

# Community-acquired pneumonia in children: A look at the IDSA guidelines

This review of the guidelines can help you adjust your care according to your patient's age and disease severity.

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## PRACTICE RECOMMENDATIONS

› *Chest x-rays and lab testing may be optional for children with community-acquired pneumonia (CAP) who are not seriously ill.* **(A)**

› *Start amoxicillin empirically for any child with mild-to-moderate CAP.* **(B)**

› *If an atypical bacterial pneumonia is suspected, azithromycin is the first-line treatment.* **(B)**

### Strength of recommendation (SOR)

- (A)** Good-quality patient-oriented evidence
- (B)** Inconsistent or limited-quality patient-oriented evidence
- (C)** Consensus, usual practice, opinion, disease-oriented evidence, case series

**W**hat are the recommended antibiotic choices for children with mild-to-moderate bacterial community-acquired pneumonia (CAP) in the outpatient setting? How much diagnostic testing is required? When might hospitalization and combination antibiotic therapy be warranted?

Evidence-based answers to these and other questions relevant to the management of CAP in infants and children older than 3 months are provided in a set of guidelines jointly published by the Infectious Diseases Society of America (IDSA) and the Pediatric Infectious Diseases Society (PIDS) in 2011.<sup>1</sup> We summarize them here.

## What the guidelines do, and don't, address

The IDSA/PIDS guidelines, which focus on the care of otherwise healthy children with CAP in both outpatient and inpatient settings, seek to decrease morbidity and mortality rates associated with this respiratory infection. The guidelines do not apply to children younger than 3 months, immunocompromised patients, children receiving home mechanical ventilation, or children with chronic conditions or underlying lung disease, such as cystic fibrosis.

■ **The need for evidence-based guidance.** Globally each year, 1.5 million children 5 years of age and younger suffer a pneumonia-related death, particularly in developing countries.<sup>2-5</sup> This is more than the number of deaths associated with any other disease in the world, including acquired immune deficiency syndrome (AIDS), tuberculosis (TB), or malaria.<sup>2</sup> In 2010, pneumonia was ranked in the United States as the sixth leading cause of death for children one to 4 years of age and the 10th leading cause of death in adolescents.<sup>5</sup> It is estimated that out of every 1000 infants and children in North



**For children who have been fully immunized and are treated as outpatients, blood cultures are indicated only if initial treatment fails.**

America and Europe, 35 to 40 will be affected by CAP.<sup>2</sup>

■ **How the guidelines define CAP.** Pneumonia can be broadly defined as a lower respiratory tract infection, but definitions vary depending on the organization, institution, or health care setting. For instance, the World Health Organization (WHO) defines pneumonia solely on the basis of clinical findings obtained by visual inspection and timing of the respiratory rate.<sup>6</sup> Another definition published by Bone and colleagues states that pneumonia is the “inflammation of the pulmonary parenchyma brought about by the presence of virulent pathogens; usually differentiated from isolated infections of the major airways.”<sup>7</sup> The new pediatric guidelines define CAP as “the presence of signs and symptoms of pneumonia in a previously healthy child caused by an infection that has been acquired outside the hospital.”<sup>1</sup>

**CAP pathogens vary with the child’s age**

Typically, diagnostic testing of children will reveal several microbes, viral and bacterial, making it difficult to determine which might be the pathogen.<sup>1</sup> Viral pathogens are more common causes of CAP in children younger than 2 years, accounting for 80% of cases<sup>1</sup>; bacterial pathogens are more common in older children.<sup>1</sup>

The virus detected most often among children younger than 2 years is respiratory syncytial virus (RSV).<sup>1,8-12</sup> Less common viruses include adenovirus, influenza types A and B, parainfluenza 1, 2, and 3, and rhinovirus. *Streptococcus pneumoniae* is the most common bacterial pathogen identified in older children.<sup>1,13</sup> The overall incidence of pneumonia decreases with age, but it has been reported that the proportion of cases from atypical bacterial pathogens—*Chlamydia pneumoniae* and *Mycoplasma pneumoniae*—may increase among older children.<sup>1,13</sup>

**Signs and symptoms also vary**

Signs and symptoms of CAP differ depending on the severity of the infection and the age of the child. In general, respiratory distress (tachy-

pnea, nasal flaring, decreased breath sounds, cough, and rales) with fever are the prominent symptoms associated with pneumonia.<sup>1,13,14</sup>

Infants and children with mild to moderate infection most commonly exhibit a temperature <38°C and a respiratory rate <50 breaths per minute (bpm).

Children with severe CAP commonly present with a temperature >38°C, flaring of nostrils, grunting with breathing, tachypnea, tachycardia, and cyanosis. Tachypnea is defined as >60 bpm in infants younger than 2 months, >50 bpm in infants 2 to 12 months, and >40 bpm in children ages 1 to 5 years.<sup>8</sup> Although respiratory rate is a valuable clinical sign, the work of breathing (as evidenced by nasal flaring, breathlessness, cough, or wheeze) required by the infant or child may be more indicative of pneumonia.<sup>15</sup>

**Utilize diagnostic testing judiciously**

Not all patients with suspected CAP require the same amount of diagnostic testing. In fact, IDSA/PIDS recommendations vary for hospitalized patients and for outpatients.<sup>1</sup> In all cases, conduct testing quickly to expedite diagnosis and minimize the need for additional testing, to help validate treatment choices, and to reduce time spent in the hospital.<sup>1</sup>

■ **Blood and sputum cultures not always indicated.** The IDSA/PIDS guidelines strongly recommend obtaining blood cultures for hospitalized patients with moderate-to-severe pneumonia, particularly those with complications.<sup>1</sup>

The guidelines strongly recommend against blood cultures for fully immunized children with CAP who are treated as outpatients. However, blood cultures are strongly recommended for any child who fails to improve after initiation of antibiotic therapy.<sup>1</sup> These recommendations are consistent with clinical data, expert opinion, and other treatment guidelines.<sup>1,8,13-18</sup>

A weak recommendation from the new guidelines states that if a hospitalized child with CAP can produce sputum, gram staining of the specimen may be warranted.<sup>1,8,13,15</sup>

■ **Use pulse oximetry.** The guidelines

TABLE 1

Influenza antiviral therapy in pediatric patients\*<sup>1</sup>

Drug (brand name)	Formulation	Dosing
Oseltamivir (Tamiflu)	75 mg capsule; 60 mg/5 mL suspension	<b>4-8 mo:</b> 6 mg/kg/d in 2 doses <b>9-23 mo:</b> 7 mg/kg/d in 2 doses <b>≥24 mo:</b> ~4 mg/kg/d in 2 doses, for 5 days ≤15 kg: 60 mg/d in 2 divided doses >15-23 kg: 90 mg/d in 2 divided doses >23-40 kg: 120 mg/d in 2 divided doses >40 kg: 150 mg/d in 2 divided doses
Zanamivir (Relenza)	5 mg per inhalation, using a Diskhaler	<b>≥7 y:</b> 2 inhalations (10 mg total per dose), twice daily for 5 days
Amantadine (Symmetrel) <sup>†</sup>	100 mg tablet; 50 mg/5 mL suspension	<b>1-9 y:</b> 5-8 mg/kg/d as single daily dose or in 2 doses; not to exceed 150 mg/d <b>9-12 y:</b> 200 mg/d in 2 doses (not studied as a single dose)
Rimantadine (Flumadine) <sup>†</sup>	100 mg tablet; 50 mg/5 mL suspension	<b>Not FDA approved for treatment in children, but published data exist on safety and efficacy in children</b> <b>Suspension:</b> <b>1-9 y:</b> 6.6 mg/kg/d (max 150 mg/kg/d) in 2 doses <b>≥10 y:</b> 200 mg/d, as single daily dose or in 2 doses

\*In children for whom prophylaxis is indicated, antiviral drugs should be continued for the duration of known influenza activity in the community (because of the potential for repeated exposures) or until immunity can be achieved as a result of immunization.

<sup>†</sup>Amantadine and rimantadine should be used for treatment and prophylaxis only in the winter, when most isolated influenza A virus strains are susceptible to adamantane; the adamantanes should not be used for primary therapy because of the rapid emergence of resistance. However, for patients requiring adamantane therapy, a treatment course of about 7 days is suggested, or one that runs until a day or 2 after the signs and symptoms have disappeared.



**Amoxicillin remains the empiric treatment of choice for patients with a suspected bacterial pathogen.**

strongly recommend using pulse oximetry with all children who have pneumonia or suspected hypoxemia.<sup>1,18</sup>

#### ■ When chest radiography can help.

Routine chest radiography may not be warranted for suspected CAP treated in the outpatient setting. Order chest films for patients with suspected or confirmed hypoxemia or respiratory distress (who tend to have worse outcomes), and for patients who do not respond to initial antibiotic treatment.<sup>1,18</sup> Follow-up radiographs are recommended for patients with advancing symptoms 2 to 3 days after starting antibiotics, complicated pneumonia with worsening respiratory distress, or clinical symptoms without improvement.<sup>1</sup>

■ Other diagnostic tests mentioned in the guidelines include complete blood cell

counts, which are recommended in severe cases of pneumonia.<sup>1</sup>

Acute-phase reactants such as erythrocyte sedimentation rate (ESR), serum procalcitonin, and C-reactive protein concentrations cannot distinguish between viral and bacterial causes of CAP, and are not routinely recommended for patients treated in the outpatient setting.<sup>1,13</sup>

For patients requiring endotracheal intubation, gram staining and cultures of aspirates of the trachea and virus testing are recommended.<sup>1</sup>

Immunocompetent patients hospitalized with severe CAP may be candidates for percutaneous lung aspiration, open lung biopsy, bronchoalveolar lavage (BAL), or bronchoscopic or blind protected brush specimen collection if prior diagnostic tests are negative.<sup>1</sup>

CONTINUED

TABLE 2

## Empiric outpatient antibiotic therapy for pediatric CAP<sup>1,19</sup>

Duration of treatment is 10 days unless otherwise noted

Patient age	Presumed bacterial pneumonia	Presumed atypical pneumonia
3 mo to <5 y, regardless of immunization status	<b>Preferred:</b> amoxicillin 90 mg/kg/d PO in 2 divided doses <b>Alternative:</b> amoxicillin clavulanate 90 mg/kg/d PO in 2 divided doses	For all children regardless of age and immunization status: <b>Preferred:</b> azithromycin 10 mg/kg PO on Day 1, followed by 5 mg/kg PO once daily on Days 2-5 <b>Alternative:</b> clarithromycin 15 mg/kg/d PO in 2 divided doses <i>OR</i> In children >7 y: erythromycin 40 mg/kg/d PO in 4 divided doses; or doxycycline 2-4 mg/kg/d PO in 2 divided doses
≥5 y and fully immunized against <i>Streptococcus pneumoniae</i> and <i>Haemophilus influenzae</i>	<b>Preferred:</b> * amoxicillin 90 mg/kg/d PO in 2 divided doses to a maximum 4 g/d, with or without a macrolide antibiotic <b>Alternatives:</b> Second- or third-generation cephalosporins such as oral cefpodoxime, cefuroxime, or cefprozil <i>OR</i> levofloxacin (5-16 y) 8-10 mg/kg PO once daily (max 750 mg/d) <sup>†</sup> <i>OR</i> linezolid (<12 y) 30 mg/kg/d PO (max 1200 mg/d) in 3 divided doses; or (≥12 y) 20 mg/kg/d (max 1200 mg/d) in 2 divided doses	
≥5 y and NOT fully immunized against <i>S pneumoniae</i> and <i>H influenzae</i>	<b>Preferred:</b> * amoxicillin 90 mg/kg/d PO in 2 divided doses to a max of 4 g/d; or amoxicillin clavulanate 90 mg/kg/d PO in 2 divided doses <b>Alternatives:</b> Second- or third-generation cephalosporins such as oral cefpodoxime, cefuroxime, or cefprozil <i>OR</i> levofloxacin (5-16 y) 8-10 mg/kg PO once daily (max 750 mg/d) <sup>†</sup>	

CAP, community-acquired pneumonia.

\*Preferred treatments of choice change in areas of high *S pneumoniae* resistance. Refer to the complete guidelines for specific recommendations.

<sup>†</sup>The guidelines do not fully address the controversy concerning the use of quinolones in children. The use of quinolones in infants and children is considered a risk vs benefit decision.

### CAP treatment and prevention

The guidelines provide recommendations for treating bacterial and viral CAP in either inpatient or outpatient settings, and discuss appropriate preventive techniques.

■ **Antiviral therapy.** As mentioned earlier, children less than 2 years of age are commonly infected with viral pathogens. Those with mild cases of viral CAP do not require anti-microbial therapy. For children with moderate-to-severe CAP consistent with influenza infection, administer influenza antiviral therapy as soon as possible, especially during a widespread local circulation

of influenza viruses. Some influenza A strains will be susceptible to antiviral therapy, even though genetic variability is high each year. The guidelines' recommended agents for treating influenza in pediatric patients are listed in TABLE 1.<sup>1</sup>

■ **Antibacterial therapy.** For patients with a suspected bacterial pathogen, start empiric antibiotic therapy as soon as possible. Preferred and alternative agents for specific age groups, immunization status, and specific pathogen(s) appear in TABLE 2.<sup>1,19</sup>

Patients with mild or moderate CAP may be treated first in the outpatient setting

TABLE 3

**Empiric antibiotic therapy for hospitalized patients with CAP<sup>1,19</sup>**

Duration of treatment is 10 days unless otherwise noted

Patient age	Presumed bacterial pneumonia	Presumed atypical pneumonia
3 mo to <5 y and fully immunized against <i>Streptococcus pneumoniae</i> and <i>Haemophilus influenzae</i>	<b>Preferred:</b> * ampicillin 150-200 mg/kg/d IV divided every 6 h; or penicillin G 200,000-250,000 units/kg/d IV divided every 4-6 h <b>Alternatives:</b> ceftriaxone 50-100 mg/kg/d IV/IM divided every 12-24 h; or cefotaxime 150 mg/kg/d IV divided every 8 h	For all children regardless of age and immunization status: <b>Preferred:</b> azithromycin, 10 mg/kg IV (max of 500 mg) on Days 1 and 2, then transition to oral therapy 10 mg/kg/d for remaining 7-10 days of therapy
<5 y and NOT fully immunized against <i>S pneumoniae</i> and <i>H influenzae</i>	<b>Preferred:</b> * ceftriaxone 50-100 mg/kg/d IV/IM divided every 12-24 h; or cefotaxime 150 mg/kg/d IV divided every 8 h <b>Alternative:</b> levofloxacin (6 mo-<5 y) 16-20 mg/kg/d IV divided every 12 h <sup>†</sup>	<b>Alternatives:</b> erythromycin lactobionate 20 mg/kg/d IV divided every 6 h; or levofloxacin 16-20 mg/kg/d IV divided every 12 h to a max of 750 mg/d <sup>†</sup>
≥5 y and fully immunized against <i>S pneumoniae</i> and <i>H influenzae</i>	<b>Preferred:</b> * ampicillin 150-200 mg/kg/d IV divided every 6 h; or penicillin G 200,000-250,000 units/kg/d IV divided every 4-6 h <b>Alternatives:</b> ceftriaxone 50-100 mg/kg/d IV/IM divided every 12-24 h; or cefotaxime 150 mg/kg/d IV divided every 8 h	
≥5 y and NOT fully immunized against <i>S pneumoniae</i> and <i>H influenzae</i>	<b>Preferred:</b> * ceftriaxone 50-100 mg/kg/d IV/IM divided every 12-24 h; or cefotaxime 150 mg/kg/d IV divided every 8 h <b>Alternatives:</b> ampicillin 150-200 mg/kg/d IV divided every 6 h; or levofloxacin 8-10 mg/kg IV once daily (max of 750 mg/d) <sup>†</sup>	

CAP, community-acquired pneumonia.

\*The addition of clindamycin 40 mg/kg/d IV divided every 6-8 hours or vancomycin 40-60 mg/kg/day IV divided every 6-8 hours is recommended for suspected or confirmed community-acquired methicillin-resistant *Staphylococcus aureus*.<sup>†</sup>The guidelines do not fully address the controversy concerning the use of quinolones in children. Use of quinolones in infants and children is considered a risk vs benefit decision.

with amoxicillin. This antibiotic has been the agent of choice for many years and continues to be the empiric therapy recommended in the guidelines.<sup>1</sup> Appropriate dosing depends on the age of the patient.

TABLE 2 also includes treatment alternatives to amoxicillin for patients with drug allergies, treatment failures, or suspected atypical pathogens. Amoxicillin and the alternative treatments provide coverage for *S pneumoniae*, the most common invasive bacterial pathogen in older children.<sup>1,20</sup> When atypical pathogens are suspected, macrolide antibiotics become the antibiotic drug class of choice, with azithromycin being the preferred first-line agent.<sup>1,21-23</sup>

#### ■ Bacterial CAP necessitating hospital-

ization. The guidelines strongly recommend hospitalization for infants and children with respiratory distress or hypoxemia (oxygen saturation <90%); for suspicion of infection caused by community-acquired methicillin-resistant *Staphylococcus aureus* (MRSA) or any pathogen with high virulence; or for infants 3 to 6 months old.<sup>1</sup>

Treat with parenteral antibiotics to provide reliable blood and tissue concentrations (TABLE 3).<sup>1,19</sup> Ampicillin or penicillin G may be given to fully immunized children; however, take into account the local resistance pattern of *S pneumoniae* to drugs within the penicillin class. For hospitalized children who are not yet fully immunized, who have life-threatening infections, or who are in a fa-

**>**  
 The recommended duration of treatment for CAP is 10 days.

cility with a documented high rate of penicillin resistance, administer a third-generation parenteral cephalosporin such as ceftriaxone or cefotaxime empirically.<sup>1,24</sup> In monotherapy treatment of pneumococcal pneumonia, non-beta-lactam agents such as vancomycin have not been shown to be more effective than the third-generation cephalosporins.<sup>1</sup>

If *S aureus* is the suspected microorganism or is confirmed with clinical, laboratory, or imaging characteristics, give vancomycin or clindamycin with a beta-lactam agent.<sup>1,25-26</sup> If you suspect an atypical pathogen such as *M pneumoniae* or *C pneumoniae*, start empiric therapy with an oral or parenteral macrolide in combination with a beta-lactam.<sup>1</sup>

Once a pathogen has been identified, adjust antimicrobial therapy as needed to target the specific microbe, to limit empiric antibiotic exposure, and to help limit the potential for antibiotic resistance.

**Duration of treatment.** The recommended duration of treatment for CAP is 10 days, supported by clinical data and the practice guidelines.<sup>1,27-29</sup> Shorter treatment courses may be effective, especially in mild cases or outpatient treatment.<sup>1</sup> Specific pathogens, such as MRSA, may need to be treated longer.<sup>30</sup>

If a patient is receiving intravenous antibiotics, switch to an oral agent as soon as clinically feasible to decrease risks from parenteral administration, and plan for the earliest possible discharge from the hospital to limit exposure to nosocomial pathogens. Hospital discharge may be considered when

a child is clinically stable (improved appetite and activity level, afebrile for 24 hours), mental status is back to baseline or stable, and the pulse oximetry level is >90% on room air for at least 24 hours.<sup>1</sup>

Children receiving adequate therapy regimens should demonstrate both clinical and laboratory signs of improvement within 48 to 72 hours.<sup>1</sup> If improvement does not occur, further your investigation with additional cultures, laboratory tests, and imaging evaluation.

**For preventive measures,** the guidelines recommend properly immunizing children with vaccines for bacterial pathogens such as *S pneumoniae*, *Haemophilus influenzae*, and *Bordetella pertussis*.<sup>1</sup> Influenza vaccine should also be offered to prevent CAP in infants and children 6 months of age and older. Offer influenza and pertussis vaccines to adults and those caring for infants and children, to help prevent the spread of disease. Also consider immune prophylaxis with RSV-specific monoclonal antibody for premature infants or those with bronchopulmonary dysplasia, congenital heart disease, or immunodeficiency, to decrease the risk of severe pneumonia and hospitalization. For detailed recommendations on the use of prophylaxis against RSV, refer to the 2003 American Academy of Pediatrics statement.<sup>31</sup> **JFP**

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