

PNEUMONIA

(Last updated 11/13/2019; Reviewers: C. Schmickl, MD, MPH; John (Jack) C. O'Horo, MD, MPH; Yuliya Pinevich, MD)

PRESENTING COMPLAINT: Cough, fever, shortness of breath

FINDINGS

- **A** Check airway, cough
- **B** ↑RR, shortness of breath, increased work of breath, low SpO₂
- **C** ↑HR, ↓BP, mottling
- **D** Variable altered (V,P,U,D)*; Pleuritic chest pain (occasionally abdominal/back pain in case of lower lobe pneumonia)
- **E** Fever, crackles, decreased/bronchial breath sounds, dullness to percussion, egophony and tactile fremitus; cyanosis in severe cases
- **L_{PC}** ↓PaO₂, ↓PCO₂, ↑A-a gradient, CBC, ↑WBC, ↑ or N lactate
- **U_{PC}** Ultrasound B lines/C pattern with or without effusion

***V** (verbal), **P** (pain), **U** (unconsciousness), **D** (delirious)

U_{PC} (point of care ultrasound) **L_{PC}** (point of care labs)

OTHER HISTORY

Signs and symptoms: Cough (productive; nonproductive in atypical pneumonia), purulent sputum, fever, shacking chill, sweats, shortness of breath; skin lesions - maculopapular, vesicular, urticarial, or erythema multiforme (Mycoplasma infection); gastrointestinal symptoms - diarrhea and abdominal cramping, and muscle aches (Legionella infection); fatigue

Onset: abrupt (typical); gradual onset and viral prodrome (atypical pneumonia)

Predisposing conditions: very young or very old, immune suppression, airway obstruction, recent contact with respiratory infection, the health care system, geographic or animal exposure

DIFFERENTIAL DIAGNOSIS

Other source of infection, pulmonary embolism, atelectasis, acute aspiration of gastric contents or other liquids, COPD or CHF exacerbation, Non-infectious pulmonary infiltrates (vasculitis, malignancy, interstitial lung disease, organizing pneumonia)

OTHER INVESTIGATIONS

- **Labs:** Blood & sputum cultures (consider BAL if suspicious of atypical organisms – PJP, histo, blasto); consider Multiplex PCR (Influenza & other viruses, Mycoplasma, Chlamydia); urinary antigen tests (Legionella, S. pneumoniae)

- **Imaging:** Chest radiographs +/- CT chest to evaluate for foreign bodies, infiltrate, nodules, masses
- **Thoracentesis** to exclude complicated effusion/empyema

THERAPEUTIC INTERVENTIONS

- **Oxygen** (goal O₂ sat ≥ 90%): If respiratory failure (RR>30 and increased work of breathing):
 - Cautious trial of high-flow oxygen or NIV
 - Prompt intubation if previous supports fail or contraindicated (lack of airway protection, shock, metabolic acidosis, severe hypoxemia (PaO₂/FiO₂ <150)): use low tidal volumes
- **Early anti-microbial therapy:**
 - As soon as possible, preferably after obtaining blood +/- sputum specimens but <4 hours
 - Start empirically according to likely pathogen, previous health care, immunosuppression (see algorithm), then narrow to pathogen-directed therapy based on cultures/clinical course
 - Adjust empiric therapy based on local antibiogram, patient allergy and renal function
- **Adjunctive therapy:** Consider steroids (e.g. methylprednisolone 0.5mg/kg q12h or Prednisone 40-60mg daily for ~ 5 days – caution if pneumonia due to Influenza/Aspergillus)
 - Chest tube if complicated parapneumonic effusion or empyema
- Early shock recognition and treatment according to local sepsis guidelines

ONGOING TREATMENT

- **Monitoring:** Follow fever curve, oxygenation requirement, mental status
 - If no improvement within 72 h, re-evaluate antibiotics choice, and consider possible other source of infection (e.g. abscess, empyema, abdominal sepsis); ultrasound, CT, bronchoscopy/BAL
- Adjust Treatment:
 - De-escalation therapy: narrow antibiotics based on results from cultures (i.e. target therapy if causative agent found; stop covering MRSA/Pseudomonas early if cultures negative)
 - If clinically improving and GI tract intact switch to oral antibiotics
 - General duration of therapy: CAP 5-7days; HAP/VAP 7days
 - Consider stopping ABs early if clinically improving and Procalcitonin negative (<0.25)
- Adjunctive Therapy: Adequate hydration and nutrition; adequate pain management; deep breathing & coughing, incentive spirometry, physical therapy; head of bed elevated ≥30 degrees, if tolerated; lateral decubitus positioning (“good lung down”) if severe unilateral disease
- Prophylaxis: Pneumococcal vaccine if age >65 or immunocompromised and not already received; Yearly influenza vaccination

CAUTIONS

- Isolation precautions: if MDR-organism, MRSA, influenza, novel pathogens (MERS/SARS)

ALGORITHM

Community-acquired Pneumonia (CAP)* (any non-HAP/VAP Pneumonia requiring ICU-level of care)	Hospital-acquired/Ventilator-associated Pneumonia (HAP/VAP) (HAP >48h after admission; VAP >48h after intubation)
<p>GENERAL EMPRIC COVERAGE</p> <p>Coverage for Pneumococcus, Legionella, GNR, MSSA:</p> <p>Anti-pneumococcal beta-lactam (e.g. Ceftriaxone 1g IV daily or Ampicillin-Sulbactam 3g IV q6h)</p> <p>PLUS</p> <p>Macrolid (e.g. Azithromycine 500mg IV daily) OR respiratory Fluoroquinolone (e.g. Levofloxacin 750mg IV daily)</p>	<p>GENERAL EMPRIC COVERAGE</p> <p>Coverage for MSSA + GNR incl Pseudomonas:</p> <p>Piperacillin-Tazobactam 4.5g IV q6h OR Cefepime 2g IV q8h OR Levofloxacin 750mg IV daily</p>
<p>SPECIAL CONSIDERATIONS</p> <p>Concern for Pseudomonas^a</p> <p>Anti-pneumococcal, anti-pseudomonal beta-lactam (e.g. Piperacillin-Tazobactam 4.5g IV q6h or Cefepime 2g IV q8h)</p> <p>PLUS</p> <p>respiratory Fluoroquinolone (e.g. Levofloxacin 750mg IV daily)</p> <p>Concern for MRSA^b or high mortality risk^c</p> <p>Add Vancomycin 15mg/kg q8-12h for goal trough 15-20mg/mL</p>	<p>SPECIAL CONSIDERATIONS</p> <p>Concern for MRSA^b</p> <p>Add Vancomycin 15mg/kg q8-12h for goal trough 15-20mg/mL</p> <p>Concern for MDR-GNR/Pseudomonas^a or high mortality risk^c</p> <p>Vancomycin 15mg/kg q8-12h for goal trough 15-20mg/mL</p> <p>PLUS 2 of the following (avoid 2 beta-lactams):</p> <p>Piperacillin-Tazobactam 4.5g IV q6h OR Cefepime 2g IV q8h OR Carbapenem (e.g. Meropenem 1g IV q8h) OR Levofloxacin 750mg IV daily OR Aminoglycoside (e.g. Gentamicin 5-7mg/kg IV daily) OR Aztreonam 2g IV q8h (OK to combine with other beta-lactam antibiotic)</p>

GNR Gram-negative rods, MSSA/MRSA Methicillin-sensitive/-resistant Staph aureus, MDR multi-drug resistant, RF risk factor

* note Health-care acquired pneumonia (HCAP) has been removed from recent IDSA guidelines [Kalil et al CID 2016], focus is now on individual MDR-RFs

^a IV antibiotics within 90days, GNR on gram stain, structural lung disease (bronchiectasis, cystic fibrosis), COPD with frequent antimicrobial and steroid use

^b Gram-positive cocci in clusters on gram stain, known MRSA colonizer; RFs incl IV Abs within 90d, IVDU, end stage renal disease, recent flu; prevalence MDR-GNR/Pseudomonas >20% or unknown (for HAP/VAP); ARDS preceding VAP, on HD (VAP)

^c estimated mortality >25%, septic shock, respiratory failure requiring ventilatory support (for CAP/HAP)

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