The purpose of this document is to guide the appropriate treatment of adult patients presenting with pneumonia. Two pathways with different empiric treatment regimens based on risk of infection with multidrug-resistant (MDR) pathogens (including MRSA, *Pseudomonas* spp., *Acinetobacter* spp., organisms not susceptible to beta-lactams (ceftriaxone or ampicillin-sulbactam) and/or fluoroquinolones (ciprofloxacin, levofloxacin)) are shown below. Of note, since the 2005 American Thoracic Society/Infectious Diseases Society of America guidelines first introduced recommendations for healthcare associated pneumonia (HCAP), several studies have been published that question the predictive value of HCAP criteria for patients infected with drug-resistant pneumonia. Multiple studies have reported various risk factors and proposed scoring tools but methodology varies widely and thus an optimal model has not yet been identified. Treatment recommendations below are based on disease severity and presence of additional risk factors for MDR pathogens. This will replace the previously defined HCAP criteria.

**Pathway A**
Patients presenting from the community without any risk factors for drug-resistant pathogens (includes patients admitted to the ICU for respiratory failure without septic shock)

**Empiric Treatment**
Ampicillin/sulbactam + Azithromycin

*See treatment guidelines for appropriate use of ceftriaxone as an alternative agent

**Pathway B**
Patients presenting with any of the following risk factors for drug-resistant pathogens:

- **Healthcare Exposure:**
  - Hospital-acquired pneumonia (current hospitalization for ≥ 72 hours)
  - Ventilator-associated pneumonia
  - Prior hospitalization for at least 48 hours within previous 90 days
  - Current resident from long-term care facility, nursing home, extended care facility, skilled nursing facility with at least partial functional dependence in ADLs (transfer, feeding, bathing, dressing, toileting, and continence)

- **Disease Severity:**
  - Septic shock requiring ICU admission

- **Antibiotic Exposure:**
  - Fluoroquinolone, linezolid or any intravenous antibiotic use within previous 90 days

- **Immunosuppression:**
  - AIDS, neutropenia (ANC <1000), or active malignancy undergoing intravenous chemotherapy
  - Kidney or liver or heart transplant recipient within previous 1 year in those who received induction with thymoglobulin
  - Kidney or liver or heart transplant recipient within previous 6 months in those who did not receive induction with thymoglobulin
  - Solid organ transplant recipient treated for rejection within previous 6 months
  - Lung transplant recipient
  - Autologous stem cell transplant within previous 6 months
  - Allogeneic stem cell transplant within previous 1 year or those with chronic GVHD

- **Other Conditions:**
  - Current tube feeding
  - History of infection or colonization with *Pseudomonas* spp., MRSA, or other MDR pathogens within previous 12 months
  - Cystic fibrosis, chronic obstructive pulmonary disease (FEV1<35% predicted, multiple antibiotic prescriptions in last year, multiple hospital admissions in last year), or chronic bronchiectasis

**Empiric Treatment**
Piperacillin/Tazobactam (+ Tobramycin if admitted to ICU) + Vancomycin

*Repeat 6-12 hours after 1st level if no antibiotics started
*See UMHS Procalcitonin Usage Guidelines for more information
### Pathway A (Part I)

<table>
<thead>
<tr>
<th>Indication</th>
<th>Common Pathogens</th>
<th>Empiric Therapy</th>
<th>Duration of Therapy</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inpatient community-acquired pneumonia (Non-ICU patient)</strong></td>
<td>Streptococcus pneumonia</td>
<td>1st line: Ampicillin/sulbactam 3 g IV q6h (except if alcoholism with aspiration) PLUS Azithromycin 500 mg IV/PO x1 day, then 250 mg q24h x4 days</td>
<td><strong>Uncomplicated Pneumonia:</strong>&lt;br&gt;- 5 days for patients who defervesce within 72 hours and have no more than 1 sign of CAP instability at the time of antibiotic discontinuation†&lt;br&gt;- Patients with delayed response should discontinue therapy 48-72 hours after defervescence and have no more than 1 sign of CAP instability† at time of antibiotic discontinuation.&lt;br&gt;- Pneumonia with non-fermenting GNRs (e.g. Pseudomonas, Achromobacter, Acinetobacter, Stenotrophomonas) should receive 7 days of therapy</td>
<td>• Appropriately tailor therapy based on respiratory culture results.</td>
</tr>
<tr>
<td></td>
<td>Haemophilus influenzae</td>
<td>PCN allergy without anaphylaxis, angioedema, or urticaria, or alcoholism with aspiration: Ceftriaxone 1 g IV q24h PLUS Azithromycin 500 mg IV/PO x1 day, then 250 mg q24h x4 days</td>
<td>Consider the addition of anaerobic coverage with metronidazole 500 mg PO q8h if aspiration with risk of enteric GNR†, empyema, lung abscess, or cavitary lesion</td>
<td></td>
</tr>
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<td>Indication</td>
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</tbody>
</table>
| Inpatient community-acquired pneumonia (ICU patient) | Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, Mycoplasma pneumoniae, Chlamydia pneumoniae, Legionella species | **1st line:** Ampicillin/sulbactam 3 g IV q6h (except if alcoholism with aspiration) PLUS azithromycin 500 mg IV/PO q24h | **5-7 days** for patients who defervesce within 72 hours and have **no more than 1 sign** of CAP instability at the time of antibiotic discontinuation‡ | **Uncomplicated Pneumonia:**  
- **5-7 days** for patients who defervesce within 72 hours and have **no more than 1 sign** of CAP instability at the time of antibiotic discontinuation‡  
- Pneumonia with non-fermenting GNRs (e.g. Pseudomonas, Achromobacter, Acinetobacter, Stenotrophomonas) should receive 7 days of therapy  
**Complicated Pneumonia:**  
- Treat *Staph. aureus* for a minimum duration of 7 days  
- Patients with empyema, infected pleural effusions, and bacteremia secondary to pneumonia may require longer durations of therapy. Bacteremic pneumococcal pneumonia should be treated for a minimum of 10-14 days. ID consult is recommended for patients with bacteremia. |
| | | **PCN allergy without anaphylaxis, angioedema, or urticaria, or alcoholism with aspiration:**  
Ceftriaxone 1 g IV q24h PLUS Azithromycin 500 mg IV q24h x5 days |  
| | | Consider the addition of anaerobic coverage with metronidazole 500mg PO q8h if aspiration with risk of enteric GNR⁵, empyema, lung abscess, or cavitary lesion  
**Severe PCN and cephalosporin allergy (anaphylaxis, angioedema, hives):**  
Vancomycin (see UMHS standard dosing nomogram) PLUS Aztreonam 2 g IV q8h PLUS Azithromycin 500 mg IV q24h x5 days |  
| | | Consider the addition of anaerobic coverage with metronidazole 500 mg PO q8h if alcoholism with aspiration or aspiration with risk of empyema, lung abscess, or cavitary lesion  
**Aspiration pneumonia:**  
Ampicillin/sulbactam 3 g IV q6h |  
| | | **Addition of vancomycin**  
Consider if high clinical suspicion for CA-MRSA (history of MRSA pneumonia or post-influenza pneumonia) |  
| | | **Uncomplicated Pneumonia:**  
- **5-7 days** for patients who defervesce within 72 hours and have **no more than 1 sign** of CAP instability at the time of antibiotic discontinuation‡  
- Pneumonia with non-fermenting GNRs (e.g. Pseudomonas, Achromobacter, Acinetobacter, Stenotrophomonas) should receive 7 days of therapy  
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Pathway B

Previous culture data should be used to guide empiric therapy.

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<tr>
<td>Patients with pneumonia presenting with risk factors for drug-resistant pathogens:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Healthcare Exposure:</strong>  · Hospital-acquired pneumonia (current hospitalization for 272 hours)  · Ventilator-associated pneumonia  · Prior hospitalization for at least 48 hours within previous 90 days  · Current resident from long-term care facility, nursing home, extended care facility, skilled nursing facility with at least partial functional dependence in ADLs (transfer, feeding, bathing, dressing, toileting, and continence)</td>
<td>Preferred  · Piperacillin/Tazobactam* 4.5 g IV q6h (+ Tobramycin* IV if admitted to ICU)  + Vancomycin** IV</td>
<td>7 days for uncomplicated pneumonia with rapid clinical response within 72 hours (including patients with Pseudomonas, Stenotrophomonas, Acinetobacter, or Burkholderia)</td>
<td>Extended interval tobramycin dosing (5 mg/kg IV x 1) is preferred. Therapeutic drug monitoring is necessary and empiric dosing adjustments should be made with PharmD.</td>
</tr>
<tr>
<td><strong>Disease Severity:</strong>  · Septic shock requiring ICU admission</td>
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<tr>
<td><strong>Antibiotic Exposure:</strong>  · Fluoroquinolone, linezolid or any intravenous antibiotic use within previous 90 days</td>
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<td><strong>Immunosuppression:</strong>  · AIDS, neutropenia (ANC &lt;1000), or active malignancy undergoing intravenous chemotherapy  · Kidney or liver transplant recipient within 1 year  · Lung transplant recipient  · Autologous stem cell transplant within 6 months  · Allogeneic stem cell transplant within 1 year of transplant date or those with chronic GVHD</td>
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<tr>
<td><strong>Other Conditions:</strong>  · Tube feeding  · History of infection or colonization with Pseudomonas spp., MRSA, or other MDR pathogens within previous 12 months  · Cystic fibrosis, chronic obstructive pulmonary disease (FEV1&lt;35% predicted, multiple antibiotic prescriptions in last year, multiple hospital admissions in last year), or chronic bronchiectasis</td>
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<td><strong>PCN Allergy without Anaphylaxis, Angioedema, or Urticaria:</strong>  · Cefepime* 2 g IV q8h (+ Tobramycin* IV if admitted to ICU)  + Vancomycin** IV</td>
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</tr>
<tr>
<td><strong>Severe PCN and cephalosporin allergy (anaphylaxis):</strong>  · Aztreonam* 2 g IV q8h (+ Tobramycin* IV if admitted to ICU)  + Vancomycin** IV</td>
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<tr>
<td>Linezolid may be used in patients with vancomycin allergy (not red mans syndrome). See restriction criteria for appropriate empiric and definitive use of linezolid.</td>
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</tbody>
</table>

*Dose may need to be adjusted for renal dysfunction  **For ADULTS: Dose per vancomycin nomogram with trough goal 10-15

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The recommendations in this guide are meant to serve as treatment guidelines for use at Michigan Medicine facilities. If you are an individual experiencing a medical emergency, call 911 immediately. These guidelines should not replace a provider's professional medical advice based on clinical judgment, or be used in lieu of an Infectious Diseases consultation when necessary. As a result of ongoing research, practice guidelines may from time to time change. The authors of these guidelines have made all attempts to ensure the accuracy based on current information, however, due to ongoing research, users of these guidelines are strongly encouraged to confirm the information contained within them through an independent source.

If obtained from a source other than med.umich.edu/asp, please visit the webpage for the most up-to-date document.