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:
• Hypothermia (<36°C)
• PaO2/FiO2 ratio ≤250
• Leukopenia (WBC <4000 cells/mm³)
• Multilobar infiltrates
• Confusion/disorientation
• Respiratory rate ≥30 breaths/min

Major Criteria:
• Invasive mechanical ventilation
• 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
• cefpodoxime, 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

(continued)
## INPATIENT EMPIRICAL TREATMENT

### Non-ICU

**Recommendations:**
- Respiratory Fluoroquinolone OR
- β-Lactam PLUS Macrolide:
  - cefotaxime, ceftriaxone, or ampicillin plus
  - ertapenem (selected patients)

**Alternative to the Macrolide:** doxycycline

**Penicillin Allergy**: use Respiratory Fluoroquinolone

### ICU

**Minimal Recommendations:**
- β-Lactam PLUS Azithromycin OR Fluoroquinolone:
  - cefotaxime, ceftriaxone, ampicillin/sublactam

**Penicillin Allergy**: a Respiratory Fluoroquinolone AND Aztreonam are recommended

#### Additional Recommendations or Modifications:

- **If Pseudomonas Infection**
  - Antipneumococcal Antipseudomonal β-Lactam* PLUS Ciprofloxacin OR Levofloxacin (750mg):
    - piperacillin-tazobactam, cefepime, imipenem, meropenem OR
  - *Above β-Lactam PLUS Aminoglycoside AND Azithromycin OR
  - *Above β-Lactam PLUS Aminoglycoside AND Antipneumococcal Fluoroquinolone

**Penicillin Allergy**: substitute Aztreonam for above β-Lactam

- If Community-Acquired Methicillin-Resistant S. aureus (CA-MRSA)
  - Add vancomycin or linezolid

### PATHOGEN SPECIFIC TREATMENT

#### S. pneumoniae
- **PCN susceptible** (MIC <2µg/mL)
  - Preferred: penicillin G, amoxicillin
  - Alternative: macrolide, cephalosporins (cefuroxime, cefdinir, erythromycin, ceftriaxone, cefotaxime), clindamycin, doxycycline, respiratory fluoroquinolone

- **PCN resistant** (MIC ≥2µg/mL)
  - Preferred: based on susceptibility including cefotaxime, ceftriaxone, fluoroquinolone
  - Alternative: vancomycin, linezolid, high-dose amoxicillin (3g/day with PCN MIC ≤4µg/mL)

#### H. influenzae non-β-lactamase producing
- Preferred: amoxicillin
  - Alternative: fluoroquinolone, doxycycline, azithromycin, clarithromycin

#### H. influenzae β-lactamase producing
- Preferred: 2nd or 3rd generation cephalosporin, amoxicillin/clavulanate
  - Alternative: fluoroquinolone, doxycycline, azithromycin, clarithromycin

#### Legionella species
- Preferred: fluoroquinolone, azithromycin
  - Alternative: doxycycline

#### Mycoplasma pneumoniae, Chlamydophila pneumoniae
- Preferred: macrolide, tetracycline
  - Alternative: fluoroquinolone

#### Influenza A
- Preferred: initiate oseltamivir or zanamivir within 48hrs if influenza A identified. Not recommended if uncomplicated influenza and symptoms ongoing for >48hrs.

#### H5N1 Influenza
- Preferred: oseltamivir 75mg twice daily for 5 days

### 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 (6cm$^3$/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)

(continued)
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 ≤37.8°C
  - Systolic blood pressure ≥90mmHg
  - Heart rate ≤100 beats per min
  - Arterial O₂ saturation ≥90% or pO₂ ≥60mmHg
  - Respiratory rate ≤24 breaths per min
  - 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