**Definition** The presence of signs and symptoms of pneumonia in a previously healthy child, due to an infection of the pulmonary parenchyma that has been acquired outside of the hospital. (1)

**Etiology** The exact etiology of pneumonia is often unidentified due to the difficulty of obtaining a direct culture of infected lung tissue. Following the introduction of Prevnar®, the burden of invasive pneumococcal disease has been reduced. (1-2) Currently, mixed etiologies account for 30 to 50% of the children with community-acquired pneumonia. (1,3-9) *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* are more common in school-age children. (1) Viruses are most often identified in children < 5 years of age with respiratory syncytial virus (RSV) being the most common viral etiology in children < 3 years of age. (1,79) In the Southwestern United States data confirm the importance of *Streptococcus pneumoniae* and atypical pathogens (*M. pneumoniae, C. pneumoniae*) plus the frequent occurrence of mixed infections in children with community-acquired pneumonia. (10) In children with parapneumonic effusion at Texas Children’s Hospital, *Staphylococcus aureus* has become the most common organism actually isolated. (11)

**Differential Diagnosis**
* Viral bronchiolitis
* Pertussis
* Tuberculosis (TB)
* Foreign body

**Guideline Eligibility Criteria**
* Age ≥ 60 days to 17 years
* Healthy children without underlying conditions
* Clinical findings of CAP

**Guideline Exclusion Criteria**
* Aspiration
* Recent hospitalization (< 7 days before the onset of illness)

**Diagnostic Evaluation** Pneumonia related pathogens vary in incidence throughout the year but peak during January through April in the Southwest United States. (10) Pathogens currently circulating in the local community should be considered in the diagnostic evaluation.

**History: Assess for**
* Age of child
* Immunization status, especially *S. pneumoniae* and influenza
* Exposure to TB

**Physical Examination:** The severity of pneumonia is based on overall clinical appearance and behavior, including a child’s alertness, respiratory effort, and ability to take oral fluids. A small percentage of children < 5 years of age may present with abdominal pain or with fever and no signs of respiratory illness. (12) Although wheezing is more common in children with asthma it can be a manifestation of viral or mycoplasma pneumonia.

A complete physical examination should be performed. A combination of clinical findings, including vital signs and pulse oximetry, is most predictive in determining CAP including:
* Infants < 12 months: Nasal flaring, O₂ sat < 96%, tachypnea (RR > 50) and retractions
* Children 1 to 5 years: O₂ sat < 96%, tachypnea (RR>40)
* Children > 5 years: O₂ sat < 96%, tachypnea (RR>30)

Consider the presence of parapneumonic effusion or empyema in children with pneumonia who present severely ill. Signs of pleural effusion include dyspnea, dry cough and pain over the chest wall, exaggerated by deep breathing, or coughing. Auscultatory findings may include a friction rub (leathery, rough inspiratory and expiratory breath sounds). Breath sounds may also be diminished or absent over the affected areas. (13-14)

**Laboratory Tests** Empiric antibiotic therapy should not be delayed while awaiting diagnostic test results. Laboratory tests and chest x-rays should be ordered based on clinical findings. CBC should only be considered when adjunctive information is necessary to help decide whether to use antibiotics. (15-17) The likelihood of a bacterial cause generally increases as WBC counts increase above 15000/mm³. (17-16) Blood cultures are not routinely recommended in the evaluation of uncomplicated bacterial pneumonia. (19) In children with more severe disease, a blood culture may be helpful particularly if drawn prior to antibiotic treatment. PPD should be placed with history of exposure to TB including personal or family travel to TB prevalent areas. Nasopharyngeal swab for pertussis PCR should be obtained in children with cough lasting more than two weeks. Consider diagnostic tests for pertussis when typical symptoms are present.
Evidence Supports
S. aureus is the most common pathogen isolated in children with parapneumonic effusions at Texas Children's Hospital (11)
Atypical organisms as a cause of CAP in children as young as 2 years (10, 20-21)
Use of penicillin (including amoxicillin) to treat uncomplicated pneumonia (22-23)
Early video-assisted thoroscopic surgery (VATS) should be considered for children with complicated pleural effusion or empyema (11, 24-27)
Use of an antiviral such as oseltamivir within 48 hours of symptom onset (28)
Fibrinolytics is a useful therapy option for children with empyema (29-35)

Principles of Clinical Management

General
The clinical picture of children with community-acquired pneumonia (CAP) is highly variable making the determination of etiology difficult. The child’s age and severity of illness are important factors to consider in diagnosing and managing this disease. (14)

Treatment Recommendations (10, 38-39)
See Antibiotic Table on pages 4-5.

Antibiotic Recommendations for Bacterial CAP, Uncomplicated - Outpatient
The effectiveness of high dose amoxicillin has been demonstrated for acute otitis media and is considered a reasonable option when treating other infections. (40-41)
Resistance of S. pneumoniae to penicillin is mediated through alterations in the penicillin-binding proteins. Using high-doses of amoxicillin saturates the penicillin-binding proteins and is therefore considered a reasonable antibiotic option. (23)
- Infants 1 to 4 months should be treated with high-dose amoxicillin + macrolide to cover S. pneumoniae and C. trachomatis. (42)
- Children > 4 months to 2 years should be treated with high-dose amoxicillin for 10 days, to cover S. pneumoniae, the most common etiologic cause of CAP. (43)
- Children < 2 years who do not tolerate an initial dose of oral antibiotics should be treated with an IM dose of ceftriaxone. (44-46)
- Children ≥ 2 to 5 years should be treated with high-dose amoxicillin for 10 days ± macrolide for 5 days, to cover S. pneumoniae and atypical pathogens. (47-49) For optimal coverage, children ≥ 2 years should be treated with amoxicillin and a macrolide. When there is lesser concern, a single antibiotic can be used. If there is no clinical improvement within 24-48 hours, a second antibiotic should be added to the treatment.
- Children > 5 years should be treated with amoxicillin for 10 days and a macrolide for 5 days, to cover S. pneumoniae and atypical pathogens. (43, 47-49)
- Allergies: Children with a Type I penicillin allergy should be treated with azithromycin for 5 days ± clindamycin for 10 days. Children with non-Type I penicillin allergy should be treated with cephalosporin for 10 days ± macrolide for 5 days.

Antibiotic Recommendations for Bacterial CAP, Uncomplicated – Inpatient or Progressive Care
It is likely that otherwise healthy children with uncomplicated pneumonia can be treated with β-lactam agents. The current susceptibility profile at Texas Children's Hospital shows that 55% of S. pneumoniae isolates are susceptible to penicillin and 79% are susceptible to cefOTAXime. (39) Pneumococcal resistance to antibiotics has not been shown to affect clinical outcomes in children (MIC < 2.0 μg/mL). (50) If complications of pneumonia are suspected or pleural effusions are present, see Antibiotic Recommendations for Pleural Effusions.
- Based on expert consensus, infants 29 to 60 days should be treated with ampicillin and cefOTAXime to treat neonatal and community-acquired pathogens.
  - Infants 1 to 4 months should be treated with cefOTAXime + macrolide to cover S. pneumoniae and C. trachomatis. (42)
  - Children > 4 months to 2 years should be treated with ampicillin or cefOTAXime, to cover S. pneumoniae. (50-52)
  - Children ≥ 2 to 5 years should be treated with ampicillin or cefOTAXime ± macrolide, to cover S. pneumoniae and atypical pathogens. (50-52)
  - Children > 5 years should be treated with ampicillin or cefOTAXime + macrolide to cover S. pneumoniae and atypical pathogens. Transition child to oral antibiotics for a minimum 10 day course of antibiotics when there are signs of clinical improvement and defervescence, and the child is able tolerate PO.

Antibiotic Recommendations for Bacterial CAP, Intensive Care
- Children < 2 years should be treated with cefOTAXime and vancomycin, to cover S. pneumoniae and S. aureus.
- Children ≥ 2 years should be treated with cefOTAXime and vancomycin ± macrolide, to cover S. pneumoniae, S. aureus, and atypical pathogens.

Antibiotic Recommendations for Pleural Effusions
Treatment of children with CAP and small simple pleural effusions should be the same as children with CAP and no effusion.
- Children should be treated with clindamycin to cover S. aureus and S. pneumoniae.
- Ill appearing children should be treated with clindamycin and cefOTAXime. If child shows no signs of clinical improvement (i.e. persistent fever and/or leukocytosis, continuing O2 requirement, progression of radiographic findings) consider consulting Infectious Diseases and consider vancomycin.

Transition child to oral antibiotics for a minimum of a three week course of antibiotics when there are signs of clinical improvement and defervescence, and the child is able tolerate PO.

© Evidence-Based Outcomes Center, 2008
Quality and Outcomes Center, Texas Children’s Hospital
Recommendations for Viral CAP
- Consider viral rapid tests based on patient’s history, time of year, and epidemiology.
- Oseltamivir for influenza in children ≥ 1 year with onset of symptoms < 48 hours. (28)

Admission Criteria
- Unable to tolerate oral fluids and medications; severely dehydrated
- Moderate or severe respiratory distress
- Failed outpatient antibiotic treatment
- Altered mental status
- Oxygen saturation consistently < 90%
- Unsafe to send home/poor follow-up

Discharge Criteria
- Uncomplicated pneumonia
- Appropriate mental status for age
- Tolerating PO
- Appropriate support system (i.e. PMD, caregivers)

Other Therapies
- Therapies directed towards airway clearance (i.e. postural drainage and chest physiotherapy) should not be used for patients with uncomplicated pneumonia. (37)
- Consider early video-assisted thoracoscopic surgery (VATS) for children with complicated pleural effusion or empyema. (24-27)
- Consider fibrinolytic therapy and thoracostomy tube for children with complicated pleural effusion or empyema. (29-35)

Consults and Referrals
- Consultation with an ID specialist is considered when allergies or prior antibiotic non-responsiveness confound the choice of therapy.
- Consultation with a pulmonary or surgery specialist is appropriate when uncertain about management of an effusion or persistent pneumonia. (53-54)

Follow Up Care
- Children diagnosed with CAP who are not hospitalized should follow up with their pediatrician within 24 to 48 hours regardless of initiating antibiotic therapy.
- Follow up care is recommended for all children hospitalized with CAP.
- The child who is not following the expected clinical course, consider complications, viral etiology, TB, an alternative diagnosis, or ineffective antibiotic treatment due to lack of antibiotic coverage or resistance patterns.

Outcomes Measures
- Failure to respond to antibiotic treatment
  - Unplanned readmit within 48 hours and type of antibiotic
  - Unplanned clinic revisit within 48 hours and type of antibiotic
- Need for surgery following fibrinolytic therapy and thoracostomy tube
- Length of stay (inpatient, intensive care)
- Mortality rate
- Direct variable costs

Prevention
Up-to-date heptavalent conjugated pneumococcal vaccine (PCV7, Prevnar®) (55)
Up-to-date annual influenza vaccine (28)
Stress importance of strict hand washing (56-58)

Infection Control
Contact precautions are required for children with upper respiratory symptoms (59)
Droplet precautions are required if Pertussis is suspected AND during influenza season in addition to contact precautions (59)
Airborne precautions are required if TB is suspected (59)

Caregiver Education
Encourage breast feeding with infants (60)
Limit exposure to other children (i.e. day care) (60)
Emphasize children should not be exposed to passive smoking; explore smoking cessation options for parents (61)
## Community-Acquired Pneumonia Antibiotic Table, Outpatient

(38-39, 62-63)

### Outpatient Therapy: First Line

<table>
<thead>
<tr>
<th>Type I Penicillin Allergy</th>
<th>First Line: macrolide ± clindamycin</th>
<th>≥5 yrs = amoxicillin + macrolide</th>
</tr>
</thead>
</table>

### Type I Penicillin Allergy

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage Form and Flavor</th>
<th>Taste &amp; Aftertaste*&lt;sup&gt;(2/3)&lt;/sup&gt;</th>
<th>Dose</th>
<th>Comments</th>
</tr>
</thead>
</table>

#### Amoxicillin

- Suspension (per 5 mL):
  - 125, 200, 250 or 400 mg [Bubble Gum]
  - 250, 500 or 600 mg [Cherry Banana Mint]
- Capsules: 250 or 500 mg
- Tablets: 500 or 875 mg

#### Azithromycin

- Suspension (per 5 mL):
  - 100 or 200 mg [Cherry Crème de Vanille Banana]
- Tablets: 250, 500 or 600 mg
- Extended Release Suspension: 2 gram [Cherry Banana]

#### Clarithromycin

- Suspension (per 5 mL):
  - 125 or 250 mg [Fruit Punch]
- Tablets: 250 or 500 mg

### Outpatient Therapy: Second Line

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage Form and Flavor</th>
<th>Taste &amp; Aftertaste*&lt;sup&gt;(2/3)&lt;/sup&gt;</th>
<th>Dose</th>
<th>Comments</th>
</tr>
</thead>
</table>

#### Cefdinir

- Suspension (per 5 mL):
  - 125 or 250 mg [strawberry]
- Capsules: 300 mg

#### CefPODoxime

- Suspension (per 5 mL):
  - 50 or 100mg [lemon creme]
- Tablets: 100 or 200mg

#### CefUROxime

- Suspension (per 5 mL):
  - 125 or 250 mg [Frutti]
- Tablets: 250 or 500 mg

#### Ceftriaxone

- Injection ONLY:
  - 1 or 2 gram

#### Clindamycin

- Solution (per 5 mL):
  - 75 mg [cherry flavor]
- Capsules: 75, 150 or 300 mg

---

<sup>NOTE: Consider insurance/Medicaid formulary restrictions.</sup>

* 1 = Good  5 = Horrible  (23 Consider asking the pharmacy to flavor; if possible.)

© Evidence-Based Outcomes Center, 2008
Quality and Outcomes Center, Texas Children’s Hospital
Community-Acquired Pneumonia Antibiotic Table, Inpatient (38-39, 62-63)

NOTE: Consider insurance/Medicaid formulary restrictions.

<table>
<thead>
<tr>
<th>Inpatient Therapy: Acute Care Status / Progressive Care Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uncomplicated Pneumonia:</strong></td>
</tr>
<tr>
<td><strong>Complicated Pneumonia:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage Form and Flavor</th>
<th>Taste &amp; Aftertaste (38-39)</th>
<th>Dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ampicillin</strong></td>
<td>Injection: 125, 250, or 500 mg 1 or 2 gram</td>
<td>N/A</td>
<td>Infants &amp; children: i.v.: 200 mg/kg/DAY divided every 6 h (MAX: 2 gram/dose or 12 gram/DAY) Adults: i.v.: 1000 mg every 4-6 h (MAX: 2 gram/dose or 12 gram/DAY)</td>
<td>Avoid use in patients with a penicillin allergy</td>
</tr>
<tr>
<td><strong>CefOTAXime</strong></td>
<td>Injection: 40 mg/mL or 200 mg/mL (Central Line)</td>
<td>N/A</td>
<td>Infants &gt; 1 month to Children 1 year: i.v.: 75 mg/kg/dose every 8 h Children ≥ 1 year: i.v.: 50-75 mg/kg/dose every 8 h (MAX: 2 gram/dose)</td>
<td>Caution use in patients with a Type I penicillin allergy</td>
</tr>
<tr>
<td><strong>Azithromycin</strong></td>
<td>Suspension (per 5 mL): 100 or 200 mg [Cherry Créme de Vanilla Banana] Tablets: 250, 500 or 600 mg Extended Release Suspension: 2 gram [Cherry Banana] Injection: 125, 250, or 500 mg 1 or 2 gram</td>
<td>3</td>
<td>Infants &amp; children ≥ 6 months: Oral: 10 mg/kg on day 1 (MAX: 500 mg/DAY) followed by 5 mg/kg/day once daily on days 2-5 (MAX: 250 mg/DAY) i.v.: 10 mg/kg/DAY once daily (MAX: 500 mg/dose)</td>
<td>First Line in patients with a Type I penicillin allergy (± clindamycin)</td>
</tr>
<tr>
<td><strong>Clarithromycin</strong></td>
<td>Suspension (per 5 mL): 125 or 250 mg [Fruit Punch] Tablets: 250 or 500 mg</td>
<td>3</td>
<td>Metallic Aftertaste</td>
<td>Children ≥ 6 months: Oral: 15 mg/kg/DAY divided every 12 h (MAX: 1000 mg/DAY) Adults: Oral: 250 mg every 12 h or 1000 mg (two 500 mg extended release tablets) once daily</td>
</tr>
<tr>
<td><strong>Clindamycin</strong></td>
<td>Solution (per 5 mL): 75 mg [cherry flavor] Capsules: 75, 150 or 300 mg Injection: 150 mg/mL (IM), 18 mg/mL (IV)</td>
<td>5</td>
<td>Infants &amp; children: Oral: 10-30 mg/kg/DAY divided every 6-8 h (MAX: 1.8 grams/DAY) I.M., i.v.: 25-40 mg/kg/DAY divided every 6-8 h (MAX: 2.7 grams/DAY) Expert Consensus Dosing: 30-40 mg/kg/DAY divided every 6-8 h (MAX: 2.7 grams/DAY) Adolescents &amp; adults: Oral: 150-450 mg/dose divided 6-8 h (MAX: 1.8 grams/DAY) I.M., i.v.: 1.2-2.7 grams/DAY in 2-4 divided doses</td>
<td>Major side effect: Diarrhea</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inpatient Therapy: Intensive Care Status (PICU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 yrs = cefOTAXime &amp; vancomycin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage Form and Flavor</th>
<th>Taste &amp; Aftertaste (38-39)</th>
<th>Dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CefOTAXime</strong></td>
<td>Injection: 40 mg/mL or 200 mg/mL (Central Line)</td>
<td>N/A</td>
<td>Infants &gt; 1 month to Children 1 year: i.v.: 75 mg/kg/dose every 8 h Children ≥ 1 year: i.v.: 50-75 mg/kg/dose every 8 h (MAX: 2 gram/dose)</td>
<td>Caution use in patients with a Type I penicillin allergy</td>
</tr>
<tr>
<td><strong>Vancomycin</strong></td>
<td>Injection: 5 mg/mL</td>
<td>N/A</td>
<td>Infants ≥ 2 months &amp; children: i.v.: 13-15 mg/kg/dose IV every 8 h (MAX: 1.5 gram/dose or 4 gram/DAY) Adults: i.v.: 13-15 mg/kg/dose IV every 8-12 h (MAX: 1.5 gram/dose or 4 gram/DAY)</td>
<td>Add if concerned for MRSA, S. aureus</td>
</tr>
<tr>
<td><strong>Azithromycin</strong></td>
<td>Injection: 125, 250, or 500 mg 1 or 2 gram</td>
<td>N/A</td>
<td>Infants &amp; children: i.v.: 10 mg/kg/DAY once daily (MAX: 500 mg/dose) Adults: i.v.: 10 mg/kg/DAY once daily (MAX: 500 mg/dose)</td>
<td>Major side effect: Diarrhea</td>
</tr>
<tr>
<td><strong>Clindamycin</strong></td>
<td>Injection: 150 mg/mL (IM), 18 mg/mL (IV)</td>
<td>N/A</td>
<td>Infants &amp; children: I.M., i.v.: 25-40 mg/kg/DAY divided every 6-8 h (MAX: 2.7 grams/DAY) Expert Consensus Dosing: 30-40 mg/kg/DAY divided every 6-8 hours (MAX: 2.7 grams/DAY) Adolescents &amp; adults: I.M., i.v.: 1.2-2.7 grams/DAY in 2-4 divided doses</td>
<td>Add if concerned for MRSA, S. aureus</td>
</tr>
</tbody>
</table>

© Evidence-Based Outcomes Center, 2008
Quality and Outcomes Center, Texas Children’s Hospital
TCH Evidence-Based Clinical Decision Support
Clinical Algorithm for Community-Acquired Pneumonia (CAP)

**Begin**

- **Initial clinical findings suggestive of CAP**
  - Yes
  - Suspect pleural effusion
    - Yes
      - Follow Presumed Infectious Pleural Effusion Algorithm
    - No
      - Manage as appropriate to clinical findings (OFF Algorithm)
  - No

**Complications of CAP**
- Pleural effusion/empyema
- Respiratory failure
- Sepsis
- Lung abscess
- Pneumatocele

**Continuum of Respiratory Severity**

**Mild**
- **Respiratory assessment**
  - Rate
    - 2-12 months < 40
    - 1-5 years < 30
    - > 5 years < 20
  - Good air movement, loose rales/crackles
  - Mild to no use of accessory muscles/retractions, +/- nasal flaring on inspiration
  - Normal to mildly irritable behavior
  - Pulse oximetry > 95% room air
  - Normal color

**Consider**

- **Diagnostic Tests**:
  - CXR
  - CBC diff/plt
  - Blood culture
  - Viral rapid tests
  - PPD
  - Other tests

**Suspect**

- **Atypical/bacterial CAP**
  - Yes
    - PPD if history of exposure
    - Initiate Antibiotic Therapy
    - Discharge Home Follow up with pediatrician within 48 hours

**Moderate**
- **Respiratory assessment**
  - Rate
    - 2-12 months 40-50
    - 1-5 years 30-40
    - > 5 years 20-30
  - Depressed air movement, crackles
  - Moderate intercostal retractions, mild to moderate use of accessory muscles, nasal flaring
    - Irritable, agitated, restless
    - Pulse oximetry 90 to 95% room air
    - Pale to normal color

**Consider**

- **Diagnosis**
  - Viral CAP suspected
  - Bacterial CAP suspected

**Suspect**

- **Viral rapid tests**
  - Yes
    - Initiate antiviral tx if sx < 48 hours
  - No
  - Initiate Antibiotic Therapy

**Severe**
- **Respiratory assessment**
  - Rate
    - 2-12 months > 60
    - 1-5 years > 50
    - > 5 years > 30
  - Diminished or absent breath sounds, severe crackles, prolonged expiration
  - Severe intercostal and substernal retractions, nasal flaring
    - Lethargic
    - Pulse oximetry < 90% room air
    - Cyanotic, dusky color

**Consider**

- **Diagnostic Tests**:
  - CXR
  - CBC diff/plt
  - Chem 7
  - Blood culture
  - PPD

**Suspect**

- **Complicated pneumonia**
  - Yes
    - Follow Presumed Infectious Pleural Effusion Algorithm
  - No
    - Admit for IV Antibiotics

**Antibiotics for Outpatient Therapy**
- Age 1 to 4 months high dose amoxicillin + macrolide for *S. pneumoniae* and *C. trachomatis*
- Age 4 months to 2 years high dose amoxicillin for typical bacterial pathogens
- Age ≥ 2 to 5 years high dose amoxicillin ± macrolide for typical/atypical bacterial pathogens
- Age > 5 years amoxicillin + macrolide
  (See abx table, p.4)

**Antibiotics for Inpatient Therapy**
- Age 1 to 4 months cefOTAXime + macrolide to cover *S. pneumoniae* and *C. trachomatis*
- Age 4 months to 2 years ampicillin or cefOTAXime for typical bacterial pathogens
- Age ≥ 2 to 5 years ampicillin or cefOTAXime ± macrolide for typical/atypical bacterial pathogens
- Age > 5 years amoxicillin or cefOTAXime + macrolide
  (See abx table, p.5)

© Evidence-Based Outcomes Center, Quality and Outcomes Center, Texas Children’s
TCH Evidence-Based Clinical Decision Support
Clinical Algorithm for Presumed Infectious Pleural Effusions

Suspect Infectious Pleural Effusion

CXR

CXR demonstrates pleural effusion
No
OFF Algorithm/Return to CAP Algorithm

Yes

Prepare for admission

Suspect complicated effusion

- CBC diff/plt
- Chem 7
- Blood culture
- Initiate antibiotic therapy
- Monitor clinically

Clinical improvement

Yes

- Repeat chest x-ray
- Consider repeat chest US
- Consider ID, pulmonary and/or surgery consultation

VATS

Continue antibiotic therapy/clinical monitoring until discharge criteria are met

No

- Repeat chest x-ray
- Consider repeat chest US
- Consider ID, pulmonary and/or surgery consultation

CXR

Indications of Complicated Effusion:
- Large effusion (>10-20%)
- Ill appearing
- Develops hypoxemia
- Worsening symptoms

Need for Intervention

Yes

Chest US
Consider surgery consultation

No

Successful procedure

Discharge Criteria
- No oxygen requirement
- Tolerating PO
- Chest tube removed
- Appropriate mental status for age
- Signs of clinical improvement and defervescence
- Appropriate support system (PCP, caregiver)

Key:
- CAP - community-acquired pneumonia
- ID - infectious disease
- US - ultrasound
- VATS - video-assisted thorascopic surgery

Complications of Community-Acquired Pneumonia
- Pleural effusion/empyema
- Respiratory failure
- Sepsis
- Lung abscess
- Pneumatocele

Antibiotics for Inpatient Therapy, Pleural Effusions
- Clindamycin to cover S. aureus and S. pneumoniae
- Clindamycin and cefOTAXime for ill appearing children

Select:
- VATS and thoracostomy tube
- Fibrinolytics and thoracostomy tube
- Thoracentesis
- Percutaneous thoracostomy (pigtail, small drain, chest tube)

Treat organized fluid collections with VATS or fibrinolytics and thoracostomy tube

- CBC diff/plt
- Chem 7
- Blood culture
- Initiate antibiotic therapy

- VATS and thoracostomy tube
- Fibrinolytics and thoracostomy tube
- Thoracentesis
- Percutaneous thoracostomy (pigtail, small drain, chest tube)

No

Consider ID, pulmonary and/or surgery consultation

- CBC diff/plt
- Chem 7
- Blood culture
- Initiate antibiotic therapy

- VATS and thoracostomy tube
- Fibrinolytics and thoracostomy tube
- Thoracentesis
- Percutaneous thoracostomy (pigtail, small drain, chest tube)
References


References continued…

References continued…


Guideline Preparation

This guideline was prepared by the Evidence-Based (EB) Clinical Decision Support Team in collaboration with content experts at Texas Children’s Hospital. Development of this guideline supports the TCH Quality and Patient Safety Program initiative to promote clinical guidelines and outcomes that build a culture of quality and safety within the organization.

Community-Acquired Pneumonia Content Expert Team
Aderonke Adekunle-Ojo, MD, Emergency Medicine
Christopher Baldez, LCSW, Social Work
Sara Bork, PharmD, Pharmacy
Darrell Cass, MD, Pediatric Surgery
Christopher Cassady, MD, Radiology
Emily Charles, Care Coordinator, Care Management
Michael Chance, Quality Improvement Specialist, Quality and Outcomes Measurement
Kim Davis, RT, Respiratory Care
Leland Fan, MD, Pulmonary
Tiffany Helme, RN, Emergency Center
Curtis Kennedy, MD, Critical Care Medicine
Daniel Lemke, MD, Emergency Medicine
Ned Nuchtern, MD, Pediatric Surgery
Flor Munoz-Rivas, MD, Infectious Diseases
Elena Ocampo, MD, Cardiology
Shea Palamountain, MD, Texas Children’s Pediatric Associates
Ricardo Quinonez, MD, Pediatric Hospital Medicine
Elaine Whaley, RN, Infection Control

EB Clinical Decision Support Team
Quinn Franklin, MS, CCLS Research Specialist
Marilyn Hockenberry, PhD, RN, PNP-CS, FAAN Co-Chair

Development Process

This guideline was developed using the process outlined in the EB Clinical Decision Support Manual (2007). The review summary documents the following steps:

1. Review Preparation
   - PICO questions established
   - Evidence search confirmed with content experts

2. Review of Existing Internal and External Guidelines
   - British Thoracic Society (BTS) guidelines and a published guideline from a children’s hospital

3. Literature Review of Relevant Evidence
   - Searched: Medline, Cochrane, AHRQ, CINAHL, Trip, Best BETS, AAP, BMJ Clinical Evidence, Google Scholar

4. Critically Analyze the Evidence
   - BTS Guidelines, Cincinnati Guideline, three systematic reviews, one meta-analysis, nine randomized control trials, and twenty-one non-randomized studies.

5. Summarize the Evidence by preparing the guideline, order sets and interdisciplinary plan of care
   - Materials used in the development of the guidelines, review summaries and content expert team meeting minutes are maintained in an community-acquired pneumonia EB review manual with the Quality and Outcomes Center.

Evaluting the Quality of the Evidence

The Critical Appraisal Skills Program (CASP) criteria were used to evaluate the quality of articles reviewed. Application of the CASP criteria are completed by rating each reviewed study or review as:

- **Strong study/systematic review** - well designed, well conducted, adequate sample size, reliable measures, valid results, appropriate analysis, and clinically applicable/relevant.
- **Study/systematic review with minor limitations** - specifically lacking in one of the above criteria
- **Study/systematic review with major limitations** - specifically lacking in several of the above criteria.

Published clinical guidelines evaluated for this review using the **AGREE criteria**. The summary of these guidelines are found at the end of this document. **AGREE criteria** uses a 1-4 point likert scale to evaluate 23 questions evaluating: Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence. The higher the score the more comprehensive the guideline.

This guideline specifically summarizes the evidence in **support of** or **against** specific interventions and identifies where evidence is **lacking/inconclusive**. The following categories describe how research findings provide support for treatment interventions.

- **“Evidence that supports”** the guideline (p.2) provides clear evidence from more than one well-done randomized controlled trial (RCT) (based on CASP criteria) that the benefits of the intervention exceed harm.
- **“Evidence against”** (p.2) provides clear evidence from more than one well-done RCT (based on CASP criteria) that the intervention is likely to be ineffective or that it is harmful.
- **“Evidence lacking/inconclusive”** (p.2) indicates there is currently insufficient data or inadequate data to recommend for or against specific intervention.

Recommendations

Recommendations for the guidelines were developed by a consensus process directed by the existing evidence, content experts and patient and family preference when possible. The Content Expert Team and EB Clinical Decision Support Team remain aware of the controversies in the management of community-acquired pneumonia in children. When evidence is lacking, options in care are provided in the guideline and the order sets that accompany the guideline.

Approval Process

Guidelines are reviewed and approved by the Content Expert Team, EB Clinical Decision Support Team, EB Executive Steering Committee, Pharmacy and Therapeutics Committee and other appropriate hospital committees as deemed appropriate for the guideline’s intended use. Guidelines are reviewed and updated as necessary every 2 to 3 years within the EB Clinical Decision Support Team at Texas Children’s Hospital. Content Expert Teams will be involved with every review and update.

Disclaimer

Guideline recommendations are made from the best evidence, expert opinions and consideration for the patients and families cared for within TCH/TCPA. The guideline is NOT intended to impose standards of care preventing selective variation in practice that are necessary to meet the unique needs of individual patients. The physician must consider each patient’s circumstance to make the ultimate judgment regarding best care.