

Management of Community Acquired Pneumonia and Its Complications

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Disclosures

I have nothing to disclose

Objectives

Discuss key elements of the community acquired pneumonia (CAP) guidelines as it relates to diagnosis, evaluation and management

Appreciate limitations in the evidence behind some recommendations

Learn about management of some of the complications of CAP

Why Guidelines?

- Adult Guidelines(IDSA/ATS), published 2007
- Adherence Decreases mortality and time to clinical stability(Arnold FW et al, Arch Int Med,2009,Machabe C et al, Arch Int Med, 2009)

PIDS/IDSA Guidelines

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

John S. Bradley, Carrie L. Byington, Samir S. Shah, Brian
Alverson, Edward R. Carter, Christopher Harrison, Sheldon L.
Kaplan, Sharon E. Mace, George H. McCracken Jr, Matthew R.
Moore, Shawn D. St Peter, Jana A. Stockwell, and Jack T. Swanson

CID, Aug 30, 2011

52 pages, 92 recommendations

IDSA/PIDS Guidelines

- IDSA/PIDS guidelines encouraged narrow spectrum antibiotics and reduced performance of certain testing such as CBC and CXR in patients being discharged from ED.
- These guidelines do not pertain to infants \leq 3 months of age, immunocompromised children, children with chronic lung disease (ex: cystic fibrosis) or ventilator dependent children.

Adherence to Guidelines

- To date, changes in antibiotic use patterns in accordance with the guideline have been modest in most US hospitals studied. Clin Infect Dis. 2014;58(6): 834–838 7, Pediatrics. 2015;136(1):44–52)
- A multicenter learning collaborative Improving Care in Community Acquired Pneumonia (ICAP) using antibiotic stewardship and guideline implementation achieved following rates of narrow-spectrum prescribing: 44% in the ED and 63% in the inpatient setting(Pediatrics. 2017 Mar;139(3)

Specific Pathogens

Approximately 80% of CAP in children < 2 years of age is caused by a virus.

- The incidence of a viral etiology decreases with age. Viruses are responsible for CAP in children > 5 years of age in only 1/3 of cases.

- Common viruses:

- Respiratory syncytial virus (found in up to 40% of children <2 years of age)

- Influenza A, B

- Parainfluenza viruses 1, 2 and 3

- Rhinovirus

- Human metapneumovirus

- Human bocavirus

- Coronavirus

- Adenovirus

Bacterial Pathogens

- Streptococcus pneumoniae (most common & most prominent invasive bacterial pathogen)
- Group A streptococcus*
- Haemophilus influenzae, Non-typable*
- Moraxella catarrhalis*
- Staphylococcus aureus, including MRSA*

Atypical Pathogens

- *Mycoplasma pneumoniae*

More common in older children and adolescents.
Course is classically slowly progressive and is associated with malaise, cough and no fever.

- *Chlamydia Pneumoniae*

More often found in infants < 3 months age.
Transmitted vertically from the mother.
May be preceded by Chlamydial conjunctivitis in the neonatal period.

Criteria for Respiratory Distress

Signs of Respiratory Distress

1. Tachypnea, respiratory rate, breaths/min

Age 0–2 months: >60

Age 2–12 months: >50

Age 1–5 Years: >40

Age >5 Years: >20

2. Dyspnea

3. Retractions (suprasternal, intercostals, or subcostal)

4. Grunting

5. Nasal flaring

6. Apnea

7. Altered mental status

8. Pulse oximetry measurement <90% on room air

Criteria for Hospitalization

- moderate to severe CAP, and hypoxemia (saturation persistently <90% on room air)
- infants less than 3–6 months of age with suspected bacterial CAP are likely to benefit from hospitalization.
- suspected or documented CAP caused by a pathogen with increased virulence, such as CA-MRSA should be hospitalized.
- signs of dehydration; persistent vomiting; inability to take oral medications & **ill-appearing**
- failure of outpatient therapy (48 to 72 hours with no response).

Criteria for PICU Admission

- Oxygen saturation $\leq 92\%$ despite supplemental oxygen on 50% FiO₂; apnea, bradypnea or hypercarbia
- Need for mechanical ventilation or non-invasive positive pressure ventilation; severe respiratory distress or concern for impending respiratory failure
- Systemic signs of inadequate perfusion, including fluid refractory shock, hypotension, sustained tachycardia, need for pharmacologic support of blood pressure or perfusion
- Toxic or septic appearing and/or altered mental status

Diagnostic Testing-CXR

	Outpatient		Inpatient
Recommendation	NOT Recommended	Recommended	Recommended
Comments	For confirmation of suspected CAP in patient well enough to be treated in outpatient setting (after evaluation in office, clinic, or ED).	Patients with hypoxemia, significant respiratory distress, and failed antibiotic therapy; to verify presence or absence of complications.	All patients hospitalized with CAP; to document presence, size, and character of infiltrates and identify complications that may require interventions.
Strength	Strong	Strong	Strong
Evidence Quality	High	Moderate	Moderate

Indications of Chest Radiograph

- Recommend **against obtaining chest radiography in patients who present with wheezing** in the absence of fever and hypoxia
- Multiple studies found that chest x-rays among pediatric patients with wheezing were positive approximately 5% of the time, and **impacted clinical management in only about 2% of cases.**
- Recommend against **routine follow-up** chest radiography for inpatients who recover completely from CAP
- Recommend obtaining chest radiography in children admitted to the hospital.

CXR: Viral vs. Bacterial

Virkki et al, Thorax, 2002

- Evaluated 254 cases of suspected CAP
- Etiology found in 85% of cases
- Compared to CXR findings

Results:

- Alveolar and especially lobar – 78% bacterial ($p=0.001$)
- Interstitial - 50% bacterial, 50% viral

Laboratory Tests

- Recommend against routinely obtaining a CBC for children with CAP in the outpatient setting
- Recommend obtaining a CBC for patients with severe pneumonia
- Recommend against measuring inflammatory markers or acute-phase reactants in outpatients or used solely to distinguish between viral and bacterial causes of CAP
- Recommend against obtaining blood cultures in the outpatient setting

Laboratory Tests

- Recommend obtaining blood cultures on patients admitted to the hospital for presumed bacterial CAP that is moderate to severe, particularly those with complicated pneumonia.
- Recommend blood cultures in children who fail to demonstrate clinical improvement and in those who have progressive symptoms after initiation of antibiotic therapy
- In patients with more serious disease, such as hospitalized or with pneumonia- associated complications, acute-phase reactants may be used in conjunction with clinical findings to assess response to therapy.

Follow-up Blood Cultures and Sputum Culture

Repeated blood cultures in children with clear clinical improvement are not necessary to document resolution of pneumococcal bacteremia.

Repeated blood cultures to document resolution of bacteremia should be obtained in children with bacteremia caused by *S. aureus*, regardless of clinical status.

Sputum samples for culture and Gram stain should be obtained in hospitalized children who can produce sputum.

Blood Cultures in Inpatient CAP

- cross-sectional study of children hospitalized with CAP in 6 children's hospitals children 3 months to 18 years of age with discharge diagnosis codes for CAP
- excluded children with complex chronic conditions
- 7509 children hospitalized with CAP were included over the 5-year study period
- 2.5% of patients with blood cultures grew a pathogen
- 78 % was streptococcus pneumonia
- 82 % susceptible to penicillin

Blood Cultures in Inpatient CAP

Among children without comorbidities hospitalized with CAP in a non-ICU setting, the rate of bacteremia was low, and isolated pathogens were usually susceptible to penicillin.

Blood cultures may not be needed for most children hospitalized with CAP.

[Pediatrics](#). 2017 Sep;140(3). pii: e20171013. doi: 10.1542/peds.2017-1013. Epub 2017 Aug 23.

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Testing for Viral Pathogens

- Tests for the rapid diagnosis of influenza virus and other respiratory viruses should be used in the evaluation of children with CAP.
- A positive influenza test may decrease both the need for additional diagnostic studies and antibiotic use.
- Antibacterial therapy is not necessary for children, either outpatients or inpatients, with a positive test for influenza virus in the absence of clinical, laboratory, or radiographic findings that suggest bacterial coinfection.
- Testing for respiratory viruses other than influenza virus can help clinical decision making (weak recommendation)

Testing for Atypical Pathogens

- Children with signs and symptoms suspicious for *Mycoplasma pneumoniae* should be tested to help guide antibiotic selection.
- Diagnostic testing for *Chlamydia pneumoniae* is not recommended.

Outpatient Management

Conditions that favor Outpatient management:

- Absence of respiratory distress
- Sustained SpO₂ ≥ 90%
- Adequate outpatient caregiver support and ability to be compliant with outpatient therapy

Outpatient Management

- Recommend against routine use of antimicrobials in preschool-age children with CAP as viral pathogens are more common
- Recommend oral amoxicillin(90 mg/kg/day) in previously healthy, appropriately immunized infants, preschool children, school aged and adolescents with mild to moderate CAP suspected to be of bacterial origin.
- In underimmunized children: oral amoxicillin-clavulanate or oral 3rd generation cephalosporin
- Recommend macrolides for school-age children and adolescents with clinical or laboratory evidence of CAP caused by atypical pathogens or if cannot differentiate from strep pneumo
- Recommend treatment for influenza early during the course of an illness in which influenza is likely , especially during the influenza season

Management- Inpatient

Recommend intravenous ampicillin (200 mg/kg/day) or penicillin G as first-line therapy for fully immunized patients with CAP

3rd -generation parenteral cephalosporin ceftriaxone (100 mg/kg/day) or cefotaxime (150 mg/kg/day) when not fully immunized and with life threatening infection (empyema).

Recommend combination therapy with a beta lactam antibiotic and a macrolide if atypical pathogens are suspected in older children and adolescents.

Vancomycin or clindamycin (based on local susceptibility data) in addition to b-lactam therapy if suspicion for *S. aureus* (multifocal pneumonia, necrotizing pneumonia/cavitary lesion, leukopenia, superinfection of influenza pna)

Amoxicillin or Pen G Allergy

For children with a history of non-anaphylactic allergic reactions to amoxicillin, treatment is not well defined and should be individualized.

Options include: 1) a trial of amoxicillin under medical observation; 2) 2nd or 3rd generation cephalosporin, or 3) clindamycin.

Anaphylactic or life threatening reactions to penicillin should be treated with linezolid or clindamycin (if susceptible) or levofloxacin.

Azithromycin is only partly effective for pneumonia. It has limited action against resistant strep pneumoniae which causes 25% or more cases of pneumonia in children.

Duration & Response to Therapy

- Recommend 10 days of treatment for uncomplicated, non-severe pneumonia. Azithromycin is dosed for 5 days due to different tissue-site pharmacokinetics
- Infections caused by certain pathogens, notably CA-MRSA, may require longer treatment.
- Children receiving adequate therapy should demonstrate clinical signs of improvement within 48–72 hours.
- For children who show no improvement in fever or clinical symptoms within 48–72 hours after initiation of antimicrobial therapy, consideration of further investigation or adjustment of antibiotic coverage should be performed.

Parapneumonic Effusion

-Most common bacterial cause is strep pneumoniae, though MRSA is emerging as an important pathogen.

The size and child's degree of respiratory compromise determines management of parapneumonic effusion.

-Small effusions: <10 mm on lateral decubitus radiograph or opacifies less than 1/4 th of hemithorax and uncomplicated effusions should **not** routinely be drained and can be treated with antibiotic therapy alone.

-Moderate effusions(>10 mm on lateral decubitus or >1/4 th hemithorax)associated with respiratory distress, large parapneumonic effusions, or documented purulent effusions should be drained.

Chest Tube or VATS

- recommend a joint pulmonary/surgical consultation early
- Parapneumonic effusions start free-flowing and then develop fibrin strands eventually leading to loculation.
- Loculated fluid cannot be drained via a simple chest tube
- if patients require pleural fluid drainage then they should first undergo imaging to assess for loculations.
- US instead of CT for evaluating effusions

Chest Tube or VATS

Both chest thoracostomy tube drainage with the addition of fibrinolytic agents and VATS effective.

The choice of drainage procedure depends on local expertise.

Both of these methods associated with decreased morbidity compared with chest tube drainage alone.

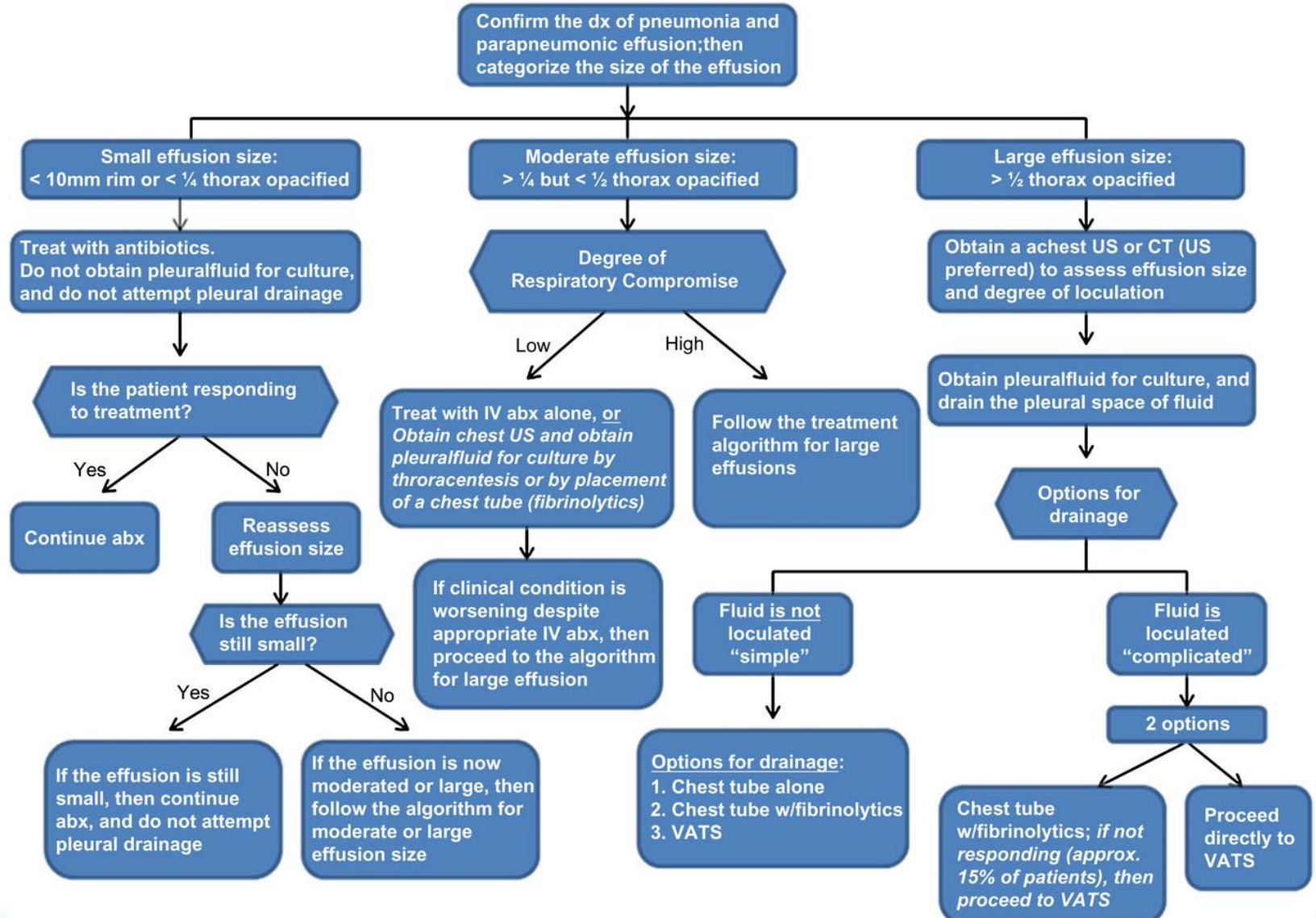
However, in patients with moderate-to-large effusions that are free flowing (no loculations), placement of a chest tube without fibrinolytic agents is a reasonable first option.

VATS in Chest Tube Patients

VATS in case of persistence of moderate-large effusions and ongoing respiratory compromise despite 2–3 days of management with a chest tube and completion of fibrinolytic therapy.

Open chest debridement with decortication represents another option for management of these children but is associated with higher morbidity rates.

Management of pneumonia with parapneumonic effusion



Laboratory Testing on Pleural Fluid

- Gram stain and bacterial culture of pleural fluid
- Antigen testing or nucleic acid amplification through PCR increases the detection of pathogens in pleural fluid.
- Analysis of pleural fluid parameters, such as pH and levels of glucose, protein, and lactate dehydrogenase, rarely change patient management and are not recommended.
- Analysis of the pleural fluid white blood cell (WBC) count, with cell differential analysis, is recommended to help differentiate bacterial from mycobacterial etiologies and from malignancy.

Antibiotic Therapy for Effusions

- When the blood or pleural fluid bacterial culture identifies a pathogenic isolate, antibiotics based on susceptibility.
- In the case of culture-negative effusions, antibiotic selection based on the treatment recommendations for patients hospitalized with CAP.
- The duration of antibiotic treatment depends on the adequacy of drainage and on the clinical response.
- In most children, antibiotic treatment for 2–4 weeks is adequate.

Lung Abscess/Necrotizing Pneumonia

- initially treated with intravenous antibiotics.
- well-defined peripheral abscesses without connection to the bronchial tree may be drained under imaging-guided procedures either by aspiration or with a drainage catheter that remains in place.
- most abscesses will drain through the bronchial tree and heal without surgical or invasive intervention.

Discharge Criteria

- documented overall clinical improvement, including level of activity, appetite, and decreased fever for at least 12–24 hours.
- consistent pulse oximetry measurements $>90\%$ in room air for at least 12–24 hours.
- stable and/or baseline mental status.
- documentation of toleration of home anti-infective regimen, whether oral or intravenous, and home oxygen regimen, if applicable, before hospital discharge.
- barriers to care, concern about careful observation at home, compliance, follow-up issues identified and addressed.

Prevention of Pediatric CAP

- Immunization with vaccines for bacterial pathogens, including *s.pneumoniae*, *haemophilus influenza* type b, and pertussis to prevent CAP.
- All infants >6 months of age and all children and adolescents should be immunized annually with influenza vaccine to prevent CAP.
- Parents and caretakers of infants < 6 months of age, including pregnant adolescents, should be immunized with influenza and pertussis vaccine to protect the infants from exposure.
- Pneumococcal CAP after influenza virus infection is decreased by immunization against influenza virus.
- High-risk infants should be provided immune prophylaxis with synagis to decrease the risk of severe pneumonia and hospitalization caused by RSV.

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Thank You