)
1.4. In patients hospitalized with CABP, urinary antigen tests for *Legionella pneumophila* and *Streptococcus pneumoniae* should be considered (see Table 1) and the results should be utilized to de-escalate antibiotic therapy when feasible.\(^\text{11,29,30}\) (**UW Health GRADE Moderate quality evidence, conditional recommendation**)

1.5. The following table may be used to guide more extensive diagnostic testing:

### Table 1: Clinical Indications for More Extensive Diagnostic Tests\(^\text{11}\)

<table>
<thead>
<tr>
<th>Indication</th>
<th>Blood Culture</th>
<th>Sputum Culture</th>
<th>Legionella Urinary Antigen Test</th>
<th>Pneumococcal Urinary Antigen Test</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive care unit admission</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Endotracheal aspirate culture if intubated</td>
</tr>
<tr>
<td>Failure of outpatient CABP antibiotic therapy</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>Evaluate for viral pathogens and resistant bacteria</td>
</tr>
<tr>
<td>Cavitary infiltrates</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>Fungal and mycobacterial (AFB) cultures and smears</td>
</tr>
<tr>
<td>Leukopenia</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Fungal culture and smear</td>
</tr>
<tr>
<td>Active alcohol use</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Chronic severe liver disease</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe obstructive or structural lung disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asplenia</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel within the past two weeks</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓(^\text{A})</td>
</tr>
<tr>
<td>Positive pneumococcal UAT result</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Thoracentesis and pleural effusion cultures</td>
</tr>
</tbody>
</table>

\(^\text{A}\) In patients who have traveled in the two weeks prior to presentation, a thorough travel history should be obtained and additional diagnostic testing should be considered based on patient risk.

2. **Assessing Patient Risk for CABP Caused by Drug-resistant Pathogens**

2.1. Healthcare-associated pneumonia (HCAP) is no longer widely accepted terminology as the criteria were not appropriately validated. However, its terminology has historical significance. Historical HCAP criteria **should not be utilized** when deciding whether or not a patient is a
candidate for broad-spectrum antimicrobials.⁵⁻⁸ *(UW Health GRADE Moderate quality evidence, strong recommendation)*

2.1.1. CABP occurring up to 5 days after admission is typically caused by standard respiratory bacteria and does not automatically require broad-spectrum antibiotics. In these cases, empiric therapy should be guided by severity of infection (e.g. sepsis) or the patient’s individual risk of resistant infection (see 2.2).⁴⁻¹³

2.2. To determine probability of pneumonia due to drug-resistant pathogens in clinically stable patients, the Drug Resistance in Pneumonia Score (“DRIP Score”) may be utilized.⁹ *(UW Health GRADE Low quality evidence, conditional recommendation)*

2.2.1. For patients with a DRIP Score less than four, probability of pneumonia due to drug-resistant pathogens is lower and empiric MRSA or pseudomonal antimicrobial coverage is not recommended.⁹ *(UW Health GRADE Low quality evidence, strong recommendation)*

2.2.2. For patients with a DRIP Score of four or greater, risk of pneumonia due to drug-resistant pathogens is higher and empiric MRSA and pseudomonal antimicrobial coverage may be considered.⁹ *(UW Health GRADE Low quality evidence, conditional recommendation)*

2.2.3. Immunosuppression correlation with risk of drug-resistant pneumonia was not observed in the derivation and multicenter DRIP score study.⁹ Providers may use the DRIP score to guide therapy in immunocompromised patients but should also use their clinical judgement when determining the necessity of antimicrobial therapy escalation. *(UW Health GRADE Very Low quality evidence, conditional recommendation)*

2.3. Tables 2 and 3 should be utilized to guide the calculation and interpretation of a patient’s DRIP Score.
Table 2: Calculation of the Modified DRIP Score\textsuperscript{9}

<table>
<thead>
<tr>
<th>Major Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous or extended oral antibiotic use in previous 60 days\textsuperscript{A,I}</td>
<td>2</td>
</tr>
<tr>
<td>Long-term care resident\textsuperscript{B}</td>
<td>2</td>
</tr>
<tr>
<td>Receipt of tube feeding\textsuperscript{C}</td>
<td>2</td>
</tr>
<tr>
<td>Prior drug-resistant pneumonia (1 year)\textsuperscript{D,I,J}</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient hospitalization lasting 48 consecutive hours or more in the previous 60 days</td>
<td>1</td>
</tr>
<tr>
<td>Chronic pulmonary disease\textsuperscript{E}</td>
<td>1</td>
</tr>
<tr>
<td>Poor functional status\textsuperscript{F,I}</td>
<td>1</td>
</tr>
<tr>
<td>Gastric acid suppression in previous 14 days\textsuperscript{G}</td>
<td>1</td>
</tr>
<tr>
<td>Wound care\textsuperscript{H}</td>
<td>1</td>
</tr>
<tr>
<td>MRSA colonization (1 year)\textsuperscript{J}</td>
<td>1</td>
</tr>
</tbody>
</table>

| Total Points Possible | 14 |

\textsuperscript{A} Antibiotic use includes systemic agents used to treat an active infection or agents used chronically to prevent infection (e.g. PJP and/or SBP prophylaxis). Excludes topical antibiotics as well as antibiotic dental and preoperative surgical prophylaxis. The original DRIP score defines this risk factor as any antibiotic use within the previous 60 days.

\textsuperscript{B} Long-term care residents include patients who live in facilities that provide long-term acute care, facilities providing nursing care and inpatient rehabilitation. Excludes patients that live in assisted living or group home facilities.

\textsuperscript{C} Tube feeding is defined as feeding via nasogastric/jejunal or percutaneous gastrostomy tube.

\textsuperscript{D} The original DRIP score defined this risk factor as an infection at any site due to organisms resistant to ceftriaxone or fluoroquinolones (CAP antibiotics) in the past year (Brandon Webb, MD, email communication, January 11, 2019).

\textsuperscript{E} This risk factor was revised to be concordant with current clinical practice and to prevent the overestimation of patients at high risk of drug-resistant pathogens.

\textsuperscript{F} Chronic pulmonary disease is defined as chronic obstructive, interstitial or bronchiectasis. Excludes cystic fibrosis.

\textsuperscript{G} Gastric acid suppression includes the use of histamine H2 receptor blockers or proton pump inhibitors within the past 14 days.

\textsuperscript{H} Active wound care is defined as wound care at the time of admission (e.g. ulcersations, burns or other tissue damage requiring specialized home health or clinic follow up care).

\textsuperscript{I} The above criteria have been modified to more clearly define risk factors and better reflect patient assessment practices at UW Health.

\textsuperscript{J} Considerations should be given for broad-spectrum antibiotic therapy based on previous cultures if the patient has a history of resistant respiratory pathogens, regardless of DRIP Score.

Table 3: Modified DRIP Score Interpretation\textsuperscript{9}

<table>
<thead>
<tr>
<th>Calculated DRIP Score</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 4 (&lt;4)</td>
<td>Low probability of pneumonia due to drug-resistant pathogens</td>
</tr>
<tr>
<td>Greater than or equal to 4 (≥4)</td>
<td>Higher probability of pneumonia due to drug-resistant pathogens</td>
</tr>
</tbody>
</table>

3. Empiric Therapy for CABP With Low Probability of Drug-resistant Pathogens

3.1 Empiric CABP treatment with a beta-lactam and an agent with atypical coverage is recommended as first-line therapy.\textsuperscript{11} (UW Health GRADE High quality evidence, strong recommendation)

3.1.1. Preferred beta-lactams include ceftriaxone, cefpodoxime, or cefuroxime,\textsuperscript{11,31} (UW Health GRADE Moderate quality evidence, strong recommendation)

3.1.1.1. Alternatively, ampicillin-sulbactam may be considered in patients with an increased need for anaerobic coverage, such as patients with radiographic evidence of a lung abscess or with a witnessed aspiration event.\textsuperscript{11,15} (UW Health GRADE Low quality evidence, conditional recommendation)
3.1.2. Preferred agents with atypical coverage include azithromycin (at a dose of 500 mg daily) or doxycycline.11,32-35 (UW Health GRADE Moderate quality evidence, strong recommendation)

3.1.2.1. The use of doxycycline over azithromycin in patients with a history of C. difficile infection may be beneficial.36 (UW Health GRADE Moderate quality evidence, conditional recommendation)

3.1.2.2. If a patient is on chronic azithromycin or doxycycline prior to admission, although the probability of an atypical pathogen is remote, it may be beneficial to treat with the alternative first-line agent. (UW Health GRADE Low quality evidence, conditional recommendation)

3.2. Refer to section 6 of this guideline for alternative empiric therapy recommendations in patients with reported beta-lactam allergies.

3.3. If unable to use first-line options (e.g. allergies, drug intolerance), it may be reasonable to treat with a respiratory fluoroquinolone (levofoxacin or moxifloxacin), as empiric monotherapy 11 (UW Health GRADE Moderate quality evidence, conditional recommendation)

3.3.1. Fluoroquinolone use may be associated with safety concerns (tendon rupture, C. difficile infection, superinfection, hypoglycemia, altered mental status and QT prolongation).37

3.4. It may be reasonable to treat with omadacycline monotherapy in patients with active or recent C. difficile infection (in the preceding 3 to 6 months) to reduce the risk of recurrence.38-41 (UW Health GRADE Moderate quality evidence, conditional recommendation)

3.5. Considerations should be given for broad-spectrum antibiotic therapy based on previous cultures if the patient has a history of resistant respiratory pathogens, regardless of DRIP Score.42,43 (UW Health GRADE Low quality evidence, strong recommendation)

4. Empiric Therapy for CABP With Higher Probability for Drug-resistant Pathogens

4.1. Empiric treatment with agents that include coverage for MRSA, Pseudomonas aeruginosa, and atypical pathogens may be considered.9,11,14 (UW Health GRADE Moderate quality evidence, conditional recommendation)

4.2. Empiric MRSA coverage should include vancomycin or an equivalent antibiotic.9,14 (UW Health GRADE Moderate quality evidence, strong recommendation)

4.2.1. Daptomycin should not be used for MRSA coverage in pneumonia, as the drug is inactivated by lung surfactant.44 (UW Health GRADE Moderate quality evidence, strong recommendation)

4.2.2. If the patient is receiving antimicrobials targeting MRSA (e.g. vancomycin) and an expectorated sputum sample is unable to be obtained, MRSA PCRs of both the nares and throat should be collected when feasible.45,46 (UW Health GRADE Moderate quality evidence, strong recommendation)

4.2.2.1. If MRSA PCRs of the nares and throat are negative, discontinuation of agents targeting MRSA should be considered. The negative predictive value of these two tests in pneumonia is greater than 95%.45,46 (UW Health GRADE Moderate quality evidence, conditional recommendation)

4.2.2.2. A positive PCR may still not support the continued use of an anti-MRSA agent, as the positive predictive value is only 35.4%.45 (UW Health GRADE Moderate quality evidence, conditional recommendation)

4.2.3. MRSA coverage should also be de-escalated based on clinical improvement, and/or respiratory cultures.14 (UW Health GRADE Moderate quality evidence, strong recommendation)

4.3. Empiric pseudomonal coverage should include cefepime, piperacillin-tazobactam or meropenem in patients without a contraindication.9,11,14 (UW Health GRADE Low quality evidence, strong recommendation)
4.3.1. Piperacillin-tazobactam may be a preferred alternative in patients at risk for seizures with the use of cefepime.\textsuperscript{47,48} (UW Health GRADE Low quality evidence, conditional recommendation)

4.3.2. Meropenem may be considered for empiric \textit{Pseudomonas aeruginosa} coverage.\textsuperscript{14} (UW Health GRADE Moderate quality evidence, conditional recommendation)

4.3.3. If there is an increased need for anaerobic coverage, such as patients with radiographic evidence of a lung abscess or with a witnessed aspiration event, piperacillin-tazobactam may be a reasonable alternative to cefepime.\textsuperscript{11,15} (UW Health GRADE Low quality evidence, conditional recommendation)

4.3.3.1. Alternatively, cefepime plus metronidazole may be considered in patients with an increased need for anaerobic coverage based on clinician judgment.\textsuperscript{11,14,15} (UW Health GRADE Very Low quality evidence, conditional recommendation)

4.3.3.2. Meropenem also has adequate anaerobic bacterial coverage.\textsuperscript{49}

4.4. Empiric atypical coverage with azithromycin or doxycycline is recommended in patients receiving beta-lactam antibiotics.\textsuperscript{11,50} (UW Health GRADE Moderate quality evidence, strong recommendation)

4.4.1. The use of doxycycline over azithromycin in patients with a history of \textit{C. difficile} infection may be beneficial.\textsuperscript{36} (UW Health GRADE Moderate quality evidence, conditional recommendation)

4.4.2. If a patient is on chronic azithromycin or doxycycline prior to admission, although the probability of an atypical organism is remote, it may be beneficial to treat with the alternative first-line agent.\textsuperscript{11} (UW Health GRADE Low quality evidence, conditional recommendation)

4.5. Refer to section 6 of this guideline for alternative empiric therapy recommendations in patients with reported beta-lactam allergies.

4.6. If unable to use first-line options, it may be reasonable to treat with a respiratory fluoroquinolone (levofloxacin or moxifloxacin), as empiric monotherapy.\textsuperscript{11,51,52} (UW Health GRADE Moderate quality evidence, conditional recommendation)

4.6.1. Fluoroquinolone use may be associated with safety concerns (tendon rupture, \textit{C. difficile} infection, superinfection, hypoglycemia, altered mental status and QT prolongation).\textsuperscript{37}

4.7. Antibiotic therapy may be de-escalated if one of the following scenarios are met;\textsuperscript{11,53} (UW Health GRADE Low quality evidence, conditional recommendation)

4.7.1. Microbiological diagnostic testing is negative for the presence of MRSA or \textit{Pseudomonas}

4.7.2. Respiratory isolates and sensitivities are known

4.7.3. If the patient’s clinical status, including rapid clinical improvement, suggests a non-drug resistant pathogen

5. \textbf{Empiric Therapy for CABP With Severe Sepsis/Septic Shock or Severe CABP}

5.1. Severe CABP is defined as a CURB-65 score ≥3, a PSI/PORT score >130 or CABP requiring treatment in an intensive care unit (ICU).\textsuperscript{11,17,18}

5.2. In patients with severe sepsis/septic shock or severe CABP, analogous to CABP patients with higher probability for drug-resistant pathogens, empiric treatment with agents that include coverage for MRSA, \textit{Pseudomonas aeruginosa}, \textit{Legionella} and other atypical pathogens is recommended.\textsuperscript{11,14,27} (UW Health GRADE Moderate quality evidence, strong recommendation)

5.2.1. Refer to UW Health’s Diagnosis and Management of Sepsis – Adult – Emergency Department/Inpatient Clinical Practice Guideline for definitions of severe sepsis and septic shock.

5.3. Empiric MRSA coverage should include vancomycin or similar alternative (excluding daptomycin, as the drug’s action is inhibited by lung surfactant).\textsuperscript{14,44} (UW Health GRADE Moderate quality evidence, strong recommendation)
5.4. Empiric *Pseudomonas aeruginosa* coverage should include cefepime or piperacillin-tazobactam or meropenem in patients without a contraindication.\(^{11,47,48,54}\) (UW Health GRADE Low quality evidence, strong recommendation)

5.4.1. Meropenem may be considered for *Pseudomonas aeruginosa* coverage according to formulary restriction exemptions (see Lexicomp for meropenem formulary restriction exemptions).\(^{14,49,27}\) (UW Health GRADE Moderate quality evidence, conditional recommendation)

5.4.2. Automatic double coverage for *Pseudomonas aeruginosa* for all patients with severe sepsis/septic shock may not be clinically necessary.\(^{27}\) (UW Health GRADE Low quality evidence, conditional recommendation)

5.4.2.1. Double coverage for *Pseudomonas aeruginosa* with two agents from different classes (aminoglycosides, beta-lactams, fluoroquinolones) may be considered on a patient-specific basis if there is concern for multidrug resistant pathogens.\(^{14,27}\) (UW Health GRADE Low quality evidence, conditional recommendation)

5.5. *Legionella pneumophila* coverage with azithromycin (in patients receiving beta-lactam antibiotics), or with a fluoroquinolone should be encouraged.\(^{11,14,27}\) (UW Health GRADE Low quality evidence, strong recommendation)

6. **Empiric Therapy for Patients with Beta-Lactam Allergies**

6.1. Switching to alternative antibiotics based on a patient reported beta-lactam allergy may adversely affect patient outcomes.\(^{55-57}\) Alternative agents may have lower efficacy, cause more adverse effects (e.g. *C. difficile* infection), treat too broadly (contributing to increased drug resistance), and be associated with increased costs.\(^{58,59}\)

6.2. In patients with reported beta-lactam allergies, critical evaluation of the allergy using UW Health’s *Treatment of Patients with Reported Allergies to Beta-Lactam Antibiotics – Adult – Inpatient Clinical Practice Guideline* is suggested.\(^{60}\) (UW Health GRADE Moderate quality evidence, strong recommendation)

6.2.1. If the patient’s beta-lactam reaction was severe (e.g. hemolysis, Stevens-Johnson Syndrome, toxic epidermal necrolysis) or IgE-mediated (immediate urticaria, angioedema, anaphylaxis), avoidance of beta-lactam antibiotics is recommended.\(^{61}\) (UW Health GRADE Moderate quality evidence, strong recommendation)

6.2.2. It is reasonable to consider aztreonam in place of a beta-lactam or cefepime in patients with severe or IgE-mediated beta-lactam allergies. However, if aztreonam is to be used in the place of a beta-lactam or cefepime, another agent with *Staphylococcus* and *Streptococcus* coverage such as vancomycin (or clindamycin) should be used in addition to aztreonam.\(^{11}\) (UW Health GRADE Low quality evidence, conditional recommendation)

6.2.2.1. Vancomycin should be continued until the causative pathogen is known because aztreonam provides insufficient coverage for *Streptococcus pneumoniae* and other gram-positive organisms.\(^{62}\)

6.2.3. Fluoroquinolone use may be considered as empiric treatment if there are no other viable options upon approval by an Infectious Diseases attending physician or fellow.\(^{11,51,52}\) (UW Health GRADE Moderate quality evidence, conditional recommendation)

7. **Definitive Therapy for CABP**

7.1. Directing antimicrobial therapy to the identified CABP pathogen(s) when microbiological testing identifies a respiratory isolate is recommended.\(^{11,63}\) (UW Health GRADE Moderate quality evidence, strong recommendation)

7.2. De-escalation of antimicrobial therapy to the narrowest spectrum antimicrobial possible based on factors such as the patient’s clinical status, respiratory isolate(s), culture and susceptibility data, severity of infection and allergies is recommended.\(^{11}\) (UW Health GRADE Moderate quality evidence, strong recommendation)
7.3. If a viral respiratory pathogen is identified and a patient’s procalcitonin (PCT) is less than 0.25 ng/mL, discontinuation of antibiotic therapy should be considered.\textsuperscript{20,21,64} (\textit{UW Health GRADE Moderate quality evidence, conditional recommendation})

7.3.1. Refer to the UW Health Procalcitonin Monitoring Related to the Diagnosis and Treatment of Respiratory Tract Infections and Emerging Sepsis – Adult – Inpatient Clinical Practice Guideline for further information (e.g. when not to use procalcitonin to guide therapy changes).

7.4. Preferred agents for the treatment of pneumonia caused by \textit{Legionella pneumophila} include azithromycin or a respiratory fluoroquinolone.\textsuperscript{11,14,27} (\textit{UW Health GRADE Low quality evidence, strong recommendation})

8. Duration of CABP Therapy

8.1. Discontinuation of CABP antimicrobials should be considered after a patient has been treated for a total duration of five days if the patient meets the following clinical criteria: \textsuperscript{11,65} (\textit{UW Health GRADE Low quality evidence, conditional recommendation})

- Patient has had a decreasing fever trend for the past 48 to 72 hours
- Patient has returned to their baseline level of clinical stability

8.2. It might be reasonable to extend CABP treatment duration beyond five days, but not usually longer than 14 days, depending on clinical, imaging and laboratory parameters and in the following clinical scenarios: \textsuperscript{11,66} (\textit{UW Health GRADE Moderate quality evidence, conditional recommendation})

- Initial therapy proves ineffective against the causative CABP pathogen
- Patient is immunocompromised
- Extrapulmonary infection exists
- CABP with associated bacteremia
- Severe CABP (sepsis, CURB-65 score ≥3, PSI/PORT score >130)
- \textit{Pseudomonas aeruginosa} respiratory isolate growth from sputum cultures
- \textit{Legionella} infection

8.3. When transitioning from intravenous to oral therapy, total duration of therapy should include the time a patient was on appropriate intravenous and oral antimicrobials.\textsuperscript{67} (\textit{UW Health GRADE Low quality evidence, strong recommendation})

8.4. Utilization of UW Health’s Medication Route Interchange – Adult – Inpatient Clinical Practice Guideline to assist with parenteral to enteral interchange can be useful.

9. Chemical Aspiration, Aspiration Pneumonitis and Aspiration Pneumonia

9.1. Chemical aspiration is the inhalation of sterile gastric contents. Due to the acidity of the gastric contents and gastric particulates, aspiration may lead to tissue damage in the lungs. This acute chemical lung injury is termed, aspiration pneumonitis. These conditions are commonly confused with pneumonia because they can progress to respiratory failure and mirror some pneumonia symptoms.\textsuperscript{16,68,69}

9.2. Supportive care is the mainstay of treatment in aspiration pneumonitis.\textsuperscript{16} (\textit{UW Health GRADE Moderate quality evidence, strong recommendation})

9.2.1. Rapid improvement is anticipated within 48 hours of the aspiration event.\textsuperscript{16}

9.2.2. There is no clinical benefit in providing prophylactic antimicrobial therapy in patients with acute aspiration pneumonitis.\textsuperscript{16} (\textit{UW Health GRADE Low quality evidence, strong recommendation})

9.2.2.1. Providing antimicrobial prophylaxis in this subset of patients has demonstrated no mortality benefit, more frequent escalation of antibiotic therapy and treatment with longer durations of therapy. Subsequently, prophylactic antimicrobial therapy in these patients may contribute to drug resistance and adverse drug events such as \textit{C. difficile} infection.\textsuperscript{16}
9.3. Although the development of superimposed bacterial pneumonia in patients with aspiration pneumonitis is possible, it only occurs in about one quarter of patients. This condition is referred to as aspiration pneumonia.16

9.3.1. In patients requiring treatment for aspiration pneumonia, it may be reasonable to use ceftriaxone monotherapy given that it has some activity against mouth anaerobes. The decision to expand anaerobic coverage in this subset of patients (e.g. to ampicillin-sulbactam) should be based on clinician judgment. Due to a low bioburden of bacteria in this circumstance, treatment courses should rarely exceed 72 hours.11,15 (UW Health GRADE Moderate quality evidence, conditional recommendation)

9.3.1.1. It may be reasonable to expand coverage to piperacillin-tazobactam plus vancomycin or equivalent antibiotic in a patient with aspiration pneumonia and risk factors for drug resistance (i.e. DRIP score ≥4) after a witnessed or suspected aspiration event.11,15 (UW Health GRADE Very Low quality evidence, conditional recommendation)

9.3.1.1.1. In patients who are unable to tolerate piperacillin-tazobactam, cefepime plus metronidazole may be a reasonable alternative.11,15 (UW Health GRADE Very Low quality evidence, conditional recommendation)

Disclaimer
Clinical practice guidelines assist clinicians by providing a framework for the evaluation and treatment of patients. This guideline outlines the preferred approach for most patients. It is not intended to replace a clinician’s judgment or to establish a protocol for all patients. It is understood that some patients will not fit the clinical condition contemplated by a guideline and that a guideline will rarely establish the only appropriate approach to a problem.
Methodology

Development Process
Each guideline is reviewed and updated a minimum of every 3 years. All guidelines are developed using the guiding principles, standard processes, and styling outlined in the UW Health Clinical Practice Guideline Resource Guide. This includes expectations for workgroup composition and recruitment strategies, disclosure and management of conflict of interest for participating workgroup members, literature review techniques, evidence grading resources, required approval bodies, and suggestions for communication and implementation.

Methods Used to Collect the Evidence:
The following criteria were used by the guideline author(s) and workgroup members to conduct electronic database searches in the collection of evidence for review.

Literature Sources:
- Electronic database search (e.g. PubMed)
- Databases of systematic reviews (e.g. Cochrane Library)
- Hand-searching journals, external guidelines, and conference publications

Time Period: 2005 to 2018

Search Terms:
- Community-acquired pneumonia AND treatment
- Prediction, drug-resistant pathogens AND community-acquired pneumonia
- Drug resistant pathogens AND community-acquired pneumonia AND treatment
- Community-acquired pneumonia AND sepsis
- Beta-lactams, allergies AND community-acquired pneumonia
- Community-acquired pneumonia AND duration, treatment

Methods to Select the Evidence:
Clinical practice guidelines, randomized controlled trials, retrospective cohort studies and recent conference publications were examined for inclusion during the literature review phase of this guideline. To be included, the literature had to be available in the English language and touch on the clinical questions considered within this guideline.

Methods Used to Formulate the Recommendations:
The workgroup members agreed to adopt recommendations developed by external organizations and/or created recommendations internally via a consensus process using discussion of the literature and expert experience/opinion. If issues or controversies arose where consensus could not be reached, the topic was escalated appropriately per the guiding principles outlined in the UW Health Clinical Practice Guideline Resource Guide.

Methods Used to Assess the Quality of the Evidence/Strength of the Recommendations:
Recommendations developed by external organizations maintained the evidence grade assigned within the original source document and were adopted for use at UW Health.

Internally developed recommendations, or those adopted from external sources without an assigned evidence grade, were evaluated by the guideline workgroup using an algorithm adapted from the Grading of Recommendations Assessment, Development and Evaluation (GRADE) methodology (see Figure 1).
Figure 1. GRADE Methodology adapted by UW Health

Rating Scheme for the Strength of the Evidence/Recommendations:

### GRADE Ranking of Evidence

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>We are confident that the effect in the study reflects the actual effect.</td>
</tr>
<tr>
<td>Moderate</td>
<td>We are quite confident that the effect in the study is close to the true effect, but it is also possible it is substantially different.</td>
</tr>
<tr>
<td>Low</td>
<td>The true effect may differ significantly from the estimate.</td>
</tr>
<tr>
<td>Very Low</td>
<td>The true effect is likely to be substantially different from the estimated effect.</td>
</tr>
</tbody>
</table>

### GRADE Ratings for Recommendations For or Against Practice

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong (S)</td>
<td>Generally should be performed (i.e., the net benefit of the treatment is clear, patient values and circumstances are unlikely to affect the decision.)</td>
</tr>
<tr>
<td>Conditional (C)</td>
<td>May be reasonable to perform (i.e., may be conditional upon patient values and preferences, the resources available, or the setting in which the intervention will be implemented.)</td>
</tr>
</tbody>
</table>

**Cost Analysis:** No cost analysis was performed.

**Recognition of Potential Health Care Disparities:** No health care disparities identified.
Collateral Tools & Resources

Order Sets & Smart Sets
- Empiric – Anti-infective Treatment – Adult – Supplemental order set [6474]

Procedures
- Blood cultures for Adult Patients [2.5.6]

Companion Guidelines
- Pharmacokinetic/Pharmacodynamic Dose Optimization of Antibiotics (β-lactams, aminoglycosides, and ciprofloxacin) for the Treatment of Gram-Negative Infections – Adult – Inpatient Clinical Practice Guideline
- Intravenous Vancomycin Use – Adult – Inpatient Clinical Practice Guideline
- Procalcitonin Monitoring Related to the Diagnosis and Treatment of Respiratory Tract Infections and Emerging Sepsis – Adult – Inpatient Clinical Practice Guideline
- Treatment of Patients with Reported Allergies to Beta-Lactam Antibiotics – Adult – Inpatient Clinical Practice Guideline
- Diagnosis and Management of Sepsis – Adult – Emergency Department/Inpatient Clinical Practice Guideline
- Medication Route Interchange – Adult – Inpatient Clinical Practice Guideline
- Treatment and Prevention of Influenza with Antiviral Medications – Adult/Pediatric – Inpatient
Appendix A. CABP Diagnosis and Treatment Flow Chart

DRIP Score

<table>
<thead>
<tr>
<th>Major Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous or extended oral antibiotic use in previous 60 days</td>
<td>2</td>
</tr>
<tr>
<td>Long-term care resident</td>
<td>2</td>
</tr>
<tr>
<td>Receipt of tube feeding</td>
<td>2</td>
</tr>
<tr>
<td>Prior drug-resistant pneumonia (1 year)</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor Risk Factors</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient hospitalization lasting 48 consecutive hours or more in the previous 60 days</td>
<td>1</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>1</td>
</tr>
<tr>
<td>Poor functional status</td>
<td>1</td>
</tr>
<tr>
<td>Gastric acid suppression in previous 14 days</td>
<td>1</td>
</tr>
<tr>
<td>Wound care</td>
<td>1</td>
</tr>
<tr>
<td>MRSA colonization (1 year)</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Points Possible 14

Pneumonia occurring prior to admission or up to 5 days after hospital admission

Community-Acquired Bacterial Pneumonia (CABP) Without Risk Factors For Drug-Resistant Pathogens

- CABP following witnessed or suspected aspiration event?
  - No
    - Begin empiric therapy with a second or third-generation cephalosporin and thymal antimicrobial coverage
      - Ceftriaxone or cefepime
      - Azithromycin or doxycycline
    - Obtain expectorated sputum culture or place an order for induced sputum by respiratory therapy if unable to obtain expectorated sample. Consider influenza and RSV testing during peak seasons of viral respiratory illness

- Yes
  - Begin empiric therapy that includes mouth anerobic antimicrobial coverage
    - Ceftriaxone or ampicillin-sulbactam
  - Obtain expectorated sputum culture or place an order for induced sputum by respiratory therapy if unable to obtain expectorated sample. Consider influenza and RSV testing during peak seasons of viral respiratory illness

Community-Acquired Bacterial Pneumonia (CABP) With Risk Factors For Drug-Resistant Pathogens

- DRIP score ≤ 4
  - Begin empiric therapy with an anti-DRP medication
    - Piperacillin-tazobactam OR carbapenem and metronidazole OR imipenem (if patient meets formulary restriction exemption)
    - Vancomycin (or an equivalent antibiotic)
  - Azithromycin OR doxycycline

- DRIP score ≥ 4 or severe CABP
  - Begin empiric therapy with MDR, penicillin, and thymal antimicrobial coverage
    - Cefepime OR piperacillin-tazobactam OR imipenem (if patient meets formulary restriction exemption)
  - Vancomycin (or an equivalent antibiotic)
  - Azithromycin OR doxycycline

De-escalate therapy based on results of respiratory cultures

Additional Key Practice Recommendations
- Previous respiratory culture results should be taken into consideration when choosing empiric antimicrobial therapy regardless of a patient’s DRIP Score in CABP.
- Doysturiclas is preferred over antimicrobials for thymal coverage in patients with a history of C. difficile infection and for those on long-term antimyclosin maintenance therapy.
- Do NOT use this flow diagram if a patient has septic shock or has a severe IGA mediated beta-lactam allergy. Refer to appropriate sections of the pneumonia guidelines.
References


37. United States Food and Drug Administration. FDA drug safety communication: FDA reinforces safety information about serious low blood sugar levels and mental health side effects with fluoroquinolones antibiotics; requires label changes. In:Published July 10, 2018.


47. MAXIPIME (cefepime) [package insert]. Lake Forest, IL: Hospira Inc; 2012. In.


