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Evidence Based Practice Guideline:

May 2024

Treatment of Pediatric Uncomplicated Community-Acquired Pneumonia

Location: Outpatient, Emergency Department, and Inpatient

Rationale & Scope

Community-acquired pneumonia (CAP) is one of the most common causes of hospitalization in children and a leading cause of childhood morbidity and mortality worldwide. In the United States, CAP causes approximately 1.5 million pediatric ambulatory visits each year and evidence suggests it is the second-leading cause of hospitalization.[1] Community-acquired pneumonia (CAP) is diagnosed based on a combination of history and physical findings. The scope of this guidance is to provide initial recommendations for patients with suspected or proven CAP based on severity of symptoms and consideration on when to alter antibiotics based on treatment response.

The guidance document is limited to the care of otherwise healthy infants and children and addresses practical questions of diagnosis and management of CAP evaluated in outpatient (offices, urgent care clinics), emergency departments, or inpatient settings.

Treatment of Pediatric Uncomplicated, Community Acquired Pneumonia Carepath v1.0

Summary of Key Management Statements

- Patients with suspected or proven mild CAP (evidenced by mild respiratory symptoms), ability to tolerate oral medications and fluid, and caregiver/family is able to follow-up adequately on an outpatient basis are recommended to be managed outpatient.
- Patients with moderate-severe CAP, outpatient treatment failure; dehydrated or unable to tolerate oral hydration therapy, or concern for inadequate outpatient follow-up are recommended to be hospitalized.
- The extent of diagnostic work-up via viral nasal swabbing, blood laboratory testing, and imaging is determined by the severity of pneumonia and response to treatment.
- The recommended antimicrobial treatment duration for uncomplicated CAP is a total of 5 days.
- In hospitalized patients, a blood culture and sepsis huddle are recommended for patients that experience a treatment failure or worsening symptoms on antibiotic therapy.
- Consider infectious diseases and/or pulmonary consult for a patient that develops complicated CAP. Complicated CAP may require a longer duration of antibiotic therapy and additional interventions that are outside the scope of this guideline.

Inclusion and Exclusion Criteria

- The target audience for this guideline is physicians, advanced practice providers, nurses, and clinical pharmacists.
- ***Exclusion Note:*** *Pneumonia in an infant less than 3 months of age that is believed to be otherwise healthy may warrant additional diagnostic work-up for underlying factors*

INCLUSION CRITERIA

a. Infants and children 3 months -18 years that are otherwise healthy

EXCLUSION CRITERIA

a. Less than 3 months of age in full term infant
b. Less than 6 months of age who were born less than 36 weeks of age
c. Children with chronic conditions or underlying lung disease such cystic fibrosis (asthma is not excluded)
d. Children with tracheostomy or receiving home mechanical ventilation
e. Immunodeficiency or immunosuppressive therapy
f. Hospital acquired pneumonia
g. Complicated CAP

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Definitions

- **Uncomplicated Pneumonia:** as either bronchopneumonia (primary involvement of airways and surrounding interstitium), or lobar pneumonia
- **Complicated Pneumonia**: is defined as a pulmonary parenchymal infection complicated by parapneumonic effusions, abscesses or cavities, necrotizing pneumonia, empyema, pneumothorax or bronchopleural fistula; or pneumonia that is a complication of bacteremia disease that includes other sites of infection
- **Mild CAP**: suspected or proven uncomplicated pneumonia in a patient that is non-toxic appearing, pulse oximetry > 90% on room air, and able to tolerate fluids and oral therapies
- **Moderate-Severe CAP:** pneumonia in a patient that has moderate or severe signs of respiratory distress
- **Treatment Failure:** defined as > 48 hours of recommended treatment in a patient with no clinical improvement or worsening symptoms

Signs of Respiratory Distress in Children with Pneumonia

- This table is adapted from IDSA and WHO criteria for respiratory distress in children[2]
  - Age related tachypnea
  - Dyspnea
  - Retractions (suprasternal, intercostal, or subcostal)
  - Grunting
  - Nasal flaring
  - Apnea
  - Altered mental status
  - Pulse oximetry measurement < 90% on room air

Management & Treatment Recommendations *(See Treatment Carepath)*

- The extent of diagnostic work-up recommended via viral pathogen nasal swabbing, ancillary diagnostic blood testing, and imaging is determined by the severity of pneumonia, immunization status of child, impact on clinical decision making, and response to treatment. [(Strong recommendation, low level evidence; local consensus statement modified from IDSA)]
- **Initial, routine chest radiographs** are not necessary for the confirmation of suspected CAP in patients well enough to be treated in the outpatient setting (after evaluation in the office, clinic, or emergency department setting). (Source: IDSA, Strong recommendation, high-quality evidence)
- **Blood cultures** should not be routinely performed in nontoxic, fully immunized children with CAP managed in the outpatient setting. (Source: IDSA, Strong recommendation, moderate quality evidence).
- **Empiric antimicrobial selection for uncomplicated CAP** is determined on a number of patient factors: severity of disease, immunization status, concurrent influenza infection, and concern for methicillin-sensitive *Staphylococcus aureus* (MSSA) or methicillin-resistant Staphylococcus aureus (MRSA). *See the Empiric Antimicrobial Treatment for Uncomplicated CAP section below.* (Strong recommendation, local consensus statement)
- The recommended **antimicrobial treatment duration for uncomplicated CAP is a total of 5 days**. (Strong recommendation, moderate certainty of evidence)
- Children and infants for whom there is **concern about careful observation at home** or who are unable to comply with therapy or unable to be followed up should be **hospitalized**. (Source: IDSA, Strong recommendation, low quality evidence)
- 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 %) **should be hospitalized for management**, including skilled

pediatric nursing care. (Source: IDSA, Strong recommendation, high-quality evidence)

- **Initial chest radiographs** (posteroanterior and lateral) **should be obtained in all patients hospitalized for management of CAP** to document the presence, size, and character of parenchymal infiltrates and identify complications of pneumonia that may lead to interventions beyond antimicrobial agents and supportive medical therapy. (Source: IDSA, Strong recommendation; moderate-quality evidence)

- Influenza antiviral therapy should be administered as soon as possible to children with CAP consistent with influenza virus infection during widespread local circulation of influenza viruses, particularly for those with moderate to severe CAP; clinically worsening disease documented at the time of an outpatient visit; or high risk for influenza complications. This includes children with asthma, metabolic conditions, neurologic disorders, neurodevelopmental conditions, and children younger than 5 years old. Because early antiviral treatment has been shown to provide maximal benefit, treatment should not be delayed until confirmation of positive influenza test results.[(Strong recommendation, moderate quality evidence, local consensus statement modified from IDSA)]

- In **hospitalized children, blood cultures should be obtained in children in the following clinical scenarios**: fail to demonstrate clinical improvement (excluding outpatient treatment), progressive symptoms, or clinical deterioration after initiation of antibiotic therapy, or concern for sepsis. (Strong recommendation, moderate level evidence, adapted from IDSA)

- A child should be admitted or transferred to the **Pediatric Intensive Care Unit** (PICU) if the child **requires oxygen support beyond low flow nasal cannula, systemic signs of inadequate perfusion (change in mental status, hemodynamic instability), and/or requires ICU level care**. [(Strong recommendation, low quality evidence, local consensus statement modified from IDSA)]

Empiric Antimicrobial Treatment for Uncomplicated CAP

Mild Oral Treatment or Transition to Oral Treatment to Complete 5 Day Duration	
Presumed bacterial CAP, first line:	Amoxicillin PO 90 mg/kg/day divided BID (max 2000 mg/dose) x 5 total days of treatment
Presumed bacterial CAP, second line: Presumed bacterial CAP in unimmunized patient	Amoxicillin-clavulanate PO 90 mg/kg/day divided BID (max 2000 mg/dose of amoxicillin component) x 5 days (use 600 mg/5 mL concentration)
Non-type 1 or Type 1 B-lactam allergy, first line:	Clindamycin PO 40 mg/kg/day divided TID (max 600 mg/dose) x 5 days
Non-type 1 B-lactam allergy, second line or no improvement in 48 hours	Clindamycin PO 40 mg/kg/day divided TID (max 600 mg/dose) x 5 days **PLUS** Cefpodoxime PO 10 mg/kg/day divided BID (max 200 mg/dose) x 5 days OR cefixime PO 8 mg/kg/day divided BID (max 200mg/dose) *Adding cefpodoxime or cefixime provides Gram-negative coverage*
Type 1 B-lactam allergy, second line: *Consider referral to allergist for allergy testing if antibiotic allergy diagnosis uncertain or initial allergy diagnosis was greater than 10 years ago*	Levofloxacin PO 6 months- < 5 years old: 20 mg/kg/day divided BID (max 375 mg/dose) x 5 days ≥5 years old: 10 mg/kg once a day (max 750 mg/dose) x 5 days

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Initial Intravenous Treatment for Hospitalized Patients (transition to oral therapy to complete a total of 5 day treatment duration when appropriate)	
Presumed bacterial CAP, fully immunized	Ampicillin 50mg/kg/dose IV q6h (max 2000 mg/dose) If Influenza positive add oseltamivir*
Presumed bacterial CAP, not fully immunized or moderate respiratory symptoms	Ceftriaxone 50mg/kg/dose IV q24h (max 2000mg/dose) If Influenza positive, add oseltamivir*
Non-type 1 B-lactam allergy, first line:	Ceftriaxone 50mg/kg/dose IV q24h (max 2000mg/dose)
Type 1 B-lactam allergy, first line and moderate respiratory symptoms	Levofloxacin IV 6 months- < 5 years old: 10 mg/kg/dose IV twice daily (max 375 mg/dose) ≥5 years old: 10 mg/kg/dose IV once a day (max 750 mg/dose)
Presumed bacterial CAP, severe symptoms, toxic appearance, or signs/symptoms of sepsis	Ceftriaxone 50mg/kg/dose IV q24h (max 2000mg/dose) **PLUS** Vancomycin IV – pharmacy to dose **PLUS** If Influenza positive add oseltamivir* PO and clindamycin IV; 13.3mg/kg/dose IV q8h (max 600mg/dose)
Non-type 1 B-lactam allergy Presumed bacterial CAP, severe symptoms, toxic appearance, or signs/symptoms of sepsis	Meropenem 20mg/kg/dose IV q8h (max 2000mg/dose) **PLUS** Vancomycin IV – pharmacy to dose **PLUS** If Influenza positive add oseltamivir* PO and clindamycin IV; 13.3mg/kg/dose IV q8h (max 600mg/dose
Type 1 B-lactam allergy Presumed bacterial CAP, severe symptoms, toxic appearance, or signs/symptoms of sepsis	Aztreonam 40mg/kg/dose IV q8h (max 2000 mg/dose) **PLUS** Vancomycin IV – pharmacy to dose **PLUS** If Influenza positive add oseltamivir* PO and clindamycin IV; 13.3mg/kg/dose IV q8h (max 600mg/dose
Concern for Atypical Pneumonia - any PO/IV regimen above	
Symptoms suggestive of atypical etiology include malaise, sore throat, and low- grade fever, cough, which usually develop slowly over 3-7 days; may find diffuse crackles or wheezes on lung exam. Can consider monotherapy with azithromycin if clear signs and symptoms of atypical pneumonia as above. Given the growing S. pneumoniae resistance to azithromycin, azithromycin should be used in conjunction with the first or second line antibiotics recommended above when diagnosis of atypical vs. community- acquired pneumonia is not clear	In school aged children, consider adding azithromycin to any above regimen if not already on levofloxacin Azithromycin 10 mg/kg day 1 (max 500 mg/dose) PO/IV followed by 5 mg/kg PO/IV days 2-5 (max 250 mg/dose)

***Oseltamivir Dosing**	
Influenza Positive: *Influenza antiviral therapy should be administered as soon as possible to children with CAP consistent with influenza virus infection during widespread local circulation of influenza viruses, particularly for those with moderate to severe CAP; clinically worsening disease documented at the time of an outpatient visit; or high risk for influenza complications. This includes children with asthma, metabolic conditions, neurologic disorders, neurodevelopmental conditions, and children younger than 5 years old.* *Treatment most effective if started within 48-72 hours of onset of symptoms.*	Oseltamivir PO x 5 days For children ≥12 months ≤15 kg: 30 mg twice daily >15 to 23 kg: 45 mg twice daily >23 to 40 kg: 60 mg twice daily >40 kg: 75 mg twice daily For children < 12 months 1-8 months: 3 mg/kg/dose twice daily 9-11 months: 3.5mg/kg/dose twice daily

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Major References

1. Gao Y, Liu M, Yang K, et al. Shorter Versus Longer-term Antibiotic Treatments for Community-Acquired Pneumonia in Children: A Meta-analysis. Pediatrics. 2023;151(6):e2022060097
2. PIDS/IDSA Guidelines for the Management of Community-Acquired Pneumonia (CAP) in Infants and Children Older Than 3 Months of Age (Archived) *Clinical Infectious Diseases*, Volume 53, Issue 7, 1 October 2011, Pages e25–e76, https://doi.org/10.1093/cid/cir531
3. Kuitunen et al. Antibiotic treatment duration for community acquires pneumonia in outpatient children in high-income countries – a systematic review and meta-analysis. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America / 2023;76(3):e1123-e11283
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12. Davis, T. R., Evans, H. R., Murtas, J., Weisman, A., Francis, J. L., & Khan, A. (2017). Utility of blood cultures in children admitted to hospital with community-acquired pneumonia. Journal of paediatrics and child health, 53(3), 232–236.
13. Johnson, D. P., Lee, V., Gourishankar, A., Rajbhandari, P., Schefft, M., & Genies, M. (2020). Things We Do For No Reason™: Routine Blood Culture Acquisition for Children Hospitalized with Community-Acquired Pneumonia. Journal of hospital medicine, 15(2), 107–110. https://doi.org/10.12788/jhm.3279

How was this Guideline Developed?

- This guideline was developed by a multi-disciplinary group of caregivers and subject matter experts experienced in the treatment of infectious and pulmonary diseases in the outpatient, emergency, and inpatient settings.
- This guideline is adapted from the 2011 IDSA guideline titled: The Management of Community-Acquired Pneumonia in Infants and Children Older Than 3 Months of Age but with limited scope to the initial treatment for uncomplicated CAP. Recommendations that were adopted from the IDSA guideline are noted and carried over with the same evidence level.
- Given the number of years since this guideline was last updated by the IDSA, our guideline team supplemented the publication with current recommended empiric antibiotic recommendations based on local antibiogram. The team reviewed more recent literature on blood culturing practices for hospitalized patients with CAP and the total duration of antibiotic therapy and made recommendations based on this literature.
- The local guideline team used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework to assign evidence levels and recommendation strengths when evidence was sufficient. Local consensus statements that are not graded should be interpreted as low-level evidence.

Acronyms and Abbreviations

CAP Community Acquired Pneumonia
IDSA Infectious Diseases Society of America

Initial Approval May 2024

Pediatric Community-Acquired Pneumonia (CAP), Uncomplicated

Scope: suspected or proven CAP managed in outpatient, emergency department, inpatient, or intensive care setting

Inclusion: Infants and children ≥ 3 months -18 years of age that are otherwise healthy

Exclusion: See exclusions (Box 1)

Box 1: Exclusion

NOTE: Pneumonia in an infant less than 3 months of age that is otherwise healthy may warrant additional diagnostic work-up for underlying factors

- Less than 3 months of age in full term infant
- Less than 6 months of age who were born less than 36 weeks of age
- Children with chronic conditions or underlying lung disease such as cystic fibrosis (asthma is not excluded)
- Children with tracheostomy or receiving home mechanical ventilation
- Children with immunodeficiency or immunosuppressive therapy
- Hospital-acquired pneumonia
- Complicated CAP

Signs/Symptoms Suggestive of Pneumonia Clinical diagnosis made following historical and physical examination (See Box 2

- Tachypnea
- Fever
- Hypoxia
- Dyspnea, retractions and/or nasal flaring
- Apnea
- Focal rales/diffuse crackles (crackles in younger children may be suggestive of bronchiolitis – see pathway)

Positive sepsis screen, concern for sepsis, or toxic appearance?

YES

Sepsis Huddle if not yet done and see Sepsis Pathway

STAT labs: CBC with diff, CRP, CMP, and blood culture

Give IV antibiotic STAT; see Sepsis Order Set

NO

Box 2: Symptom Severity and Definitions

Mild Respiratory Symptoms **Mild Uncomplicated CAP**	• Pulmonary parenchymal infection that can be managed in the outpatient setting • No moderate/severe retractions, grunting, nasal flaring, or apnea • Pulse oximetry ≥ 90% in room air • Non-toxic appearance
Moderate Respiratory Symptoms **Hospitalized, Uncomplicated CAP**	• Pulmonary parenchymal infection that failed outpatient management and/or necessitates inpatient non-ICU care • Moderate dyspnea, including: moderate retractions or nasal flaring • Pulse oximetry < 90% on room air; need for low flow oxygen support (e.g. nasal cannula or vent-mask) and does not meet severe criteria • Follow Escalation of Care Pathway for recognition of clinical deterioration
Severe Respiratory Symptoms **Hospitalized, Uncomplicated CAP**	• Pulmonary parenchymal infection necessitating ICU level care or escalation from acute, non-ICU setting • Apnea, grunting, severe retractions, hypoxemic, oxygen support beyond low flow nasal or hypercarbic respiratory failure requiring invasive mechanical ventilation or non-invasive mechanical ventilation with requirement attributable to bacterial pneumonia • Systemic signs of inadequate perfusion (change in mental status, hemodynamic instability). ***If severe respiratory symptoms develop during hospitalization, see sepsis pathway***
Additional Definitions:	
Complicated CAP	Pulmonary parenchymal infection complicated by parapneumonic effusions, abscesses or cavities, necrotizing pneumonia, empyema, pneumothorax or bronchopleural fistula; or pneumonia that is a complication of bacteremia disease that includes other sites of infection
Treatment Failure	Treatment failure is defined as > 48 hours of recommended treatment in a patient with no clinical improvement or worsening symptoms

Mild CAP:

- Mild respiratory symptoms
- Laboratory and radiologic testing is not routinely recommended if clinical diagnosis consistent with mild CAP
- During influenza season, add influenza testing to determine need for oseltamivir
- **See Box 3 for Treatment Recommendations** with consideration of vaccination status
- Patients may be discharged if:
  - Able to tolerate oral medications and fluids
  - Adequate observation/ follow-up care established
  - No inpatient supportive measures required
- Patient should return for re-evaluation if symptoms persist or worsen within 48-72 hours after starting treatment
- Encourage routine vaccines as pneumonia prevention

Admission required?

Yes

Mild Needing Inpatient Management:

- **Admit to Inpatient**
- See **Box 3 for antimicrobial treatment recommendations**

- Once patient meets discharge criteria, transition to oral antibiotics to complete a 5 day course

If patient develops complicated CAP, remove from algorithm and consider ID and/or pulmonary consult

Moderate-Severe CAP:

- Obtain chest X-ray
- Obtain CBC with diff, CRP, and CMP
- Blood culture recommended during work-up with severe respiratory symptoms, concern for sepsis, or worsening on antibiotic therapy
- Consider respiratory viral testing (e.g. RSV, SARS CoV-2) if viral etiology thought to be sole cause of disease and detection of virus will change management
- During flu season, add influenza testing to determine need for oseltamivir in addition to antibiotic coverage

Uncomplicated CAP with Moderate Respiratory Symptoms:

- **Admit to Inpatient**
- See **Box 3 for Treatment Recommendations**
- Initiate ADT20 order if transport to main campus required
- Administer supplemental low flow oxygen for SpO2 < 90% with continuous pulse oximetry

Uncomplicated CAP with Severe Respiratory Symptoms:

- **Admit to PICU**
- See **Box 3 for Treatment Recommendations**
- Initiate ADT20 order if transport to main campus required

Treatment Failure or Worsening of Symptoms after 48 hours?

No

Yes

Treatment Failure or Worsening Symptoms

- Perform sepsis huddle and obtain blood culture
- If on floor, see Escalation of Care Pathway; initiate watcher status if applicable
- Consider infectious diseases and/or pulmonary consult
- Broaden antibiotic therapy; see antibiotic recommendations (Pneumonia PEDS or Sepsis Order Set)
- If complicated CAP confirmed, remove from pathway. Patient may require longer duration of antibiotics

Box 3: Antibiotics for Treatment of Uncomplicated Community-Acquired Pneumonia

Mild Oral Treatment or Transition to Oral Treatment to Complete 5 Day Duration	
Presumed bacterial CAP, first line:	Amoxicillin PO 90 mg/kg/day divided BID (max 2000 mg/dose) x 5 total days of treatment
Presumed bacterial CAP, second line: Presumed bacterial CAP in unimmunized patient	Amoxicillin-clavulanate PO 90 mg/kg/day divided BID (max 2000 mg/dose of amoxicillin component) x 5 days (use 600 mg/5 mL concentration)
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Concern for Atypical Pneumonia - any PO/IV regimen above	
Symptoms suggestive of atypical etiology include malaise, sore throat, and low- grade fever, cough, which usually develop slowly over 3-7 days; may find diffuse crackles or wheezes on lung exam. Can consider monotherapy with azithromycin if clear signs and symptoms of atypical pneumonia as above. Given the growing S. pneumoniae resistance to azithromycin, azithromycin should be used in conjunction with the first or second line antibiotics recommended above when diagnosis of atypical vs. community- acquired pneumonia is not clear	In school aged children, consider adding azithromycin to any above regimen if not already on levofloxacin Azithromycin 10 mg/kg day 1 (max 500 mg/dose) PO/IV followed by 5 mg/kg PO/IV days 2-5 (max 250 mg/dose)

***Oseltamivir Dosing**	
Influenza Positive: *Influenza antiviral therapy should be administered as soon as possible to children with CAP consistent with influenza virus infection during widespread local circulation of influenza viruses, particularly for those with moderate to severe CAP; clinically worsening disease documented at the time of an outpatient visit; or high risk for influenza complications. This includes children with asthma, metabolic conditions, neurologic disorders, neurodevelopmental conditions, and children younger than 5 years old.* *Treatment most effective if started within 48-72 hours of onset of symptoms.*	Oseltamivir PO x 5 days For children ≥12 months ≤15 kg: 30 mg twice daily >15 to 23 kg: 45 mg twice daily >23 to 40 kg: 60 mg twice daily >40 kg: 75 mg twice daily For children < 12 months 1-8 months: 3 mg/kg/dose twice daily 9-11 months: 3.5mg/kg/dose twice daily