Consensus Guidelines for Inpatient Management of Community Acquired Pneumonia in Infants & Children > 2 Months: UCSF Northern California Pediatric Hospital Medicine Consortium

Executive summary

Objectives
• Standardize and improve the quality of care of pediatric patients with uncomplicated community acquired pneumonia (CAP) in the outpatient and inpatient settings; specifically:
  o Decrease unnecessary laboratory testing and imaging
  o Standardize admission / discharge criteria to decrease unnecessary hospital days
  o Decrease use of broad-spectrum antibiotics and use best available evidence to guide selection of appropriate antibiotic therapy

Recommendations
• Do NOT routinely obtain laboratory testing or imaging in children with CAP who can be treated in the outpatient setting
• Consider obtaining blood culture in children with moderate to severe CAP requiring hospitalization
• Obtain PA and lateral chest x-ray in children requiring hospital admission for CAP
• Obtain rapid influenza and other respiratory viral testing in the evaluation of children with CAP
• Use Amoxicillin / Ampicillin for first-line treatment of uncomplicated, typical CAP in fully immunized children
• Discontinue use of continuous pulse oximetry monitoring in hospitalized patients who are clinically stable and not requiring supplemental oxygen

Methods
This guideline was developed through local consensus based on published evidence and expert opinion as part of the UCSF Northern California Pediatric Hospital Medicine Consortium.

Metrics Plan
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Consensus Clinical Guidelines for Inpatient Management of Community Acquired Pneumonia in Infants & Children > 2 Months: UCSF Northern California Pediatric Hospital Medicine Consortium

Consensus Clinical Guidelines

Criteria for Use of Inpatient Community-Acquired Pneumonia (CAP) Guidelines

- Age >2 months and <20 years
- Absence of chronic lung disease, immunodeficiency, or other congenital anomalies / chronic medical condition predisposing to unusual or recurrent infection
- Community acquired infection (excludes hospital acquired, aspiration, other etiologies)
- Uncomplicated pneumonia (excludes >small or loculated pleural effusion)

Site of Care Management Decisions

- Indications for admission to inpatient setting:
  - Most common:
    - “moderate to severe” disease
      - respiratory distress / work of breathing
      - hypoxia (<90% on RA)
      - “toxic” appearance
    - dehydration / poor PO intake
    - inability to tolerate PO therapy
  - Less common:
    - Failed appropriate PO antibiotic therapy
    - 2-6 mo old infants with CAP

Diagnostic Testing

- Blood Culture:
  - NOT indicated in outpatient setting
  - Indications for BCx on admission to inpatient setting:
    - “Moderate to severe” CAP:
      - hypoxia
      - work of breathing
      - “toxic” or “sick” appearance
  - Balancing factors:
    - (-) risk of contaminants
    - (-) low yield
    - (+ / -) potential change in management
    - (+) opportunity to identify organism pre-abx therapy

- Chest X-ray:
  - NOT routinely indicated in outpatient setting
  - PA & Lateral CXR indicated in ALL children upon admission to inpatient setting (for new diagnosis or worsening clinical symptoms / failed outpatient tx)
  - Consider repeat CXR prior to broadening or switching antimicrobial therapy in inpatient setting
Microbiologic Testing:
- NOT routinely recommended in outpatient setting
- Recommendations for testing upon admission to inpatient setting:
  - Flu testing indicated during influenza season
  - RSV testing indicated during RSV season in patients <2 yo with consistent symptoms
  - Serum testing for *mycoplasma pneumoniae* NOT routinely indicated for suspected atypical infections
  - Sputum sampling NOT routinely indicated

Pulse Oximetry Monitoring:
- Indications for continuous pulse oximetry monitoring:
  - Initial assessment (for period of 4hrs)
  - Unstable clinical status
  - Supplemental oxygen (for period of at least 24hrs)
- Indications for spot O2 sat checks with periodic vital signs:
  - Clinically stable patient x >24hrs
  - Patients not requiring supplemental oxygen

**Antimicrobial Therapy (Inpatient, typically IV)**
- *NOTE*: Children with suspected or confirmed viral PNA should NOT be treated with antibiotics
- *NOTE*: Institutional antibiogram susceptibilities may not be applicable for CAP because susceptibility data is drawn from patient population with higher acuity disease / more invasive disease processes
- *NOTE*: Immunization status affects antimicrobial treatment decisions
  - Children >6mo old with complete primary pneumococcal immunization vs. partial but incomplete primary immunization series may be considered as equivalent for antibiotic treatment decisions
  - Children ages 2-6mo with partial / incomplete immunization status should be treated cautiously
  - Completely un-immunized children should be considered separately
- **SEE APPENDIX 1: EMPIRIC ANTIBACTERIAL THERAPY FOR PEDIATRIC CAP**

- **Ampicillin 1st Line:**
  - Typical / lobar / uncomplicated CAP:
    - CXR evidence of typical / lobar bacterial CAP
    - Hemodynamically stable
    - >6mo old & otherwise healthy (no immunodeficiency, chronic lung disease, etc)
    - No effusion or small effusion
    - Caution in 2-6 mo age range (young age, incompletely immunized)
- **Ceftriaxone 1st Line:**
  - Failed appropriate PO antibiotics (high-dose Amoxicillin) x 24-48hrs outpatient = suspect PCN-resistant pneumococcal strain
  - Failed IV Ampicillin x 24-48hrs inpatient
  - Completely un-immunized children
  - Consider for 2-6mo age range (young, incomplete primary immunization series)
- **Vancomycin 1st Line:**
  - May use in combination with Ceftriaxone for suspected Staphylococcal PNA:
    - Complicated PNA
      - Loculated / large effusion, empyema
Necrotizing PNA

- Lobar PNA following documented or suspected influenza infection
- Poor response to typical CAP treatment (PO or IV) or prolonged treatment course with typical CAP antibiotic regimen + suspicion for Staph PNA

- May use as monotherapy in selected cases of suspected Staph PNA if discussed with Pediatric ID consult
- In ICU setting, use as dual therapy with Ceftriaxone (+/- potential other abx):
  - “Toxic” / critically ill patients
    - Severe respiratory distress, hypoxia
    - Hemodynamic instability
  - Pediatric ID and surgery consults recommended for patients with severe disease of this type

Clindamycin 1st Line:

- NOTE: Not recommended as first-line monotherapy for suspected Staph PNA unless discussed with Pediatric ID consult
- May be used as monotherapy in selected cases of suspected Staph PNA if discussed with Pediatric ID consult:
  - NOTE: gap in coverage = H.flu, gram negatives
  - Consider repeat CXR / diagnostic thoracocentesis / pleural tap prior to use as monotherapy (or transfer to UCSF from community hospital sites)
- May be used as dual therapy with Ceftriaxone, particularly in ICU setting

Azithromycin 1st Line:

- Suspected atypical PNA in school-aged child or adolescent (>5yo)
  - Low-grade fever
  - Non-focal pulmonary exam
  - Non-focal CXR with bilateral / interstitial infiltrates
  - Bacterial cause more likely then viral if indolent / protracted symptoms
- Consider for dual therapy with Ampicillin or other antibiotic in younger patients IF:
  - Wheezing (asthmatic patient or first-time wheeze)
  - Patient not improving on Ampicillin / other monotherapy
  - CXR consistent with atypical infection

Oseltamivir 1st Line:

- Presumed or confirmed influenza PNA

Diagnosis of Effusion & Adjunctive Therapy

- Diagnosis of effusion:
  - History, exam, + CXR
  - If CXR inconclusive or >small effusion → Chest Ultrasound or Chest CT
- Management of effusion:
  - If small / simple: antibiotics only
  - If large / loculated (= complicated PNA):
    - Transfer to UCSF from community sites for chest tube / VATS
    - Community hospital sites may consider IR vs. general surgery chest tube placement for children >10yo
  - NOTE: This guideline does not detail recommended antimicrobial therapy and other management for complicated PNA
Discharge Criteria / Discharge Planning

- Choice of PO Antibiotic:
  - Typical PNA treated with Ampicillin IV: High-dose Amoxicillin
  - Typical PNA treated with Ceftriaxone IV or Ampicillin-Sulbactam IV: High-dose Amoxicillin-Clavulaunate or Cefdinir
  - Staph PNA: Clindamycin (or alternative based on further diagnostic evaluation and/or ID consult recommendation)
  - Atypical PNA: Azithromycin
  - Influenza PNA: Oseltamivir

- Duration of Therapy
  - Mild-moderate CAP: 7-10 days
  - Severe CAP: 14 days

- PMD follow-up: within 2 days of hospital discharge
References


- UCSF IDMP Guidelines for CAP: [http://clinicalpharmacy.ucsf.edu/idmp/peds_home.htm](http://clinicalpharmacy.ucsf.edu/idmp/peds_home.htm)

**APPENDIX 1: Empiric Antibacterial Therapy for Pediatric CAP**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Common Pathogens</th>
<th>(PO)</th>
<th>(IV)</th>
<th>ICU (IV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young infant / Un-immunized</td>
<td>S. pneumoniae</td>
<td>(Admission and IV recommended)</td>
<td>Ceftriaxone</td>
<td>Ceftriaxone +/- Vancomycin</td>
</tr>
<tr>
<td></td>
<td>H. influenzae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical / Lobar, Uncomplicated (small or no effusion)</td>
<td>S. pneumoniae, M. catarrhalis (RARE: H. influenzae, S. aureus)</td>
<td>High dose Amoxicillin (2)</td>
<td>Ampicillin (2)</td>
<td>Ceftriaxone +/- Vancomycin</td>
</tr>
<tr>
<td>Failed Outpt Amoxicillin treatment</td>
<td>S. pneumoniae, M. catarrhalis</td>
<td>Second Line: Amoxicillin-Clavulanate</td>
<td>Ampicillin-Sulbactam</td>
<td>Ceftriaxone +/- Vancomycin (2) Alternative: Ampicillin-Sulbactam</td>
</tr>
<tr>
<td>Complicated (3) and/or Suspected S. aureus (4)</td>
<td>S. aureus, S. pneumoniae, M. catarrhalis</td>
<td>High dose Amoxicillin-Clavulanate (2)</td>
<td>Ceftriaxone (2)</td>
<td>Ceftriaxone +/- Vancomycin (2) Alternative: Ampicillin-Sulbactam</td>
</tr>
<tr>
<td>Atypical (3)</td>
<td>M. pneumoniae, C. pneumophilia</td>
<td>Azithromycin</td>
<td>Azithromycin (generally added to coverage for standard pathogens for inpatients)</td>
<td>Alternative: Fluorquinolones (Levofloxacin)</td>
</tr>
</tbody>
</table>

*Pediatric ID and Surgery Consults Recommended*
### Antibiotic Doses for CAP in Children > 1 Month of Age

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oral Options</strong></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>45 mg/kg/dose twice daily</td>
</tr>
<tr>
<td>Amoxicillin/Clavulanate</td>
<td>45 mg amoxicillin/kg/dose twice daily</td>
</tr>
<tr>
<td>(Augmentin ES-600)</td>
<td></td>
</tr>
<tr>
<td>Azithromycin</td>
<td>10 mg/kg x1, then 5 mg/kg/dose daily on days 2-5</td>
</tr>
<tr>
<td>Cefdinir (Omnicef)</td>
<td>14 mg/kg/dose daily</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>10 mg/kg/dose three times daily</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>6 mo to &lt;5yo: 10mg/kg/dose twice daily &gt;5yo: 10mg/kg/dose once daily</td>
</tr>
<tr>
<td><strong>IV Options</strong></td>
<td></td>
</tr>
<tr>
<td>Ampicillin</td>
<td>50 mg/kg/dose q6h</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>10 mg/kg/dose q24h</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>50 mg/kg/dose q8h</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>50 mg/kg/dose q24h</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>8 mg/kg/dose q8h</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>6mo to &lt;5yo: 10mg/kg/dose q12h &gt;5yo: 10mg/kg/dose q24h</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>15 mg/kg/dose q6h</td>
</tr>
</tbody>
</table>

**Footnotes:**

1. **Criteria for Use of Guidelines:**
   - Age >1 month (or correct gestational age >44 weeks) and <20 years
   - Absence of chronic lung disease, immunodeficiency, or congenital anomaly
   - Community-acquired infection (not hospital-acquired infection)

2. **Type I PCN Hypersensitivity Alternatives:**
   - Outpatient: Levofloxacin or Azithromycin
   - Inpatient: Levofloxacin or Azithromycin
   - ICU: Levofloxacin +/- Vancomycin

3. **Signs of Complicated CAP:**
   - Necrotizing PNA
   - Large effusion / empyema

4. **Suspect S. aureus CAP if:**
   - Complicated PNA
   - Lobar PNA following documented or suspected influenza infection
   - Poor response to typical CAP treatment or prolonged treatment course with typical CAP antibiotic regimen + suspicion for Staph PNA

5. **Coverage for atypical etiologies of CAP can be added to standard bacterial coverage for inpatients or used exclusively for outpatients. Signs suggestive of atypical etiologies include:**
   - Low-grade fever
   - Non-focal pulmonary exam
   - Non-focal CXR with bilateral / interstitial infiltrates
   - Bacterial cause more likely than viral cause if indolent / protracted symptoms