CLINICAL GUIDELINE

Community Acquired Pneumonia (CAP): Initial evaluation

(Age 2 months-17 years)

Children's MINNESOTA

Aim: To decrease variation in the treatment of CAP.

Is history consistent with possible CAP *AND* does the patient have ≥ 1 of the following findings? (Note 1)
- Tachypnea for age
- Fever
- Hypoxia defined as SpO2 <90%
- Respiratory distress (retractions/nasal flaring)
- Focal rales/crackles

No → Consider alternate diagnoses **Off guideline**

Yes → **Is there concern for Septic Shock?** (note 2)

Yes → **Manage off-CAP guideline,** follow Sepsis Guideline/Order set and Sepsis antimicrobial recommendations

No → **Does the patient meet any initial admission criteria?**
- Hypoxia-SpO2 <90%
- Increased work of breathing
- Failed appropriate first-line outpatient management
- Unable to tolerate PO

No → **Outpatient Management**
- Immunization status does not alter treatment (note 4)
- CXR and labs not recommended (note 5)
- Consider viral etiology for kids <5 years
- Initiate PO Amoxicillin 45 mg/kg/dose BID **x 5 days** (page 4 and note 6)
- Follow-up with PCP in 2-3 days if not improving

Yes → **Patient will need admission**
- Obtain 2-view CXR unless suspected viral etiology (note 3)
- Test for SARS-CoV2 and Influenza (seasonal) (notes 7 & 8)

Does patient have any signs of severe/critical illness?
- Remains hypoxic on >50% FiO2
- Severe respiratory distress or concern for impending respiratory failure
- Inadequate perfusion (altered mental status, hypotension)
- Need for NIPPV or ventilator support
- Complicated pneumonia (effusion/empyema) requiring drainage (see separate guideline)

No → **Admit to Med-Surg**
- Consider viral etiology for kids <5 years
- Blood culture and blood tests (e.g. CBC) not routinely indicated unless complicated pneumonia (note 5)

Bacterial CAP treatment (page 4)
- Immunization status does not alter treatment (note 4)
- Initiate PO Amoxicillin **or** IV Ampicillin
  - If patient is admitted with history of amoxicillin treatment <48 hours, initiate IV ampicillin (see inpatient management)
  - For beta-lactam allergies, refer to Children's MN Beta-Lactam Allergy Guideline:
    - If able to use cephalosporin: Ceftriaxone
    - Severe Penicillin allergy: Levofloxacin
- Influenza +: initiate Oseltamivir (note 8)
- Empiric azithromycin not recommended regardless of age (note 9)

Yes → **Admit to PICU**
- Obtain labs: VBG, CBC w/ diff, CMP, CRP, blood culture, nasal MRSA PCR, consider Respiratory pathogen panel

Bacterial CAP treatment (page 4)
- Initiate IV Ceftriaxone
- Severe penicillin allergy: Levofloxacin
- Consider addition of **vancomycin** if question of necrotizing pneumonia
- Add **vancomycin and azithromycin** (note 9) if hemodynamically unstable (see also sepsis guidelines)
- Influenza +: Initiate Oseltamivir (note 8)

Exclusion:
- Age: <60 days
- Age 18 years and older (may reference Empiric Antimicrobial Recommendations for Common Infections in Adult Patients (≥ 18 and < 25 Years Old)
- Chronic or high-risk lung disease (e.g. cystic fibrosis)
- Immunosuppressed/deficient
- Tracheostomy or vent dependent
- High risk of aspiration
- Hospital acquired pneumonia

Community Acquired Pneumonia (CAP): Outpatient Management

(Age 2 months-17 years)

Children's MINNESOTA

Aim: To decrease variation in the treatment of CAP

History consistent with possible CAP *AND* with ≥ 1 of the following findings? (note 1)
- Tachypnea for age
- Fever
- Hypoxia defined as SpO2 <90%
- Respiratory distress (retractions/nasal flaring)
- Focal rales/crackles

Does the patient have any of the following?
--Hypoxia-SpO2 <90%
--Increased work of breathing
--Concern for sepsis
--Failed appropriate first-line outpatient management
--Unable to tolerate PO

Yes

Refer patient to Emergency Department
- *Patients with respiratory illness are typically not considered candidates for direct admission*
- Initiate low-flow nasal cannula to keep O2 saturations above 90% while awaiting transfer

No

Outpatient Management
- NO labs (blood and swabs) nor radiologic studies recommended
- Consider viral pathogens as primary source of infection for pre-school aged children (< 5 years).
- Careful observation off antibiotics is appropriate if there is low suspicion of bacterial CAP

Bacterial CAP treatment (page 4)
- Initiate Amoxicillin 45 mg/kg/dose BID x 5 days, max dose 2000 mg/dose (note 6)
- For beta-lactam allergies, refer to Children's MN Beta-Lactam Allergy Guideline:
  - If able to use cephalosporin: Cefprozil 15 mg/kg/dose BID (note 10)
  - Severe Penicillin allergy: Levofloxacin 10 mg/kg/dose x 5 days, max 375 mg/dose
- Assess social determinants of health: access to follow-up—phone, transportation

Exclusion:
- Age: <60 days
- Age 18 years and older (may reference Empiric Antimicrobial Recommendations for Common Infections in Adult Patients (≥ 18 and < 25 Years Old)
- Chronic or high-risk lung disease (e.g. cystic fibrosis)
- Immunosuppressed/deficient
- Tracheostomy or vent dependent
- High risk of aspiration
- Hospital acquired pneumonia

Community Acquired Pneumonia (CAP): Inpatient Management

(Age 2 months-17 years)

Children's MINNESOTA

Aim: To decrease variation in the treatment of CAP.

Patient admitted for Community Acquired Pneumonia

Is patient improving within 48 hours of initiating antimicrobial therapy?

Yes

- Repeat imaging not recommended
- Transition to oral antibiotics (if not on already)
  - Ampicillin → Amoxicillin
  - Ceftriaxone → Cefprozil (note 10)
- Wean O2 support as tolerated (see HHNC guideline if indicated)

No

Is the patient being treated with amoxicillin (v ampicillin)?

Yes

Initiate Ampicillin*

***Note**: Given its 100% bioavailability, IV ampicillin remains effective in patients admitted with worsening symptoms on 1-2 days of oral amoxicillin

No

Assess source
- Assess for complications, revisit differential diagnosis
- Revisit exposure history

Labs/Rad
- 2-view CXR
- CBC/diff, CMP, CRP
- Blood culture
- Resp pathogen panel (RPP)
- Nasal MRSA PCR

Consult
- Pulmonology
  - If complicated PNA
- Infectious Disease
  - For antibiotic considerations
  - Expanded differential diagnosis

Treatment
- Initiate Ceftriaxone (Page 4: dosing)

Discharge criteria
- O2 saturations > 90% on room air
- Able to maintain hydration
- No barriers to ongoing outpatient management
- Tolerating enteral antibiotics

- Total antibiotic duration: **5-7 days** (note 6)
- Assess social determinants of health: access to follow-up
- Follow-up with PCP within 48 hours of antibiotic completion

Exclusion:
- Age: <60 days
- Age 18 years and older (may reference Empiric Antimicrobial Recommendations for Common Infections in Adult Patients (≥ 18 and < 25 Years Old)
- Chronic or high-risk lung disease (e.g. cystic fibrosis)
- Immunosuppressed/deficient
- Tracheostomy or vent dependent
- High risk of aspiration
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Community Acquired Pneumonia (CAP): Antimicrobials and Allergy considerations

(Age 2 months-17 years)

Children's MINNESOTA

Antimicrobial	Dosing	Interval	Max single dose
Amoxicillin (PO)	45 mg/kg/dose	BID	2,000 mg
Ampicillin (IV)	50 mg/kg/dose	q6h	2,000 mg
Cefdinir (PO)	7 mg/kg/dose	BID	300 mg
Cefprozil (PO)	15 mg/kg/dose	BID	500 mg
Ceftriaxone (IV) Hemodynamically-stable	50 mg/kg/dose	q24h	2,000 mg
Hemodynamically unstable		q12h	
Levofloxacin (IV/PO) 6 mos to 4 years	10 mg/kg/dose	BID	375 mg
>4 years		Once daily	750 mg
Oseltamivir (PO) *Red Book* **Birth to <12 months** **9-11 months** **1-12 years** ≤15 kg 15.1-23 kg 23.1-40 kg >40 kg **≥13 years**	 3 mg/kg PO 3.5 mg/kg 30 mg PO 45 mg PO 60 mg PO 75 mg PO 75 mg PO	BID	See Dosing

Beta-lactam notes:

1. **High-dose amoxicillin** (90 mg/kg/day) **divided BID** is expected to be adequate for the treatment of uncomplicated pneumonia in the majority of children given the low rates of *Streptococcus pneumoniae* resistance to penicillin locally. Recent US clinical trials on pediatric CAP have used BID dosing (SCOUT-CAP).
2. **Please see Children's Minnesota Beta-Lactam Allergy Guideline for further information:**
   - **Severe Penicillin Allergy** definition: includes any of the following: anaphylaxis, angioedema, cardiac arrest, respiratory distress, interstitial nephritis, serum sickness, severe cutaneous reaction (e.g. Stevens-Johnson syndrome, erythema multiforme, DRESS, and TEN.)
   - **Nonsevere allergic reactions to amoxicillin**, these are the options per the AAP 2011 CAP guideline: trial of amoxicillin under medical observation; trial of cephalosporin under medical supervision; treatment with levofloxacin.

Community Acquired Pneumonia (CAP): Supplemental Notes

(Age 2 months-17 years)

Note 1. Community acquired pneumonia

- Typical bacterial pathogens that cause CAP include *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*. However, with the advent of novel diagnostic technologies, *viral* respiratory pathogens are increasingly being identified as frequent etiologies of CAP.
- There is no universal presentation of pneumonia. Overlapping features occurring in various lower respiratory tract conditions (e.g., asthma, bronchiolitis, pneumonitis, pneumonia) makes the clinical diagnosis challenging. Common signs and symptoms include fever, cough, tachypnea, increased work of breathing, dehydration and hypoxia. Other symptoms can include abdominal pain and emesis. Physical exam findings may include rales, crackles, wheezing, dyspnea as demonstrated by retractions, nasal flaring or grunting, and decreased breath sounds.

Note 2. Sepsis: signs and symptoms

- Core temp abnormality: • T > 38.4°C • Or T < 36.0°C in any age PLUS 1 or more of the following: • High-risk condition • Change in perfusion: grey, cool, mottled, clammy or flush • Change in mental status: agitation, distress, inc: 5yonsolable, lethargic, limp • Hypotension (MAP ≤ 5th %ile for age)
- Additional signs include: • Tachycardia • Reduced urine output • Tachypnea/new O2 requirement • High caregiver concern
- Severe Sepsis:
  - Sepsis + CV dysfunction or ARDS or 2+ organ dysfunctions
  - (Also referred to as Sepsis-Associated acute organ dysfunction)
- Septic Shock: Sepsis + CV dysfunction that persists after ≥40 mL/kg NS in one hour

Note 3. CXR considerations: No need to repeat if imaging from outside facility is readily available for review or strong suspicion of viral illness.

Note 4. Immunization status. This guideline recommends that treatment utilize same practice for vaccinated and unvaccinated patients. Immunization status influenced antibiotic choices in the 2011 IDSA/PIDS CAP guideline. However, these guidelines were composed during the widespread use of the pneumococcal conjugate vaccine 7 (PCV7), introduced in 2000. The adoption of PCV13, beginning in 2010, had a further effect on clonal circulation and herd immunity. This has led to: 1. Reduction in Pneumococcal pneumonia hospital admissions in vaccinated *and* unvaccinated children; 2. Reduction in penicillin-resistant invasive pneumococcal infections; 3. rare HiB-associated pneumonias

Note 5. Blood culture: Multiple studies reviewing utility of BC in management of CAP--5-yr retrospective cohort study reviewing >7500 non-ICU hospitalized children found only a 2.5% positive rate (78% positive with Pneumococcus; 82% penicillin susceptible). Prevalence of bacteremia among severe or complicated PNA was 4.2% v 2.2%.

Note 6. Short course antibiotics for treatment of CAP: 5-7 days is recommended.

- SAFER (blinded RCT) trial reviewed short v long course (5 days v 10 days) Amoxicillin for non-hospitalized CAP had comparable clinical cure rates
- Same et al. (2020) Retrospective review of non-ICU hospitalized children comparing short v long (5-7d b v 8-14 days) antibiotic course had no difference in treatment failure between two therapy duration groups (3% v 6%)
- 5 day duration is adequate in most hospitalized patients who are improving and have reached clinical stability by day 5 of treatment. 7 day duration may be favored in hospitalized patients who are slower to respond to initial therapy, and is indicated for those with CAP due to *MRSA* or *Pseudomonas aeruginosa*.

Note 7. COVID-19 considerations: continue to follow local Children's Minnesota guidance for outpatient and inpatient testing.

Note 8. Influenza considerations: Influenza-Like Illness (ILI): Fever ≥ 100.4°F and Cough and/or Sore Throat; During Influenza Season

- Starting Oseltamivir: High risk patients: ≤ 12 months old or chronic conditions such as pulmonary (e.g., asthma), cardiac, renal, hepatic, hematologic, metabolic, neurologic; Immunosuppressed; long term ASA therapy; morbid obesity; social factors; resident of chronic care facility; household contact < 6 months or with chronic condition

Note 9. Azithromycin: Empiric use of azithromycin for coverage of atypical pathogens (e.g. *Mycoplasma pneumoniae*) is ***not recommended*** for the majority of pediatric patients regardless of patient age.

- A large observational study showed no benefit of empiric combination therapy with a macrolide plus beta lactam compared with beta lactam monotherapy in hospitalized children (<18 years of age) with radiographically confirmed CAP with regards to length of stay, re-hospitalizations, or recovery at follow-up.[9] Lack of benefit of macrolide therapy was also shown among a subgroup of hospitalized children with atypical bacteria detected

Note 10. Cephalosporin availability and insurer coverage: Historically, insurer coverage for 2nd/3rd generation cephalosporins is variable—which places families at risk for out-of-pocket (OOP) cost.

- Cefprozil is usually covered by insurance. Children's Minnesota Outpatient Pharmacy stocks 250mg/5ml suspension and 500 mg tablets.
- Alternatively, if Cefprozil is not ideal for OOP cost and/or availability, Cefdnir may be used.

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Prior workgroup members: Hester, Koutsari

Clinical Guidelines: Seattle Children's and Children's Hospital of Philadelphia

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