Uncomplicated Pediatric CAP guideline SIU-SOM

This guideline applies to children 90 days of age and older. All neonates with pneumonia should be hospitalized and treated with empiric antimicrobial therapy similar to neonatal sepsis treatment.

DEFINITIONS

Community Acquired Pneumonia: Infection of airways and lung tissue caused by a multitude of organisms, including a viral and bacterial etiology, which was acquired outside of the hospital.

Uncomplicated Pneumonia: Pneumonia in the absence of significant effusion, empyema, severe or impending respiratory failure, and/or signs and symptoms of sepsis or shock.

Occult Pneumonia: The presence of radiographic pneumonia in children who do not show signs of respiratory distress or lower respiratory tract findings on physical exam.

Complicated Pneumonia: Pneumonia with significant effusion empyema, necrotizing pneumonia, severe or impending respiratory failure, and/or signs and symptoms of sepsis or shock.

CRITERIA

Inclusion Criteria

- 90 days through 18 years of age with signs, symptoms or other finding of uncomplicated pneumonia acquired by exposure to organisms in the community

Exclusion Criteria

- Patients with complicated pneumonia (i.e., empyema, large effusion)
- Immunocompromised host
- Children less than 90 days of age
- Aspiration pneumonia
- Hospital acquired pneumonia
- Tracheostomy dependent patients
- Patients in need of immediate critical care
- Systemic illness concerning for sepsis

CLINICAL ASSESSMENTS

Assessment elements should include:

- Immunization history (less than 2 doses of Hib vaccine, no influenza vaccine, no pneumococcal vaccine and no *Bordetella pertussis* vaccine)
- Comorbidities: asthma/previous history of wheezing; seizures/neuromuscular diseases, heart disease, prematurity/BPD, sickle cell disease, immunocompromised status
- TB exposure including exposure to anyone with a chronic cough
- History of foreign body aspiration risk

- Travel history
- Consider exposure to unusual pathogens including tularemia (ticks/rabbits), plague (squirrels/prairie dogs/dead animals), and Fusobacterium (persistent sore throat)
- Other ill contacts including family members or day care/school exposure

Should patient be hospitalized?

The PIDS/IDSA[1] guideline offers specific recommendations for hospitalization for children and infants with CAP.

- Children and infants who have moderate to severe CAP, as defined by several factors, including respiratory distress and hypoxemia (sustained saturation of peripheral oxygen [SpO2], ≤90 % on room air (Table 1) should be hospitalized for management, including skilled pediatric nursing care.
- Infants less than 3-6 months of age suspected of bacterial pneumonia.
- Children/infants suspected of pneumonia with *Staphylococcus aureus* as a pathogen (empyema, pneumatocele, multiple abscesses, rapidly progressive pneumonia)
- Children/infants with concerns for compliance with therapy.

Table 1. Criteria for Respiratory Distress in Children with Pneumonia

Signs of Respiratory Distress
1. Tachypnea, respiratory rate, breaths/min*
Age 0-2 months: >60
Age 2-12 months: >50
Age 1 – 5 years: >40
Age > 5 years: >20
2. Dyspnea
3. Retractions (suprasternal, intercostal, or subcostal)
4. Grunting
5. Nasal flaring
6. Apnea
7. Altered mental status
8. Pulse oximetry measurement <90% on room air

***Adapted from the World Health Organization criteria.**

Bradley, J.S., et al., The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis, 2011. 53(7): p. e25-76.

Table 2. Criteria for CAP severity of Illness in Children with CAP

Clinicians should consider care in an ICU or a unit with continuous cardiorespiratory monitoring for the child having ≥ 1 major or ≥ 2 minor criteria

Major Criteria
Invasive mechanical ventilation
Fluid refractory shock
Acute need for NIPPV
Hypoxemia requiring FiO2 greater than inspired concentration or flow feasible in general care area
Minor Criteria
Respiratory rate higher than WHO classification for age
Apnea
Increased work of breathing (eg, retractions, dyspnea, nasal flaring, grunting)
PaO2/FiO2 ratio <250
Multilobar infiltrates
PEWS score (Pediatric Early Warning Score) > 6
Altered mental status
Hypotension
Presence of effusion
Comorbid conditions (eg, HgbSS, immunosuppression, immunodeficiency)
Unexplained metabolic acidosis

Modified from Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults [2, table 4].

Abbreviations: FiO2, fraction of inspired oxygen; HgbSS, Hemoglobin SS disease; NIPPV, noninvasive positive pressure ventilation; PaO2, arterial oxygen pressure; PEWS, Pediatric Early Warning Score

DIAGNOSTIC TESTS / STUDIES

Initial Radiologic Studies

- CXR AP and lateral (on hospitalized patients)
- Repeat single view AP only if clinical deterioration or lack of clinical improvement at 48 hours

Laboratory Studies

- CBC with differential should ***not*** be obtained unless necessary to help decide whether to use antibiotics

    - Limited role in differentiating viral versus bacterial pneumonia
    - May be helpful in children < 5 years with fever (> 39C) without a source and WBC > 20k
- CRP and ESR should ***not*** be performed
    - ESR and procalcitonin have limited role in differentiating viral from bacterial pneumonia. The sensitivity of CRP is too poor to be useful.
    - CBC/ESR/CRP may be helpful to monitor patients who are improving or if concerning for sepsis.
- A viral respiratory study (Biofire PCR upper respiratory profile) is indicated only if results would change management.
- Sputum – consider Gram stain and culture on high quality specimen in children capable of producing an adequate sample (typically school aged).
    - Note: High quality is presence of < 10 squamous epithelial cells and > 25 WBCs per low power field
- Blood cultures are ***not*** needed for simple uncomplicated pneumonia.
- Blood culture should be obtained in children requiring hospitalization for presumed complicated pneumonia or if clinically worsening on appropriate antibiotic therapy.
- If child well appearing and reliable follow-up can be assured, discharge home should not be delayed for blood cx results.
- When history, physical, radiologic, or laboratory findings are inconsistent, additional studies should be considered to evaluate for foreign body aspiration or immunodeficiency.
- Consider pertussis if predominant symptom is cough (paroxysmal or prolonged).
- The Biofire PCR upper respiratory profile can detect *Mycoplasma pneumoniae*, *Chlamydophila pneumoniae* and *Bordetella pertussis*, *Bordetella parapertussis*, in addition to influenza A and B, RSV, human metapneumovirus (hMPV), adenovirus, rhinovirus/enterovirus, coronavirus SARS CoV-2, 229E, HKU1, NL63, OC43, and parainfluenza 1,2,3, 4.

THERAPEUTICS

- In children < 5 yrs, etiology is more likely to be viral and routine use of antibiotics is not recommended (viral causes include influenza A and B, respiratory syncytial virus, parainfluenza virus, human metapneumovirus, adenovirus, rhinovirus).
- Common bacterial causes of pneumonia in childhood include the following
    - *Streptococcus pneumoniae*
    - *Staphylococcus aureus* (including MRSA)
    - *Haemophilus influenzae* (if under-immunized)
    - *Streptococcus pyogenes*
    - Atypical pathogens (*Bordetella pertussis*, *Mycoplasma pneumoniae* and *Chlamydophila pneumoniae* in school-aged children)

Route of treatment

- According to PIDSA guidelines, “Children with suspected bacterial CAP that is serious enough to warrant hospitalization should routinely be treated with parenteral antibiotics

to provide reliable blood and tissue concentrations." Therefore, IV antibiotics for initial therapy should be considered in patients with uncomplicated CAP admitted to the hospital with vomiting or suspected decreased GI absorption.

- For patients with mild illness, initial therapy with oral antibiotics may be appropriate.
- Failure of outpatient oral therapy is defined as fever greater than or equal to 38.0C lasting > 48 hrs, and may be due to inadequate choice or dosing of antibiotic, poor compliance, natural history of disease, or resistant organism. **It is still reasonable to treat IV with ampicillin as pharmacokinetics are far superior to oral amoxicillin or cephalosporins.** Other choices should be used if gram negatives or *Staphylococcus aureus* are suspected.

Duration of treatment

- Duration of therapy is suggested to be **5 – 7 days** for non-severe CAP.
- If child fails to improve within 48 – 72 hours of initiation of treatment, consider alternative diagnosis or therapy.

Additional considerations for the treatment of Mycoplasma pneumoniae (and other atypical pathogens)

- Azithromycin should not be used to treat *Streptococcus pneumoniae*, only suspected or confirmed *Mycoplasma pneumoniae*, due to poor susceptibilities.
- Testing and treatment for *Mycoplasma pneumoniae* is not routinely recommended.
- **The SJH Biofire PCR upper respiratory profile tests for both *Mycoplasma pneumoniae* and *Chlamydophila pneumoniae*. Testing is indicated if results will change management.**

Pneumonia in the setting of influenza

- Pneumonia is a common complication in children hospitalized with influenza.
- Children hospitalized with influenza co-infected with *S. aureus* have higher rates of severe outcomes (ICU admission, death).
- Signs of secondary bacterial pneumonia include: secondary fever after period of defervescence, lobar consolidation, increased WBC, and later onset (4 – 7 days) of respiratory compromise after initial symptoms.
- Consider covering these patients with empiric coverage for *S. aureus.*

Other Therapies

- Therapies directed toward airway clearance (CPT, VEST, cough assist) should not be used for patients with uncomplicated pneumonia.
    - Chest physiotherapy does not decrease length of stay in children hospitalized with pneumonia.
    - Gentle activity should be encouraged to mobilize secretions.
    - Bronchodilators should not be routinely used unless there is a known component of asthma. Wheezing heard in a patient with pneumonia is most likely related to airway inflammation.

Table 3. CAP Antimicrobials – Dosing and Implications of Therapy

Antibiotic	Recommended Dose	Implications of Therapy
Amoxicillin (PO)	PREFERRED: 30 mg/kg/dose every 8 hours (max: 1000mg/dose)	Best choice for susceptible and intermediate *S. pneumoniae* in order to achieve adequate time above MIC.
Amoxicillin / clavulanate (PO)	PREFERRED: 30 mg/kg/dose every 8 hours (max: 500 mg/dose)	- Amoxicillin/clavulanate adds some gram negative, MSSA, and anaerobic coverage and should be reserved for patients in which expanded coverage is desirable (i.e. underimmunized) - It is recommended that total daily dose of clavulanate remain below **10mg/kg/day to mitigate GI side effects.** - Ratio of amoxicillin and clavulanate vary **"High"** dose (90mg/kg/day) Amox-clav ES suspension 600-42.9mg/5mL Amox-clav 875-125mg tablets (be aware of max dosing) **"Low"** dose (45mg/kg/day) Amox-clav suspension 400-57mg/5mL Amox-clav 500-125mg tabs
Ampicillin (IV)	PREFERRED 50 mg/kg/dose every 6 hours (max: 2000 mg/dose)	- Preferred IV antibiotic for initial treatment - Does not cover MSSA, MRSA, or *M. catarrhalis*. - From Jan-Dec 2019 ~46% of *H. influenzae* were resistant.
Ampicillin / sulbactam (IV)	50 mg/kg/dose every 6 hours (max: 2000 mg/dose)	Does not cover MRSA.
Azithromycin (IV or PO)	10 mg/kg/dose on day 1, single dose (max: 500 mg/day), followed by 5 mg/kg/dose, every 24 hours on days 2 – 5 (max: 250 mg/day)	- ONLY indicated for coverage of atypical pneumonia as 70% S*. pneumoniae* isolates were resistant from Jan-Dec 2019. -If the NP PCR is ordered and *Mycoplasma pneumoniae, Chlamydophila pneumoniae*, or *Bordetella pertussis* are not detected, it is strongly encouraged to discontinue azithromycin therapy.
Cefpodoxime (PO) (available at HSHS St John's community pharmacy)	5 mg/kg/dose every 12 hours (max: 200 mg/dose)	- Can be used as an alternative for PCN-allergic patients; however, oral cephalosporins inferior to amoxicillin, particularly for non-susceptible S. *pneumoniae*. - Has relatively poor oral absorption compared to amoxicillin
Cefprozil (PO) (available inpatient and at HSHS St John's community pharmacy)	15 mg/kg/dose every 12 hours (max: 500 mg/dose)	- Can be used as an alternative for PCN-allergic patients; however, oral cephalosporins inferior to amoxicillin, particularly for non-susceptible S. *pneumoniae*.
Ceftriaxone (IV)	50mg/kg/dose every 24 hours (max: 2000 mg/dose)	- Can be used for unimmunized or penicillin-allergic patients

		- Higher dose to overcome PCN-resistant pneumococci - If a PO transition is warranted, it is recommended that either amoxicillin or amoxicillin / clavulanate be prescribed given the unfavorable. pharmacokinetic profile of oral cephalosporins (esp. cefdinir) in the treatment of *Streptococcus pneumoniae*.
Cefuroxime axetil (PO) (available at HSHS St John's community pharmacy)	15 mg/kg/dose every 12 hours (max: 500 mg/dose)	- Can be used as an alternative for PCN-allergic patients; however, oral cephalosporins inferior to amoxicillin, particularly for non-susceptible S. *pneumoniae*.
Clindamycin (IV or PO)	13 mg/kg/dose IV every 8 hours (max IV: 900 mg/dose) 10 mg/kg/dose PO every 8 hours (max PO: 600 mg/dose)	- Between Jan-Dec 2019 ~7% of *S. pneumoniae* were resistant. - Between, Jan-Dec 2019 16% of MSSA and MRSA were resistant. - Highly bioavailable, consider transitioning to oral therapy if patient can tolerate.
Doxycycline (IV or PO)	1 – 2 mg/kg/dose every 12 hours (max: 100 mg/dose)	- Avoid if < 8 yrs old - Place in therapy is for patients with true β-lactam allergies - Also covers atypicals
Oseltamivir (PO)	Infants/Children < 1 year: 3 mg/kg/dose PO q12h Children 1 – 12 years: ≤ 15 kg: 30 mg PO q12h 16-23 kg: 45 mg PO q12h 24-40 kg: 60 mg PO q12h >40 kg: 75 mg PO q12h Children >12 years: 75 mg PO BID PROPHYLAXIS: 3 months – 1 year: 3 mg/kg PO q24h Children 1 – 12 years: ≤ 15 kg: 30 mg PO q24h 16-23 kg: 45 mg PO q24h 24-40 kg: 60 mg PO q24h >40 kg: 75 mg PO q24h Children >12 years: 75 mg PO q24h	
Levofloxacin (IV or PO)	6 mo – 4 yrs: 10 mg/kg/dose every 12 hours ≥ 5 yrs: 10 mg/kg/dose every 24 hours (max: 750 mg/dose)	- Place in therapy is for patients with true β-lactam allergies - Also covers atypicals

REFERENCES

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SIU SCHOOL of MEDICINE

Children's St. John's Hospital

TREATMENT PATHWAY – UNCOMPLICATED PNEUMONIA

Does the patient meet **inclusion criteria** (previously healthy 90 days through 18 years of age with symptoms, signs, or other finding of **uncomplicated pneumonia**[a] acquired by exposure to organisms in the community)?

No → Off Pathway

Yes ↓

Does the patient meet ***any*** of the following: admission criteria[b], failed outpatient oral antibiotic therapy[c], decreased GI absorption, or inability to tolerate oral medications?

Yes ↓

PA and Lateral Chest Radiograph
& IV Antibiotic Therapy Recommended*

- Patients with ≥ 2 doses HIB Vaccine: **Ampicillin 50mg/kg/dose IV q6h**
- Patients with 0-1 doses HIB Vaccine: **Ampicillin/sulbactam 50 mg/kg/dose IV q6h** OR **ceftriaxone 50 mg/kg/dose IV q24h**

No ↓

Oral Antibiotic Therapy Recommended*

- Patients with ≥ 2 doses HIB Vaccine: **Amoxicillin[d] 30mg/kg/dose PO q8h**
- Patients with 0-1 doses HIB Vaccine: **Amoxicillin/clavulanate[e] 30 mg/kg/dose PO q8h** OR consider certain cephalosporins[f]

Ready for transition to oral Abx and/or discharge[g]?

***For all patients:**

- Total duration of therapy is **5 – 7 days**
- If an atypical pathogen is suspected (*Chlamydophila pneumoniae*, *Bordetella pertussis*, or *Mycoplasma pneumoniae*) include azithromycin[1]
- If *Staphylococcus aureas* or CA-MRSA is suspected, substitute clindamycin or vancomycin.
- If suspected or confirmed influenza, consider antiviral (refer to CDC website for current recommendations)

[a] Patients with *complicated pneumonia* (empyema, large effusion, multiple abscesses), immunocompromised status, aspiration pneumonia, hospital acquired pneumonia, in need of immediate critical care, or those with concern of sepsis do NOT fall under this treatment algorithm

[b] Children with moderate to severe CAP, infants < 3-6 mo suspected with bacterial CAP, or children/infants with concerns for compliance with therapy.

[c] Failure of outpatient oral therapy is defined as ≥ 38 C lasting ≥ 48 hours and may be due to inadequate choice or dosing of antibiotic, poor compliance, natural history of disease or resistant organism

[d] Amoxicillin is the drug of choice for bacterial CAP due to its favorable pharmacokinetics against *S. pneumoniae* susceptible and intermediate strains (when dosed 30 mg/kg/dose TID)

[e] Amoxicillin component should be dosed at 30 mg/kg/dose TID if concerned for *S. pneumoniae* or other isolates with higher MICs (including *H. influenza* and *S. aureus*). See table 3

[f] Oral cephalosporin formulations are considered pharmacologically inferior to amoxicillin particularly for non-susceptible *S. pneumoniae.* If used, they should be used with the highest dose and shortest interval allowable. See table 3.

[g] Clinical improvement (level of activity, appetite, decreased fever for 12-24 hrs), pulse oximetry ≥90 % on room air, stable/baseline mental status, tolerated and comply with oral medications.