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Community Acquired Pneumonia Algorithm

Inclusion Criteria:
- Suspected community-acquired pneumonia (CAP) in patients ≥3 months of age

Exclusion Criteria:
- Age <3 months
- Immunodeficiency or immunosuppressive medication
- Known or suspected aspiration
- Known lung disease (e.g. cystic fibrosis, chronic lung disease, structural anomalies) excluding asthma
- Preexisting tracheostomy or mechanical ventilation
- Symptomatic and/or unrepaired cyanotic congenital heart disease or cardiomyopathy

General Considerations:

Consider blood culture if:
- Failed outpatient po therapy

Send blood culture and CONSIDER ID consult if any one of the following:
- Not fully immunized
- Central line
- Complicated pneumonia

Reconsider need for antibiotics if viral season (Dec-Apr) and/or URI symptoms

Severe allergy definition:
- Urticaria
- Angioedema
- Anaphylaxis
- Delayed reaction (i.e. SJS/ TEN, DRESS, or serum sickness-like reaction)

Review H&P, labs, and CXR, and consider modification of therapy if:

- Mycoplasma pneumoniae: Add Azithromycin if age is >5 years based on clinical suspicion
- Influenza: Add or substitute Oseltamivir
- Viral (including influenza): Hold antibiotics if bacterial co-infection or super-infection not suspected
- Complicated pneumonia or suspicion of S. aureus infection: Substitute Ceftriaxone for ampicillin AND consider adding Clindamycin OR Vancomycin

Click here for Antibiotic Table

*Recommend ID Consult for complicated pneumonia

Mild Illness:
(Meets all the following)
- Sats >90% on room air, no work of breathing
- Maintains adequate hydration PO

Click here for AAP Pneumonia Severity Definitions

Moderate Illness:
(At least one of the following)
- Oxygen saturation persistently <90% on room air, increased work of breathing
- Requires nasal cannula or HFNC
- Signs of dehydration, persistent vomiting, inability to tolerate oral meds

Click here for common pneumonia phenotypes

Severe Illness:
(At least one of the following)
- Oxygen saturation ≤ 92% despite supplemental O2 with FiO2 50%
- Requires non-invasive positive pressure ventilation or mechanical ventilation
- Inadequate perfusion systemically despite adequate fluid resuscitation

Do **NOT** Routinely Recommend:
- CXR
- CBC, CRP, ESR, respiratory panel, and blood culture

- Recommend: 2-view CXR
- Consider: viral testing and CBC
- Do not recommend: blood culture, CRP, and ESR

Recommend:
- 2-view CXR
- CBC with differential
- Blood culture
- Respiratory panel
- **If requires intubation, obtain gram stain and culture**

Do not recommend:
- Routine ESR and CRP

Discharge Criteria Met?
- Minimal to no respiratory distress
- O2 Sat ≥ 90%
- Able to maintain hydration

Antibiotic Recommendations:

1st line therapy for moderate CAP: Ampicillin

Substitute **Ceftriaxone** for ampicillin if:
- Non-severe Beta-Lactam allergy
- Delayed or incomplete pneumococcal or Hib immunization (<6 months and/or <3 doses)
- Treatment failure with high dose Amoxicillin (80-90mg/kg/day) ≥ 48 hours.

**See below for more on Beta-Lactam allergy recommendations.*

Antibiotic Recommendations:

1st line therapy for severe CAP: Ceftriaxone

If complicated pneumonia or suspicion of S. aureus infection, consider adding Vancomycin OR Clindamycin

Discharge Home
On Amoxicillin x 5 days
(See Antibiotic Table for Allergy considerations)

Admit to Floor
1st line therapy: Ampicillin
(total antibiotic duration 7 days)

Admit to PICU
1st line therapy: Ceftriaxone

If worsening clinical status, consider:
- repeat CXR
- ID consult
- send CBC & blood culture
- if not already sent, send respiratory panel
- if intubated, send sputum gram stain & culture
- modify antimicrobial therapy as needed

NO ← Patient Improving?

YES

Penicillin allergy:
- oral therapy--clindamycin (preferred); levofloxacin (alternate)
- IV therapy (moderate CAP): clindamycin (preferred); levofloxacin (alternate)
- IV therapy (severe CAP): levofloxacin

Discharge Criteria Met?
- Tolerating PO
- If on IV antibiotics for bacterial PNA, transition to oral therapy

(See Antibiotic Table)

Discharge Home

Last update: 08.28.2024 NJS

Anti-Infectives: Dosing and Implications of Therapy

Antibiotic	Recommended Dose	Implications of Therapy
Amoxicillin (PO)	90mg/kg/day divided BID-TID (max: 1000mg TID) *TID dosing is more likely to achieve desired concentrations for more resistant pneumococci	• **First line oral antibiotic for previously healthy, appropriately immunized children and adolescents with mild bacterial CAP**
Amoxicillin/clavulanate (PO)	**Take note of appropriate formulation of choice** 90mg/kg/day divided BID-TID (max: see next column)	• Amoxicillin/clavulanate adds some gram negative, MSSA, and anaerobic coverage and should be reserved for patients in which expanded coverage is desirable. •Do not exceed total daily dose of clavulanate 10mg/kg/day due to GI side effects ****Formulations for CAP "high" amox dosing (90mg/kg/day)** -Amoxicillin-clavulanate ES suspension 600-42.9mg/5mL;max 1000mg TID -Amoxicillin-clavulanate 875-125mg tablets; max 875mg TID -Amoxicillin-clavulanate XR 1000-62.5mg tablets; max 2000mg BID
Ampicillin (IV)	50mg/kg IV q6h (max: 2000mg q6h)	• Criteria for use: **first line for moderate CAP** • Oral step-down: amoxicillin
Azithromycin (IV or PO)	10mg/kg/day 1st day, followed by 5mg/kg/day x 4 more days (max: 500mg/day)	Criteria for use: •Suspected Mycoplasma infection: age >5 years, insidious onset, malaise, sore throat, low-grade fever, diffuse rales, and diffuse, bilateral, interstitial infiltrates on x-ray •Mycoplasma infection is unlikely in children <5 years, particularly if not detected on multiplex PCR respiratory panel •Nearly 40% of S. pneumonia isolates are resistant to azithromycin, not recommended for monotherapy for typical pneumonia
Ceftriaxone (IV)	50-75mg/kg IV q24h (max: 2000 mg q 24h)	**Criteria for use:** •**First line for severe CAP** •Non-severe penicillin allergy or tolerated cephalosporin in the past •Infants and children who are not fully immunized •Treatment failure with high dose amoxicillin (80-90 mg/kg/day) ≥48 hours **Oral step-down:** •Amoxicillin or amoxicillin-clavulanate •For children initially treated with broad spectrum antimicrobilas but in whom adequate cultures are either not obtained or are obtained after antimicrobial treatment has begun and do not document a pathogen, transition to oral therapy with amoxicillin is still appropriate[3] •No oral cephalosporin provides activity that equals high-dose amoxicillin due to inferior bioavailability of oral cephalosporins. Oral cephalosporins provide activity against only 60%-70% of penumococcus[3]
Clindamycin (IV or PO)	40mg/kg/day divided TID (max PO: 600mg TID) (max IV: 900mg q8h)	**Criteria for use:** •Complicated pneumonia (moderate to large parapneumonic effusions, multilobar disease, abscesses or cavities, necrotizing pneumonia, empyema, pneumothorax, bronchopleural fistula, or disseminated bacterial infection) •6% of our *S.pneumoniae* are resistant; 35% of our *S.aureus* are resistant (2020 data)
Levofloxacin (IV or PO)	<5 years: 10mg/kg q 12h ≥5 years: 10mg/kg q24h (max: 750mg q24h)	**Criteria for use:** •Patients with serious penicillin or cephalosporin allergy (uticaria, angioedema or anaphylaxis)
Oseltamivir (PO)	1-8 months: 3mg/kg BID 9-23 months: 3.5 mg/kg BID ≥24 months: 4mg/kg BID (max 15-23kg: 45 mg BID) (max 23-40kg: 60mg BID) (max >40kg: 75mg BID)	**Criteria for use**: •Mild CAP with risk factors for severe influenza infection (asthma, diabetes mellitus, hemodynamically significant cardiac disease, immunosuppression, age<1month, and neurologic and neurodevelopmental disorder) OR moderate to severe CAP, PLUS laboratory confirmation of influenza infection or clinical suspicion (pending lab confirmation) •Antibacterial therapy is not routinely recommended for children with influenza, parainfluenza, human metapneumovirus or RSV infection, in the absence of clinical, laboratory and radiographic findings suggestive of bacterial co-infection
Vancomycin (IV)	15 mg/kg q6h (goal trough about 10)	**Criteria for use:** •Severely ill patients when clinical, laboratory or imaging characteristics are consistent with infection caused by S.aureus • Oral step-down: suggest calling ID

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Common Pneumonia Phenotypes	
Typical CAP	• Rapid onset • High fevers • Focal findings
Atypical CAP	•More common in age >5yo • Low-grade fever, cough, sore throat • Insidious onset • Mild/protracted course
Influenza Pneumonia	•Rapid onset •Chills or rigors, headache, malaise, diffuse myalgia, nonproductive cough
Viral Pneumonia (except influenza)	•Most common cause of CAP •Gradual onset, preceding URI symptoms • Diffuse findings
Complicated Pneumonia	•Moderate/large effusions • Multilobar disease • Abscesses or cavities •Necrotizing pneumonia •Empyema • Pneumothorax • Bronchopleural fistula •Disseminated bacterial infection

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Evidence

1. AAP Section on Emergency Medicine Committee on Quality Transformation Clinical Algorithm for Emergency Department Evaluation and Management of Pediatric Community Acquired Pneumonia: https://downloads.aap.org/DOCCSA/SOEM%20Pneum.pdf

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10. McDaniel CE, Haaland W, Parlaman 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

11. 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/pq9.0000000000000105

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14. Williams DJ, Zhu Y, Grijalva CG, Self WH, Harrell FE Jr, Reed C, Stockmann C, Arnold SR, Ampofo KK, Anderson EJ, Bramley AM, Wunderink RG, McCullers JA, Pavia AT, Jain S, Edwards KM. Predicting Severe Pneumonia Outcomes in Children. Pediatrics. 2016 Oct;138(4):e20161019. doi: 10.1542/peds.2016-1019. PMID: 27688362; PMCID: PMC5051209

*This is not a comprehensive list of all literature but rather a starting point for those wishing to better understand the guidelines, evidence and reviews that have informed this guideline and/or share these resources with colleagues in their institution.

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