ASSESSMENT AND MANAGEMENT OF

Pediatric Community-Acquired Pneumonia (CAP)

patients age 3 months and older without bronchiolitis

This care process model (CPM) is produced by Intermountain Healthcare's Pediatric Infectious Disease Team, a subgroup of the Pediatric Speciality Clinical Program. The CPM summarizes evaluation and treatment recommendations for **community-acquired pneumonia (CAP) in previously healthy children without chronic health conditions age 3 months and older.** Recommendations are based on recent studies in peer-reviewed medical literature, local susceptibility data and practice patterns, and recent consensus guidelines from the Infectious Disease Society of America (IDSA) and the British Thoracic Society Standards of Care Committee (BTS).[1,2]

Note that this model **does not provide guidance for treating children with bronchiolitis;** refer instead to Intermountain protocols available on the Bronchiolitis clinical topic page. Also note that this model **does not apply to healthcare-associated pneumonia (HCAP) or to complicated pneumonia** requiring care in the ICU or interventions for effusion.

WHY FOCUS ON PEDIATRIC PNEUMONIA?

- **Pneumonia remains common, serious, and costly.** Pneumonia is the leading cause of death in children worldwide. Each year, more than 2 million children younger than 5 years die from pneumonia, representing approximately 20% of all deaths in children within this age group.[1] Within Intermountain Healthcare, pneumonia is the fourth most common reason for a pediatric admission and is the pediatric condition with the fourth highest cost.[3]
- **Well designed and implemented guidelines have decreased morbidity and mortality for adults with CAP.**[1] For the management of pediatric CAP, retrospective studies support the safety and efficacy of the recommendations in the IDSA and BTS guidelines; adapting these to our Intermountain system local practice can guide outpatient and inpatient care and drive better outcomes.[4]
- **We have an opportunity to improve care and reduce variability in several areas of practice.** Analysis of Intermountain practice patterns reveals several areas where we can standardize care around evidence-based guidelines:
  - Use of pulse oximetry to support diagnosis and guide site-of-care decisions
  - Use of immunization screening and viral testing to guide treatment decisions
  - Appropriate use of chest x-rays for diagnosis and follow-up
  - Blood culture testing at admission and prior to antibiotic therapy
  - Selection and administration of anti-infective agents used in outpatient and inpatient care
  - Discharge criteria for inpatients

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The inside pages of this tool provide an algorithm and can be folded open and posted in your office or clinic. The back page provides a discussion of recommendations and information about resources and references.

KEY RECOMMENDATIONS IN THIS CPM

- Use **pulse oximetry** and clinical assessments of respiratory distress to make site-of-care determinations
- Assess **immunization status** of all patients
- For outpatients, **do not** routinely order chest x-rays; **do not** automatically prescribe anti-infective therapy
- Perform **viral testing** — always for inpatients, as needed for outpatients
- Obtain **blood cultures** on all admitted patients before starting anti-infective therapy; do not routinely perform cultures in fully immunized children well enough for outpatient care
- When antibiotic therapy is indicated, begin with **amoxicillin or ampicillin** (and when IV ampicillin is used, convert early to oral medication)
- Provide **influenza antiviral therapy** for all children hospitalized with flu

GOAL

To support our overall goal of improving clinical outcomes and appropriate use of resources, in 2013 we will begin measuring in select Intermountain facilities the percentage of **children admitted to the hospital** with uncomplicated CAP and given antibiotics **who receive amoxicillin** or **ampicillin**. **Our goal: 55% or better.**

Pediatric Community-Acquired Pneumonia (CAP)

patients age 3 months and older without bronchiolitis

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ALGORITHM: ASSESSMENT AND DISPOSITION

Previously healthy child presents to physician office or ED with **signs/symptoms suggestive of pneumonia (a)**

1. ASSESS for RESPIRATORY DISTRESS

**starred items have best positive predictive value for CAP*

- ❑ ***Tachypnea:** RR breaths/minute
  - >50 for age 3–11 months
  - >40 for age 1–5 years
  - >20 for age >5 years
- ❑ ***Pulse oximetry <90% on room air**
- ❑ ***Nasal flaring**
- ❑ Grunting
- ❑ Dyspnea
- ❑ Apnea
- ❑ Altered mental status
- ❑ Retractions (suprasternal, intercostals, subcostals)

If bronchiolitis, follow appropriate guidelines.

Clinical diagnosis of CAP? (b) — no → *Consider other diagnoses*

yes

2. ASSESS IMMUNIZATION STATUS

to guide decision-making re: labs and therapy

*(Appropriate immunizations for **pneumococcus** and **Hib** allow for narrow-spectrum dosing when antibiotics are chosen)*

- ❑ yes / ❑ no **pneumococcus** (appropriate for age)
- ❑ yes / ❑ no **Hib** (appropriate for age)
- ❑ yes / ❑ no **influenza** (this season, appropriate for age)

3. ASSESS NEED FOR INPATIENT CARE

- ❑ Moderate to severe CAP as determined by several factors, including respiratory distress and sustained hypoxemia
- ❑ Age <6 months with suspected bacterial CAP (RSV negative)
- ❑ Persistent respiratory distress
- ❑ Suspicion/confirmation of CA-MRSA, other highly virulent cause of CAP
- ❑ Dehydration or inability to feed
- ❑ Concern about observation at home or ability to follow up

Plan OUTPATIENT care ← *none of above* — *any one of above* → **Plan INPATIENT care**

4. PERFORM LIMITED TESTING AS NEEDED

- **If child is NOT immunized appropriate for age, obtain:**
  - – CBC – Blood culture
- **Consider:**
  - – Influenza testing as seasonally appropriate (see GermWatch.org) when symptoms are compatible with influenza and the results may influence decision to treat with antiviral medication.
  - – Testing for other viruses, if results will influence clinical decisions such as withholding or discontinuing antibiotics.
  - – Chest x-ray **(c)**. Note that chest radiographs are generally **NOT** needed to confirm CAP in patients well enough to be treated in an outpatient setting.

OUTPATIENT care

4. PERFORM FULL TESTING

- Obtain: – Chest x-ray (c) – CBC – Blood culture
  - – Seasonal RSV and influenza testing (rapid test is okay for RSV, but not for flu) or full viral panel as available by facility. See GermWatch.org for information on disease activity.
- **Consider** CRP testing

Need ICU? (d) — yes → **ICU** (discuss w/ICU staff)

no

Effusion requiring intervention? (e) — *Manage per IDSA algorithm (e)*

no

INPATIENT care (non-ICU)

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a) SIGNS AND SYMPTOMS suggestive of pneumonia: Clinical presentation varies depending upon the responsible pathogen and the severity. Symptoms may be subtle, especially in young children.

- Fever
- Cough
- Chest pain
- Abdominal pain
- Breath sounds: striking focal findings of bronchial breath sounds or crackles
- In infants and young children: difficulty feeding, restlessness, or fussiness

For guidance distinguishing CAP from bronchiolitis, see the Discussion on page 4 of this CPM.

(b) CLINICAL DIAGNOSIS OF CAP: Best positive predictive value: **tachypnea**, **O_2 saturation < 90%,** and **nasal flaring** (for age <12 months); best negative predictive value is absence of tachypnea, other signs and symptoms of respiratory distress

(c) CHEST X-RAY: Per IDSA and BTS guidelines:

- For children well enough to be treated as outpatients, do NOT routinely order chest x-rays.
- For inpatients, use posteroanterior (PA) and lateral radiographs to note presence, size and character of infiltrates and to identify complications.
- Do NOT routinely order follow-up chest x-rays for children recovering uneventfully from CAP; do obtain them for patients who fail to improve within 48 to 72 hours after initiation of antibiotics.

(d) ICU Admit: Consider ICU admit if:

- Requires non-rebreather to maintain O_2 saturation >90%
- Requires >8 liters O_2 by simple mask
- Impending respiratory failure, sustained tachycardia, inadequate BP, or need for pharmacologic support of BP or perfusion
- Need for invasive ventilation via a nonpermanent artificial airway (e.g., endotracheal tube)
- Need for noninvasive positive pressure ventilation (e.g., CPAP or BPAP)
- Altered mental status, whether due to hypercarbia or hypoxemia due to CAP

(e) ASSESS & MANAGE PARAPNEUMONIC EFFUSION: Size of effusion and proportion of thorax opacity determine management; intervention is recommended when **effusion ≥10mm rim of fluid** or **≥ ¼ of thorax is opacified**.

For guidance on managing effusion, refer to the IDSA guidelines.[1]

ALGORITHM: TREATMENT

OUTPATIENT care for mild-moderate CAP

5. SELECT TREATMENT OPTION(S.)

- **NO TREATMENT.** Most children well enough to be treated as outpatients do not require antibiotics, as viral pathogens are responsible for the majority of clinical disease. Influenza antiviral therapy is needed only in the circumstances indicated below.
- **ANTIBIOTICS.** If you choose to give antibiotics, follow these recommendations (see **(f)** for first-line choices, doses):
  - GIVE **PO antibiotics.**
  - ADD **azithromycin** if suspected atypical pathogen (may be used alone if high suspicion of single atypical pathogen).
- **INFLUENZA ANTIVIRAL THERAPY.** Start if symptoms <48 hours and flu is suspected or confirmed in a child <2 years or at high risk (see back page for discussion, sidebar **(g)** for dosing):
  - PROVIDE **oseltamivir** for moderate disease or to high-risk patients UNLESS OR UNTIL negative PCR result is obtained, and
  - CONTINUE antiviral therapy if flu result is positive

6. PROVIDE OTHER OUTPATIENT CARE

- **IMMUNIZATIONS.** Give influenza and pneumococcal immunizations if appropriate **(h).**
- **Patient education.** Use Intermountain fact sheet *Pneumonia: Prevention and Care at Home* or *Let's Talk About...Pneumonia* (pediatric), available in English and Spanish at i-printstore.com.

7. FOLLOW-UP WITH OUTPATIENTS

- **Follow-up visit or phone call in 48-72 hours.**
- **Modify anti-infective treatment as test results become available.**
- **As needed for parents:** Provide smoking cessation advice/counseling; can use Intermountain's *Quitting Tobacco — your journey to freedom booklet* available at i-printstore.com.

INPATIENT care (non-ICU) for moderate-severe CAP

If not already done, **obtain blood cultures BEFORE starting antibiotic.** Do not wait for culture results before giving antibiotics.

5. SELECT TREATMENT OPTION(S)

- **NO TREATMENT.** If testing suggests pneumonia is caused by a viral process, antibiotics may not be needed. Influenza antiviral therapy is needed only in the circumstances indicated below.
- **ANTIBIOTICS.** If you choose to give antibiotics, follow these recommendations (see **(f)** for first-line choices, doses):
  - BEGIN trial of **PO antibiotics** if:
    - ➛ patient is tolerating PO fluids, able to absorb PO medication, and
    - ➛ patient's RR allows for PO medications, and
    - ➛ patient has NOT failed a trial of high-dose amoxicillin (no improvement within 48-72 hours) prior to admission;

    OTHERWISE...
  - BEGIN **IV antibiotics** and at 24 hours convert to **PO antibiotics** if patient can tolerate oral therapy
  - ADD **azithromycin** if suspected or confirmed atypical pathogen
- **INFLUENZA ANTIVIRAL THERAPY.** Choose during flu season (see **(g)** for dosing):
  - PROVIDE **oseltamivir** UNLESS OR UNTIL negative PCR result is obtained, and
  - CONTINUE both antibiotic and antiviral if flu result is positive

Modify antinfective treatment as test results become available or with ability to tolerate PO meds.

6. IMPLEMENT INPATIENT BEST PRACTICES

- **Pulse oximetry.**
- **Early ambulation.** Sitting in chair and/or ambulating for at least 20 minutes during the first 24 hours of hospitalization.
- **Patient/family education.** Use Intermountain's *Pneumonia: Guide to Hospital Care* fact sheet, available at i-printstore.com.

7. EVALUATE CLINICAL STATUS AT 48–72 HOURS

NOT improved → **Further investigation**
Chest x-ray **(c)**
Additional or repeat tests
Infectious Disease consult

Improved

- ATTEMPT TRANSITION to oral medication if not already done (**f**)
- IMMUNIZE as needed (**h**)
- DISCHARGE per criteria (**i**)

(f) ANTIBIOTIC DOSING.

The first-line therapy choices listed below provide appropriate coverage for *Streptococcus pneumoniae*, the most prominent invasive bacterial pathogen. *For more medication options, see IDSA guidelines.*[1]

Antibiotic and dose		
PO (outpatient and hospital)	**If APPROPRIATELY immunized*** for age: **amoxicillin, PO:** 30 mg/kg/dose (max 1000 mg/dose) 3 times daily x 10 days	**if allergic: clindamycin, PO:** 13 mg/kg/dose (max 600 mg) 3 times daily x 10 days
	If NOT appropriately immunized* for age: **amoxicillin/clavulanate ES, PO:** 45 mg/kg/dose (max 2000 mg/dose) 2 times daily x 10 days	
IV (hospital)	**If APPROPRIATELY immunized*** for age: **ampicillin, IV:** 50 mg/kg/dose (max 2000 mg/dose) every 6 hours	**if allergic: clindamycin, IV:** 13 mg/kg/dose (max 600 mg) every 8 hours
	If NOT appropriately immunized* for age: **ceftriaxone, IV:** 75 mg/kg/dose (max 2000 mg/dose) every 24 hours	
PO or IV (outpatient and hospital)	**Add a 2nd antibiotic if suspected/confirmed atypic pathogen** (symptoms are slow-progressing with malaise, sore throat, low-grade fever, cough developing over 3 to 5 days): **azithromycin,** preferably **PO:** 10 mg/kg/dose (max 500 mg) once daily for 3 days	

*appropriately immunized for **pneumococcus, Hib**

(g) INFLUENZA ANTIVIRAL DOSING.

Antiviral and dose		
PO	Per the algorithm, give **oseltamivir** alone or in conjunction with antibiotic therapy:	
	Birth to <12 months: 3 mg/kg/dose 2 times daily	**12 months or greater:** • <15 kg: 30 mg 2 times daily • 15–23 kg: 45 mg 2 times daily • 24–40 kg: 60 mg 2 times daily • ≥41 kg: 75 mg 2 times daily

(h) IMMUNIZATIONS.

- **Screen all patients** for **influenza**, **pneumococcal**, **Hib** and/or **pertussis** immunizations at the clinic or before hospital discharge.
- Promote immunizations for influenza virus and pertussis for all parents and caretakers of infants age <6 months.

(i) DISCHARGE CRITERIA.

- Documented overall clinical improvement (↓ fever, ↑ appetite and activity) for at least 12 hours
- Consistent pulse oximetry measurements demonstrating adequate oxygenation
- Normal and/or baseline mental status
- NO substantially increased work of breathing or sustained tachypnea or tachycardia
- NO barriers to follow-up or at-home care

DISCUSSION

CAUSE of CAP	ASSESSMENT considerations	TREATMENT considerations
Viral Remember that viral pathogens are responsible for CAP in the majority of preschool age children. The most common viral causes of CAP include influenza (A and B) and respiratory syncytial virus (RSV A and B).[5]	A positive viral test may decrease need for additional studies, influence decisions about antibiotics, and guide the appropriate use of influenza antiviral therapy for both outpatients and inpatients. • **For children with CAP admitted to the hospital, test for respiratory viruses** to guide management and cohorting decisions. • **When seasonally appropriate, test for influenza** for all admitted patients and consider testing outpatients as per the algorithm. • **If the patient has underlying illness or immunodeficiency,** perform an extended respiratory panel.	In children with a positive viral test result in the absence of clinical findings that suggest bacterial infection, antibiotics are generally not necessary. **For suspected or confirmed influenza, give antiviral therapy (oseltamivir) per the algorithm. All children hospitalized with influenza should receive oseltamivir.** **For outpatients with suspected or confirmed influenza,** the decision to use oseltamivir may take into consideration several factors, including: • **Duration of symptoms** (healthy people with symptoms >48 hours will likely not benefit from antiviral therapy). • **Cost**. • **Risk for influenza complications**. Oseltamivir is indicated for outpatients who are at increased risk for influenza complications; this group includes: – Children <5 years (children <2 years have highest risk) – People with chronic pulmonary conditions (including asthma), metabolic disorders including diabetes), or neurologic or neurodevelopmental conditions (including seizure disorders) – Postpartum or pregnant women – People with immunosuppression – American Indians/Alaska Natives See the CDC for complete list of populations at higher risk for influenza complications.[6]
Bacterial In our region, the most prominent bacterial pathogen is *S. pneumoniae*. Providers should be aware of the possibility of the **atypical pathogen** *Mycoplasma pneumoniae (M. pneumoniae)*, which is found most often in school-age children and adolescents.	Blood cultures are sometimes useful, as positive results can lead to meaningful changes in clinical management.[7] We recommend making decisions about cultures per the algorithm, emphasizing that: • **Inpatients:** Blood cultures should be obtained for all hospitaliized children. • **Outpatients who are appropriately immunized for age:** Blood cultures should NOT be routinely performed. • **All children whose symptoms worsen** after antibiotics are initiated should have blood cultures performed. • **Repeat blood cultures to document clearance are not necessary** unless bacteremia is caused by *S. aureus*. **Suspect the atypical pathogen *Mycoplasma pneumoniae?*** • Features of atypical pneumonia include slow-progressing illness with malaise, sore throat, low-grade fever, and cough developing over 3-5 days. • Decision to treat as atypical pneumonia can be made on the basis of clinical presentation; the precise role for testing is unclear. Some extended respiratory panels include *M. pneumoniae* and may help guide therapy; however, this is costly. Note that the cold agglutinin test lacks sensitivity, specificity, and reproducibility and is not recommended.	When antibiotic therapy is indicated, proceed as per algorithm, noting that: • **In the era of bacterial resistance, it is our goal to choose the most narrow spectrum agent appropriate** for the disease process. A lengthy discussion about recommended antibiotic choices is available in the IDSA CAP guideline.[1] • **The child's immunization status with respect to *S. pneumoniae* and *H. influenzae* type B is a factor in antibiotic selection.** Parental report of immunization is acceptable, but attempt should be made to obtain records. • **Oral medication is preferred for most children,** even those treated as inpatients who meet the criteria outlined in the algorithm. Findings of a recent large pooled analysis show that treatment with oral amoxicillin is associated with low failure rates and very few serious morbidities or deaths across a range of settings. Infants age 2–5 months, particularly those with fast breathing, may be at highest risk of treatment failure.[8] • **First-line choice for appropriately immunized children with CAP is amoxicillin/ampicillin.** This provides appropriate coverage for *S. pneumoniae*. – **High-dose amoxicillin 30 mg/kg/dose three times daily** is recommended given the local MIC data for 2011. (Three times daily dosing appears better for pneumococcus with MIC of 2 and greater; our MIC is 4. This dosing recommendation may change as MIC data is updated.) – **If the child is not immunized appropriately for age for pneumococcus and Hib,** first-line choice is oral amoxicillin/clavulanate or IV ceftriaxone with move to oral therapy as able. – **If the child is allergic to penicillin,** oral or IV clindamycin is a reasonable alternative to amoxicillin/ampicillin. – **If the child has a penicillin sensitivity**, consider a trial of oral amoxicillin under medical observation. – **Cefdinir lacks substantial activity against *S. pneumoniae* and should not be used.** • **If an atypical pathogen is suspected or confirmed**, azithromycin may be used, but this is not adequate therapy for *S. pneumoniae* secondary to resistance. • **If *S. aureus* is suspected or confirmed**, refer to IDSA CAP guidelines for options.[1]

CAP or Bronchiolitis?

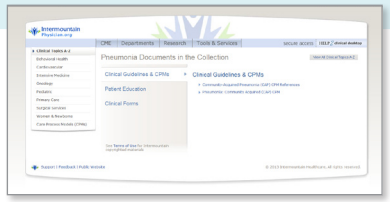
To ensure appropriate treatment and use of resources, it's important to distinguish bronchiolitis from CAP. Bronchiolitis is swelling and excess mucus limited to the bronchioles, while pneumonia involves the alveolar space and interstitium. Bronchiolitis is most commonly diagnosed in children younger than age two; the diagnosis is made clinically, based on signs and symptoms which can be similar to those seen with pneumonia. These points may guide assessment:[9,10]

- **History supporting bronchiolitis includes an upper respiratory prodrome progressing to lower respiratory symptoms:** cough, tachypnea, wheezing and increased respiratory effort. Symptoms usually peak between day 3 and 5 of illness and include increased mucus production (rhinorrhea and congestion) requiring frequent suctioning.
- **With bronchiolitis, physical exam reflects the variable and dynamic disease course.** Serial exams show tachypnea, retractions, often with crackles and expiratory wheezing; the distribution may change over time.
- **Bronchiolitis often occurs during winter.** Positive viral testing can confirm the diagnosis, though negative testing does not exclude the diagnosis. Viral studies are not generally needed, except to guide inpatient isolation/cohorting.
- **Although chest x-ray is not indicated with bronchiolitis,** if incidentally completed it can show peribronchial cuffing, hyperinflation and small areas of atelectasis which can often be confused as areas of consolidation as seen in pneumonia.
- **Secondary bacterial infections are uncommon in bronchiolitis** but should be suspected if there is worsening of respiratory symptoms and fever after an initial improvement.

For treatment advice, see the "Bronchiolitis" topic page at **intermountainphysician.org/clinicalprograms**

REFERENCES & RESOURCES

For a list of the **references** used to develop this model, the related **order set**, and **patient education** on variety of conditions and treatments, see the "Pneumonia" topic page at **intermountainphysician.org/clinicalprograms**



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This CPM is based on best evidence at the time of publication. It is not meant to be a prescription for every patient. Clinical judgment based on each patient's unique situation remains vital. We welcome your feedback; contact Carolyn.Reynolds@imail.org