

# Clinical Pathway for Children with Community Acquired Pneumonia

See CAP order set

Well appearing child > 3 months\* with suspected CAP\*\*

If toxic, see sepsis pathway

## \*\*CAP signs/symptoms

Viral CAP: #1 cause of CAP, gradual onset, preceding URI symptoms, diffuse lung findings

Typical CAP: rapid onset, high fevers, focal lung findings

Atypical CAP: >5yo, low-grade fever, cough, sore throat, mild/protracted course

Complicated pneumonia: Moderate/large effusions, multilobar disease, abscess/cavities, necrotizing, empyema, pneumothorax, bronchopleural fistula or disseminated bacterial infection

## Assess severity of CAP

Mild CAP	Moderate CAP	Severe CAP
No/minimal resp distress	Moderate resp distress	Severe resp distress
SaO <sub>2</sub> ≥ 90% on room air	SaO <sub>2</sub> < 90% requiring nasal cannula or high flow	SaO <sub>2</sub> < 90% requiring CPAP, BiPAP or ventilator
Tolerating PO	Not tolerating PO	AMS
Outpatient	Inpatient/PICU	PICU
		Hemodynamic instability

## \*Exclusion criteria

Tracheostomy/ventilator Lung disease (excluding asthma)  
Immunocompromised  
Symptomatic and/or cyanotic heart disease  
Sepsis/septic shock

## Mild CAP (outpatient)

No routine testing including CXR

## Moderate CAP (Inpatient/PICU)

CXR 2-view  
Blood culture if complicated CAP\*\*  
Consider Mycoplasma PCR/RVP if atypical or viral CAP\*\* suspected  
Influenza PCR if concern for flu

## Severe CAP (PICU)

CXR 2-view  
CBC with differential  
Blood culture  
Respiratory panel  
Gram stain/culture if intubated  
No routine ESR/CRP

## Outpatient management

Antibiotics not routinely needed for kids <5yo as viruses cause most disease

Typical CAP:  
PO Amoxicillin (1st line)

Consider if vaccines not up to date and <5yo:  
PO Augmentin

β-lactam allergy\*\*\*:  
PO Clindamycin (1st line)  
PO Levofloxacin (2nd line)

Atypical CAP:  
PO Azithromycin

## Antibiotics for moderate CAP

Typical CAP:  
IV Ampicillin (1st line)  
  
Failed high dose Amoxicillin ≥ 48 hours or consider if vaccines not up to date and < 5yo:  
IV Ceftriaxone

β-lactam allergy\*\*\*:  
IV Clindamycin (1st line)  
IV Levofloxacin (2nd line)

Atypical CAP:  
IV/PO Azithromycin

Assess daily for improvement

## Antibiotics for severe CAP

IV Ceftriaxone (1st line)

Add if complicated CAP or suspect Staphylococcus aureus:  
IV Vancomycin or Clindamycin

β-lactam allergy\*\*\*:  
IV Levofloxacin

## Discharge criteria

Minimal to no respiratory distress  
SaO<sub>2</sub> ≥ 90% on room air  
Tolerating oral hydration and medication  
Established follow up with PCP in 2-3 days

## Duration of therapy

Mild-moderate typical CAP: 7 days  
Atypical CAP: 5 days

## \*\*\*β-lactam allergy

1. Avoid β-lactam if history of SERIOUS CUTANEOUS REACTION (serum sickness, EM, SJS/TEN or DRESS) to a β-lactam.
2. Assess for TYPE 1 ALLERGY to β-lactam: onset <1 hour, hives/urticaria, angioedema, laryngeal edema, shortness of breath, wheezing, hypotension, epinephrine requirement.
3. If the reaction is not consistent with a serious cutaneous reaction or type 1 allergy as above, proceed with first-line β-lactam. Consult Pharmacy, Allergy and/or Peds ID as needed.
4. If the patient has a type 1 allergy to a β-lactam, consult Pharmacy, Allergy and/or Peds ID for further management. Recommend outpatient referral to Allergy by PCP for discharges. Reactions are based on similarity of side chains.

# Antibiotic Recommendations

Pneumonia type	Antibiotic choice	Duration
<b>Typical mild CAP</b>	<p><b>First line:</b></p> <p>PO Amoxicillin 45mg/kg/dose BID or TID* (max 4g/day)</p> <p><b>Consider if vaccines not updated and &lt;5yo:</b></p> <p>PO Augmentin ES 600-42.9mg/5mL (14:1) 45 mg/kg/dose of Amoxicillin BID (max 4g/day)</p> <p><b>β-lactam allergy (see allergy box on clinical pathway):</b></p> <p>First line: PO Clindamycin 13 mg/kg/dose TID (max dose 600mg)</p> <p>Second line: PO Levofloxacin 10 mg/kg/dose BID if 6mo-5yo, daily if ≥5yo (max 750mg/day)</p> <p>Third line: PO Cefdinir 7mg/kg/dose BID (max 600mg/day)</p>	<p><b>Mild CAP:</b></p> <p>7 days</p>
<b>Moderate typical CAP</b>	<p><b>First line:</b></p> <p>IV Ampicillin 50mg/kg Q6H (max dose 2g)</p> <p><b>Consider if vaccines not updated and &lt;5yo:</b></p> <p>IV Ceftriaxone 50 mg/kg/dose Q24H (max dose 2g)</p> <p><b>β-lactam allergy (see allergy box on clinical pathway):</b></p> <p>First line: IV Clindamycin 13 mg/kg/dose Q8H (max dose 900mg)</p> <p>Second line: IV Levofloxacin 10 mg/kg/dose Q12H for 6mo-5yo (max dose 375mg), Q24H if ≥5yo (max dose 750mg)</p>	<p><b>Moderate CAP:</b></p> <p>7 days</p>
<b>Severe typical CAP</b>	<p><b>First line:</b></p> <p>IV Ceftriaxone 75 mg/kg/dose Q24H (max dose 2g)</p> <p><b>β-lactam allergy (see allergy box on clinical pathway):</b></p> <p>IV Levofloxacin 10 mg/kg/dose Q12H for 6mo-5yo (max dose 375mg), Q24H if ≥5yo (max dose 750mg)</p> <p><b>PLUS</b></p> <p>IV Clindamycin 13 mg/kg/dose Q8H (max dose 900mg)</p> <p><b>OR if toxic or history of MRSA colonization/infection</b></p> <p>IV Vancomycin 15 mg/kg/dose Q6-12H</p>	<p><b>Severe or complicated CAP:</b></p> <p>10+ days (consult ID)</p>
<b>Atypical CAP</b>	<p>PO Azithromycin 10mg/kg/dose once on Day 1 (max dose 500mg) then 5 mg/kg/dose daily on Day 2-5 (max dose 250mg)</p> <p>IV Azithromycin 10 mg/kg/day (max dose 500mg) once on Day 1, then 5 mg/kg/dose (max dose 250mg) on Day 2-5</p>	<p><b>Atypical CAP:</b></p> <p>5 days</p>
<b>Aspiration pneumonia</b>	<p><b>First line:</b></p> <p>IV Unasyn 50 mg/kg of Ampicillin, Q6H (max dose of Ampicillin 2g)</p> <p><b>Failed β-lactam ≥ 48H or β-lactam allergy (see allergy box on clinical pathway):</b></p> <p>IV Clindamycin 13 mg/kg/dose Q8H (max dose 900mg)</p>	<p><b>Aspiration pneumonia:</b></p> <p>7 days</p>
<b>Hospital or ventilator associated pneumonia or history of gram negative pneumonia</b>	<p>IV Cefepime 50 mg/kg Q8H (max dose 2g)</p> <p>IV Zosyn 100 mg/kg Q6H (max dose of Piperacilin 2g)</p>	<p><b>Hospital associated pneumonia:</b></p> <p>7 days</p> <p><b>Ventilator associated pneumonia:</b></p> <p>5 days</p>

\*Consider TID dosing for children with concern for resistant organisms or compliance issues.

# Literature

1. Addo-Yobo E, Chisaka N, Hassan M, et al. Oral amoxicillin versus injectable penicillin for severe pneumonia in children aged 3 to 59 months: a randomised multicentre equivalency study. *Lancet*. 2004;364(9440):1141-1148. doi:10.1016/S0140-6736(04)17100-6
2. Agweyu A, Gathara D, Oliwa J, et al. Oral amoxicillin versus benzyl penicillin for severe pneumonia among kenyan children: a pragmatic randomized controlled noninferiority trial. *Clin Infect Dis*. 2015;60(8):1216-1224. doi:10.1093/cid/ciu1166
3. Ambroggio L, Thomson J, Murtagh Kurowski E, et al. Quality improvement methods increase appropriate antibiotic prescribing for childhood pneumonia. *Pediatrics*. 2013;131(5):e1623-e1631. doi:10.1542/peds.2012-2635
4. Atkinson M, Lakhanpaul M, Smyth A, et al. Comparison of oral amoxicillin and intravenous benzyl penicillin for community acquired pneumonia in children (PIVOT trial): a multicentre pragmatic randomised controlled equivalence trial. *Thorax*. 2007;62(12):1102-1106.
5. Bradley JS, Byington CL, Shah SS, 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):e25-e76. doi:10.1093/cid/cir531
6. Dean P, Schumacher D, Florin TA. Defining pneumonia severity in children: A Delphi study. *Pediatric Emergency Care*. 2020 Sept. doi:10.1097/PEC.0000000000002088
7. Donà D, Zingarella S, Gastaldi A, et al. Effects of clinical pathway implementation on antibiotic prescriptions for pediatric community-acquired pneumonia. *PLoS One*. 2018;13(2):e0193581. Published 2018 Feb 28. doi:10.1371/journal.pone.0193581
8. Girdwood SCT, Sellas MN, Courter JD, et al. Improving the transition of intravenous to enteral antibiotics in pediatric patients with pneumonia or skin and soft tissue infections. *J Hosp Med*. 2020;15(1):10-15. doi:10.12788/jhm.3253
9. Harris M, Clark J, Cote N, et al. British Thoracic Society guidelines for the management of community acquired pneumonia in children: update 2011. *Thorax*. 2011;66 Suppl 2:ii1-ii23. doi:10.1136/thoraxjnl-2011-200598
10. Leyenaar JK, Lagu T, Shieh MS, Pekow PS, Lindenauer PK. Variation in resource utilization for the management of uncomplicated community-acquired pneumonia across community and children's hospitals. *J Pediatr*. 2014;165(3):585-591. doi:10.1016/j.jpeds.2014.04.062
11. Leyenaar JK, Andrews CB, Tyksinski ER, Biondi E, Parikh K, Ralston S. Facilitators of interdepartmental quality improvement: a mixed-methods analysis of a collaborative to improve pediatric community-acquired pneumonia management. *BMJ Qual Saf*. 2019;28(3):215-222. doi:10.1136/bmjqs-2018-008065
12. McDaniel CE, Haaland W, Parlamán J, Zhou C, Desai AD. A Multisite Intervention for Pediatric Community-acquired Pneumonia in Community Settings [published online ahead of print, 2018 Mar 7]. *Acad Emerg Med*. 2018;10.1111/acem.13405. doi:10.1111/acem.13405
13. Parikh K, Biondi E, Nazif J, et al. A Multicenter Collaborative to Improve Care of Community Acquired Pneumonia in Hospitalized Children. *Pediatrics*. 2017;139(3):e20161411. doi:10.1542/peds.2016-1411
14. Rogers AJ, Lye PS, Ciener DA, Ren B, Kuhn EM, Morrison AK. Using Quality Improvement to Change Testing Practices for Community-acquired Pneumonia. *Pediatr Qual Saf*. 2018;3(5):e105. Published 2018 Sep 20. doi:10.1097/pq9.000000000000105
15. Tribble AC, Ross RK, Gerber JS. Comparison of Antibiotic Prescribing for Pediatric Community-Acquired Pneumonia in Children's and Non-Children's Hospitals. *JAMA Pediatr*. 2019;173(2):190-192. doi:10.1001/jamapediatrics.2018.4270
16. Williams DJ, Edwards KM, Self WH, et al. Effectiveness of  $\beta$ -Lactam Monotherapy vs Macrolide Combination Therapy for Children Hospitalized With Pneumonia. *JAMA Pediatr*. 2017;171(12):1184-1191. doi:10.1001/jamapediatrics.2017.3225
17. Hurst A, Rounds A, Child J, Parker S. The Infamous Oral Cephalosporins – A Step Up or a Step Down? *Children's Hospital Colorado Contagious Comments*. 2017;32(1)
18. Parker S, Mitchell M, Child J. Cephem Antibiotics: Wise Use Today Preserves Cure for Tomorrow. *Pediatr Rev*. 2013;34(11):510-23; quiz 23-4