

SITE-OF-CARE DECISIONS

- Determine if patient should be treated inpatient or outpatient
 - Outpatient care:** able to take oral medications and have adequate outpatient care
 - Inpatient care:** based on severity-of-illness scores (eg, CURB-65 criteria [confusion, uremia, respiratory rate, low blood pressure, 65 years or older]) or prognostic models (eg, Pneumonia Severity Index [PSI]) and professional judgment
- Patients with **CURB-65** score ≥ 2 require hospitalization or aggressive outpatient care
- If inpatient treatment required, determine if patient should be admitted to ICU or general ward
 - ICU admission required:** septic shock necessitating vasopressors, or acute respiratory failure requiring intubation and mechanical ventilation
 - ICU admission recommended:** 1 major criteria or 3 minor criteria are present

SEVERE CAP CRITERIA

Minor Criteria:

- | | |
|---|---|
| <ul style="list-style-type: none"> Hypothermia ($<36^{\circ}\text{C}$) $\text{PaO}_2/\text{FiO}_2$ ratio ≤ 250 Leukopenia ($\text{WBC} < 4000$ cells/mm^3) Multilobar infiltrates Confusion/disorientation Respiratory rate ≥ 30 breaths/min | <ul style="list-style-type: none"> Uremia ($\text{BUN} \geq 20\text{mg/dL}$) Thrombocytopenia (platelets < 100000 cells/mm^3) Hypotension requiring aggressive fluid resuscitation Other considerations: hypoglycemia, acute alcoholism/alcoholic withdrawal, hyponatremia, unexplained metabolic acidosis, elevated lactate, cirrhosis, asplenia |
|---|---|

Major Criteria

- | | |
|---|---|
| <ul style="list-style-type: none"> Invasive mechanical ventilation | <ul style="list-style-type: none"> Septic shock requiring vasopressors |
|---|---|

DIAGNOSTIC TESTS

- Physical exam:**
 - Crackles or rales, bronchial breath sounds, hypoxemia, tachypnic
 - Signs/symptoms of cough, fever, sputum production, pleuritic chest pain
- Chest radiograph:**
 - Observe apparent lobar or bilateral infiltrates with or without microbiological evidence
 - Hospitalized for suspected pneumonia but negative chest radiograph: may receive empiric antibiotics with repeat chest radiograph 24–48hrs later
- Lab tests:**
 - Pretreatment blood culture and/or expectorated sputum samples for culture and gram stain should be taken if: ICU admission, outpatient antibiotic therapy failure, cavitary infiltrates, leukopenia, active alcohol abuse, chronic severe liver and lung disease, asplenia, positive *Legionella* or pneumococcal UAT result, pleural effusion; optional for other indications
 - Tests mentioned above are optional in patients without these conditions
- Pulse oximetry**
- Severe CAP:** should obtain blood culture, expectorated sputum culture, urinary antigen tests for *Legionella pneumophila* and *S. pneumoniae*; endotracheal aspirate sample for intubated patients
- Nonresponsive to antibiotics:** chest CT, thoracentesis, bronchoscopy with BAL and transbronchial biopsies to rule out other reasons for antibiotic failure
- Diagnostic tests to determine etiology are optional for outpatients

OUTPATIENT EMPIRICAL TREATMENT

Previously healthy with no risk factors for drug-resistant *S. pneumoniae* (DRSP) infection or no use of antimicrobials within previous 3 months

Macrolide:

- azithromycin, clarithromycin, or erythromycin

Alternative: doxycycline

Comorbid conditions:

Diabetes, chronic heart, lung, liver, or renal disease, alcoholism, malignancies, asplenia, immunosuppressive conditions or drugs, use of antimicrobials in the previous 3 months, or other risks for DRSP infection

Respiratory Fluoroquinolone:

- moxifloxacin, gemifloxacin, or levofloxacin (750mg)

OR

β -Lactam PLUS Macrolide:

- amoxicillin (1g three times daily) or
- amoxicillin/clavulanate (2g twice daily) or
- cefepodoxime, ceftriaxone, or cefuroxime (500mg twice daily) plus
- azithromycin, clarithromycin, or erythromycin

Alternative to the Macrolide: doxycycline

Regions with high rate ($>25\%$) of macrolide-resistant *S. pneumoniae*:

Consider alternative agents:

- eg, β -Lactam or Respiratory Fluoroquinolone

INPATIENT EMPIRICAL TREATMENT

Non-ICU

Recommendations:	<p>Respiratory Fluoroquinolone OR β-Lactam PLUS Macrolide:</p> <ul style="list-style-type: none"> • cefotaxime, ceftriaxone, or ampicillin plus • ertapenem (selected patients) <p>Alternative to the Macrolide: doxycycline</p> <p>**Penicillin Allergy**: use Respiratory Fluoroquinolone</p>
-------------------------	--

ICU

Minimal Recommendations:	<p>β-Lactam PLUS Azithromycin OR Fluoroquinolone:</p> <ul style="list-style-type: none"> • cefotaxime, ceftriaxone, ampicillin/sulbactam <p>**Penicillin Allergy**: a Respiratory Fluoroquinolone AND Aztreonam are recommended</p>
Additional Recommendations or Modifications: If <i>Pseudomonas</i> Infection	<p>Antipneumococcal Antipseudomonal β-Lactam* PLUS Ciprofloxacin OR Levofloxacin (750mg):</p> <ul style="list-style-type: none"> • piperacillin-tazobactam, cefepime, imipenem, meropenem <p>OR</p> <p>*Above β-Lactam PLUS Aminoglycoside AND Azithromycin OR</p> <p>*Above β-Lactam PLUS Aminoglycoside AND Antipneumococcal Fluoroquinolone</p> <p>**Penicillin Allergy**: substitute Aztreonam for above β-Lactam</p>
If Community-Acquired Methicillin-Resistant <i>S. aureus</i> (CA-MRSA)	Add vancomycin or linezolid

PATHOGEN SPECIFIC TREATMENT

<i>S. pneumoniae</i> PCN susceptible (MIC <2µg/mL)	<p>Preferred: penicillin G, amoxicillin</p> <p>Alternative: macrolide, cephalosporins (cefepodoxime, cefprozil, cefuroxime, cefdinir, ceftriaxone, cefotaxime), clindamycin, doxycycline, respiratory fluoroquinolone</p>
<i>S. pneumoniae</i> PCN resistant (MIC ≥2µg/mL)	<p>Preferred: based on susceptibility including cefotaxime, ceftriaxone, fluoroquinolone</p> <p>Alternative: vancomycin, linezolid, high-dose amoxicillin (3g/day with PCN MIC ≤4µg/mL)</p>
<i>H. influenzae</i> non-β-lactamase producing	<p>Preferred: amoxicillin</p> <p>Alternative: fluoroquinolone, doxycycline, azithromycin, clarithromycin</p>
<i>H. influenzae</i> β-lactamase producing	<p>Preferred: 2nd or 3rd generation cephalosporin, amoxicillin/clavulanate</p> <p>Alternative: fluoroquinolone, doxycycline, azithromycin, clarithromycin</p>
<i>Legionella</i> species	<p>Preferred: fluoroquinolone, azithromycin</p> <p>Alternative: doxycycline</p>
<i>Mycoplasma pneumoniae</i> , <i>Chlamydia pneumoniae</i>	<p>Preferred: macrolide, tetracycline</p> <p>Alternative: fluoroquinolone</p>
Influenza A	<p>Preferred: initiate oseltamivir or zanamivir within 48hrs if influenza A identified. Not recommended if uncomplicated influenza and symptoms ongoing for >48hrs.</p>
H5N1 Influenza	<p>Preferred: oseltamivir 75mg twice daily for 5 days</p>

OTHER TREATMENTS

- Consider local resistance patterns, previous antibiotic use, and comorbidities when choosing empirical antibiotics
- Administer noninvasive ventilation in cases of hypoxemia or respiratory distress unless immediate intubation necessary due to severe hypoxemia or bilateral alveolar infiltrates
- Low-tidal-volume ventilation (6cm³/kg of IBW) for patients with diffuse bilateral pneumonia or acute respiratory distress syndrome
- Screen for occult adrenal insufficiency in hypotensive fluid-restricted patients with severe CAP

TREATMENT DURATION

- **Admission through Emergency department:** administer 1st antibiotic dose in the ED
- Initiate treatment within 6–8hrs of presentation
- **Duration:** minimum 5 days of treatment, should be afebrile 48–72hrs, and no more than 1 CAP associated sign of clinical instability before discontinuing therapy
- Longer duration of therapy may be warranted in certain circumstances (eg, initial therapy did not target identified pathogen, extrapulmonary infections such as meningitis or endocarditis)

IV TO ORAL SWITCH

- Switch once hemodynamically stable, notable clinical improvement, normal functioning GI tract, and can ingest oral therapy
- Usually switch to oral form of same antibiotic or same pharmacological class
- Discharge once clinically stable, no other active medical problems, and have a safe environment for continued care as an outpatient
- **Criteria for Clinical Stability:**
 - Temp $\leq 37.8^{\circ}\text{C}$
 - Heart rate ≤ 100 beats per min
 - Respiratory rate ≤ 24 breaths per min
 - Systolic blood pressure ≥ 90 mmHg
 - Arterial O_2 saturation $\geq 90\%$ or $\text{pO}_2 \geq 60$ mmHg
 - Maintain oral intake and normal mental status

PREVENTION

- Smoking cessation should be advised in hospitalized patients
- Assess vaccination status at time of hospital admission
- Inactivated influenza vaccine recommended for all children 6–23 months and ≥ 50 years of age, high risk persons 6 months–49 years of age, household contacts of high-risk persons, healthcare workers, pregnancy, diabetes, asthma
- Pneumococcal vaccine recommended for persons ≥ 65 years of age, high-risk persons 2–64 years of age, smokers, diabetes, asplenia, alcoholism, chronic cardiovascular, pulmonary, renal, or liver disease
- Offer influenza vaccine administration during discharge or outpatient treatment; vaccines can be given during either time

REFERENCES

- Mandell LA, Wunderink RG, Anzueto A, et. al. Infectious Disease Society of America/American Thoracic Society Consensus Guidelines on the Management of Community-Acquired Pneumonia in Adults. *IDSA/ATS*. 2007; 44 Suppl 2: S27–S63. (Rev. 11/2017)