ACUTE BRONCHITIS, BRONCHIOLITIS, PNEUMONIA

Olga Cirstea, MD, PhD,
Clinical Lecturer, Department of Pediatrics
ACUTE BRONCHITIS
Definition

- **Acute bronchitis** is an acute infection of the bronchial mucosa produced by inflammation of the trachea, bronchi and bronchioles.
- *Acute bronchitis* is a syndrome, usually viral in origin, with cough as a prominent feature.
- *Acute tracheobronchitis* is a term used when the trachea is prominently involved.
Etiology

- Acute bronchitis is preceded by follow viral infections:
  - Adenovirus,
  - Influenza,
  - Parainfluenza,
  - Respiratory syncytial virus,
  - Rhinovirus,
  - Human bocavirus,
  - Coxsackievirus,
  - Herpes simplex virus.
Secondary to bacterial infection in acute upper respiratory tract with the following germs:

- *S. pneumonia*,
- *M. catarrhalis*,
- *H. influenza*,
- *Chlamydia pneumonia*,
- *Mycoplasma species*. 
Etiology (cont.)

- Other causes:
  - allergies,
  - chronic aspiration or gastroesophageal reflux,
  - fungal infection
Clinical manifestations

- dry, hacking, harsh unproductive cough,
- retrosternal pain during breathing or coughing,
- within 4-5 days the cough becomes productive, the sputum become purulent,
- afebrile patient or low grade fever,
Evolution

- first nonspecific upper respiratory infectious symptoms (rhinitis) develops
- 3-4 days later – a frequent, dry, hacking cough
- after several days, the sputum may become purulent, indicating leukocyte migration but not necessarily bacterial infection
- chest pain may be a prominent complaint in older children, exacerbated by coughing
- the mucus gradually thins, usually within 5–10 days, and then the cough gradually abates
- the entire episode usually lasts about 2 wk and seldom longer than 3 wk
Physical findings

- EARLY findings:
  - low-grade fever, nasopharyngitis, conjunctivitis, and rhinitis.
  - auscultation of the chest – unremarkable

- PROGRESSIVE evolution:
  - coarse breath sounds, coarse and fine crackles, rough high pitched rhonchi, scattered high-pitched wheezing.
  - chest radiographs – normal or increased bronchial markings.
Differential diagnosis

- foreign bodies aspiration (often in children less than 3yr of age);
- immotile cilia syndrome (suggest in presence of chronic sinusitis, otitis media, situs inversus in addition to bronchitis);
- acute pneumonia (suspected in high fever more than five days, fast breath, chest retraction, leucocytosis with neutrophilosis, X-ray is useful to confirm the diagnosis)
Treatment

- there is no specific therapy for acute bronchitis;
- the disease is self-limited;
- frequent shifts in position to facilitate pulmonary drainage in infants;
- cough suppressants may produce symptomatic relief but may also increase the risk of suppuration and inspissated secretions.
Other recommendations:

- nasopharyngeal lavage with isotonic solution (normal saline or Ringer lactate);
- treat fever with Acetaminophen in $t^\circ > 38.5$ (10-15 mg/kg body weight every 6 h)
Evaluation of patients

- Onset of dyspnea: stridor, wheezing
- Onset of general danger signs: convulsions or abnormally sleepy
- Not able to drink, stopped feeding well
- Patient doesn’t improve after 5 days
Refer to hospital if:

- Presence of general danger signs
- Fever > 39°C resistant to antipyretic treatment
- Acute respiratory distress and cardiac failure
- Chronic cough > 30 days duration
- Hemoptysis
ACUTE BRONCHIOLITIS
Definition

- A **wheeze** is a musical and continuous sound that originates from oscillations in narrowed airways. Wheezing is heard mostly on expiration as a result of critical airway obstruction.

- Wheezing is **polyphonic** when there is widespread narrowing of the airways causing various pitches or levels of obstruction to airflow as seen in asthma.
- **Monophonic** wheezing refers to a single-pitch sound that is produced in the larger airways during expiration as in distal tracheomalacia or bronchomalacia.

- When obstruction occurs in the extrathoracic airways during inspiration, the noise is referred to as **stridor**.
Etiology

- Predominantly a viral disease.
  - Respiratory syncytial virus (RSV) in >50% of cases.

- Other agents include:
  - parainfluenza,
  - adenovirus,
  - *Mycoplasma*,
  - Human metapneumovirus
more common in males,
more common in those who have not been breast-fed,
more common in those who live in crowded conditions,
older family members are a common source of infection – they may only experience minor respiratory symptoms.
Immune response in RSV bronchiolitis:

- Eosinophils degranulate and release eosinophil cationic protein, which is cytotoxic to airway epithelium;
- Immunoglobulin E (IgE) antibody release;
- Chemokines – interleukin 8 (IL-8), macrophage inflammatory protein (MIP) 1α, and RANTES (regulated on activation, normal T cell expressed and secreted);
- Higher levels of interferon-γ in the airway as well as leukotrienes.
Clinical manifestations

- mild upper respiratory tract infection with sneezing and clear rhinorrhea;
- diminished appetite and fever of 38.5–39°C;
- respiratory distress develops with paroxysmal wheezy cough, dyspnea, and irritability;
- tachypnea;
- apnea – more prominent than wheezing early in the course of the disease, particularly with very young infants (<2 mo old) or former premature infants.
Physical findings

- wheezing;
- severe tachypnea >70-80 breaths/min;
- the degree of tachypnea does not always correlate with the degree of hypoxemia or hypercarbia;
- spasmodic cough, irritability, difficult sucking and swallowing;
- work of breathing markedly increased, with nasal flaring and retractions;
Physical findings (cont.)

- chest indrawing, intercostal, subcostal and xyphoid retractions;
- auscultation –
  - fine crackles
  - overt wheezes
  - prolongation of the expiratory phase of breathing.
barely audible breath sounds – very severe disease with nearly complete bronchiolar obstruction;

hyperinflation of the lungs may permit palpation of the liver and spleen.
Diagnostic evaluation

- chest radiography – hyperinflated lungs with patchy atelectasis;
- white blood cell and differential counts are usually normal;
- viral testing (usually rapid immunofluorescence, polymerase chain reaction, or viral culture)
Treatment

- infants with respiratory distress should be hospitalized;
- cool humidified oxygen in all infants with hypoxia;
- sedatives are to be avoided;
- feeding through a nasogastric tube;
- frequent suctioning of nasal and oral secretions;
Treatment (cont.)

- bronchodilators (β-agonists, nebulized epinephrine);
- oral intake and parenteral fluids;
- antibiotics in secondary bacterial pneumonia;
- Ribavirin 15mg/kg/day, 7-10days
- In severe cases – parenteral Prednisone 3-5 mg/kg, orally or inhaled
**Prognosis**

- Highest risk for further respiratory compromise in the 1st 48–72 hr after onset of cough and dyspnea.
- Case fatality rate is <1%, with death attributable to apnea, uncompensated respiratory acidosis, or severe dehydration.
- The median duration of symptoms in ambulatory patients is ≈12 days.
- Infants with conditions such as congenital heart disease, bronchopulmonary dysplasia, and immunodeficiency often have more severe disease, with higher morbidity and mortality.
- Approximately 60% of infants who wheeze will stop wheezing.
PNEUMONIA
Bacterial Pneumonia

Typical Features

- Fever, cough, dyspnea.
- Abnormal chest examination (crackles or decreased breath sounds).
- Abnormal chest radiograph (infiltrates, hilar adenopathy, pleural effusion).
Bacterial pneumonia is an uncommon cause of pneumonia in children.

The most common cause of bacterial pneumonia in children of all ages is *S. pneumoniae*.

Bacterial pneumonia usually follows a viral lower respiratory tract infection.
Children at high risk for bacterial pneumonia are those with compromised pulmonary defense systems.

For example, children with abnormal mucociliary clearance, immunocompromised children, children who aspirate their own secretions or who aspirate while eating, and malnourished children are at increased risk for bacterial pneumonia.
Symptoms and Signs

- The bacterial pathogen, severity of the disease, and age of the patient may cause substantial variations in the presentation of acute bacterial pneumonia.
- Infants may have few or nonspecific findings on history and physical examination.
- Immunocompetent older patients may not be extremely ill.
Symptoms and Signs

- According to international studies, children with bacterial pneumonia are more likely to have high fevers (more than 39°C), tachypnea, and cough.

- However, most children with fever, cough, and tachypnea do not have bacterial pneumonia.

- Chest auscultation may reveal crackles or decreased breath sounds in the setting of consolidation or an associated pleural effusion.
## WHO Definition of Tachypnea

<table>
<thead>
<tr>
<th>Age</th>
<th>Respiratory Rate (breaths/min)</th>
<th>Indication of severe infection (breaths/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 months</td>
<td>&gt; 60</td>
<td>&gt;70</td>
</tr>
<tr>
<td>2 to 12 months</td>
<td>&gt; 50</td>
<td></td>
</tr>
<tr>
<td>12 months to 5 years</td>
<td>&gt; 40</td>
<td>&gt;50</td>
</tr>
<tr>
<td>Greater than 5 years</td>
<td>&gt; 20</td>
<td></td>
</tr>
</tbody>
</table>
Other signs of pneumonia - Indrawing

Lower chest wall indrawing: with inspiration, the lower chest wall moves in out---breathing---in
Other signs of pneumonia - Nasal Flare

Nasal flaring: with inspiration, the side of the nostrils flares outwards
**Symptoms and Signs**

- Some patients may have additional extrapulmonary findings, such as meningismus or abdominal pain, due to pneumonia itself.
- Others may have evidence of infection at other sites due to the same organism causing their pneumonia: meningitis, otitis media, sinusitis, pericarditis, epiglottitis, or abscesses.
Diagnosis in a Health Care Setting

- Vital signs that should routinely be taken in an Emergency Care setting include:
  - Respiratory Rate
  - Heart Rate
  - Temperature
  - Oxygen saturation (if available)

- Any child with an increased respiratory rate should be immediately identified as having possible pneumonia.
Both heart rate and respiratory rate are influenced by the presence of fever.

Heart rate increases by approximately 10 beats per minute for each 1 degree Celsius.

Respiratory Rate has been estimated to vary by 0.5-2 breath per minute to 5-11 breaths per minute for each 1 degree Celsius.
- Absence of tachypnea is the best individual finding for ruling out pneumonia.
- Chest indrawing, other signs of increased work of breathing and abnormal findings on auscultation can be used toward ruling in pneumonia.
- If clinical signs are negative (respiratory rate, auscultation, and work of breathing), it is unlikely that there will be chest x-ray findings.
# Pneumonia Severity Assessment

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infants</strong></td>
<td>Temperature $&lt;38.5$ C&lt;br&gt;RR $&lt; 50$ breaths/min&lt;br&gt;Mild recession&lt;br&gt;Taking full feeds</td>
<td>Temperature $&gt;38.5$ C&lt;br&gt;RR $&gt; 70$ breaths/min&lt;br&gt;Moderate to severe recession&lt;br&gt;Nasal Flaring&lt;br&gt;Cyanosis&lt;br&gt;Interruption Apnea&lt;br&gt;Grunting Respirations&lt;br&gt;Not feeding</td>
</tr>
<tr>
<td><strong>Older Children</strong></td>
<td>Temperature $&lt;38.5$ C&lt;br&gt;RR $&lt; 50$ breaths/min&lt;br&gt;Mild breathlessness&lt;br&gt;No vomiting</td>
<td>Temperature $&gt;38.5$ C&lt;br&gt;RR $&gt; 50$ breaths/min&lt;br&gt;Severe difficulty in breathing&lt;br&gt;Nasal Flaring&lt;br&gt;Cyanosis&lt;br&gt;Grunting Respirations&lt;br&gt;Signs of dehydration</td>
</tr>
</tbody>
</table>
Laboratory Findings

- An elevated peripheral white blood cell count may be a sensitive marker of possible bacterial pneumonia.
- However, a low white blood count (< 5000/L) can be an ominous finding in this disease.
- Blood cultures should be obtained in children admitted to the hospital with pneumonia.
Imaging Studies

- Alveolar densities or a lobar consolidation on chest x-ray suggests bacterial pneumonia.
- Radiographs should be taken in the lateral decubitus position to identify pleural fluid.
- Severity of disease may not correlate with radiographic findings.
- Clinical resolution precedes resolution apparent on chest radiograph.
Right Upper Lobe Pneumonia
Right Middle Lobe Pneumonia
Initial Chest X-Ray – Rationale

- Chest x-rays (CXRs) **not routinely** required for outpatient CAP
- CXRs:
  - Do not reliably distinguish bacterial from viral CAP or among the various bacterial pathogens
  - Impractical in office setting
    - Often requires travel to a separate facility
    - Barriers to physicians obtaining timely results
  - CXR in outpatient setting infrequently changes clinical management
- Guideline provides guidance on when to perform CXR in outpatient setting
Repeated Chest X-Ray – Rationale

- Repeat CXRs commonly identify persistent or residual abnormalities 3–6 weeks later.
  - Abnormalities rarely alter management.
  - Abnormalities do not predict treatment failure or worse clinical outcome.

- Repeat CXRs represent unnecessary radiation exposure to infants and children.
Imaging Studies

- A diagnostic thoracocentesis should be performed whenever possible in a child with a pleural effusion.
- Invasive diagnostic procedures (bronchial brushing or washing, lung puncture, or open or thoracoscopic lung biopsy) should be undertaken in critically ill patients when other means do not adequately identify the cause.
Blood Cultures – Rationale

- **Outpatient**
  - Infrequently identifies pathogens (<2%)  
  - False-positives more common than true positives at some hospitals  
  - Rarely informs outpatient management

- **Inpatient**
  - Positive in ~3% of uncomplicated pneumonia  
  - Positive in ~15% with empyema  
  - Allows for culture-directed therapy when positive  
  - Provides local epidemiologic data
The differential diagnosis of pneumonia varies with the age and immunocompetence of the host.

The spectrum of potential pathogens to be considered includes aerobic, anaerobic, and acid-fast bacteria as well as *Chlamydia trachomatis*, *Chlamydia pneumoniae*, *C psittaci*, *Coxiella burnetii* (Q fever), *P jiroveci*, *B pertussis*, *M pneumoniae*, mycobacteria, *Legionella pneumophila*, and respiratory viruses.

*S pneumoniae* is the most prevalent bacterial pathogen.
Differential Diagnosis

Noninfectious pulmonary disease should be considered:

- gastric aspiration,
- foreign body aspiration,
- atelectasis,
- congenital malformations,
- congestive heart failure,
- malignancy, tumors such as plasma cell granuloma,
- pulmonary hemosiderosis
Differential Diagnosis:
A Focus on Respiratory Syncytial Virus (RSV)
Respiratory Syncytial Virus (RSV)

- RSV is the most common cause of LRTIs in children less than 1.
- Infants and young children typically present with pneumonia or bronchiolitis.
- Older children may have upper respiratory tract infection symptoms.
- RSV is associated with apnea in infants.
- Wheezing is common.
RSV Seasonality

- Seasonal outbreaks occur throughout the world.
- In the northern hemisphere outbreaks peak in January and February.
- In the southern hemisphere outbreaks peak in May, June and July.
- In tropical climates outbreaks are often associated with the rainy season.
Differential Diagnosis: Consider Tuberculosis
Tuberculosis

Common symptoms of tuberculosis include:

- Chronic cough that has been present for more than 3 weeks and is not improving
- Fever greater than 38°C for at least two weeks, not attributable to other common causes
- Weight loss or failure to thrive
Physical exam findings of children with pulmonary tuberculosis are similar to those of a lower respiratory tract infection.

In children less than age five tuberculosis can progress rapidly from latent infection to active disease and serve as a sentinel case in the community.

Consider the diagnosis of tuberculosis, especially in those children who fail to respond appropriately to routine treatment for pneumonia.
Pneumonia in Malnourished Children
Pneumonia in Malnourished Children

- History of cough, fast breathing and difficulty breathing were significant predictors of pneumonia in malnourished children.
- Only difficulty breathing was a significant predictor of pneumonia in well-nourished children.
- As malnourished children are a high risk group, those who present with a history of cough, fast breathing, or difficulty breathing should be treated with antibiotics.
- Fast breathing and lower chest wall indrawing are not specific predictors of pneumonia in malnourished children.
Pneumonia and HIV infected Children
Pneumonia and HIV infected Children

- The prevalence of HIV-1 in children admitted with severe pneumonia (by WHO criteria) in Africa is 55-65%.
- The case fatality rate is 20-34%.
- This case fatality rate is 3-6 times higher for children infected with HIV compared to those not infected with HIV.
- Pneumonia caused by *Pneumocystis jiroveci* may be the first indicator of HIV infection, and lead to HIV testing and diagnosis.
Complications of bacterial pneumonia

- Empyema can occur frequently with staphylococcal, pneumococcal, and group A - hemolytic streptococcal disease.
- Distal sites of infection—meningitis, otitis media, sinusitis (especially of the ethmoids), and septicemia—may be present, particularly with disease due to *S pneumoniae* or *H influenzae*. 
Complications

- Certain immunocompromised patients, such as those who have undergone splenectomy or who have hemoglobin SS or SC disease or thalassemia, are especially prone to overwhelming sepsis with these organisms.
# Indications for Admission

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Indications for Admission to Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants</td>
<td>Oxygen Saturation $\leq 92%$, cyanosis&lt;br&gt;RR $&gt; 70$ breaths /min&lt;br&gt;Difficulty in breathing&lt;br&gt;Interruption apnea, grunting&lt;br&gt;Not feeding&lt;br&gt;Family not able to provide appropriate observation or supervision</td>
</tr>
<tr>
<td>Older Children</td>
<td>Oxygen Saturation $\leq 92%$, cyanosis&lt;br&gt;RR $&gt; 50$ breaths /min&lt;br&gt;Difficulty in breathing&lt;br&gt;Grunting&lt;br&gt;Signs of Dehydration&lt;br&gt;Family not able to provide appropriate observation or supervision</td>
</tr>
</tbody>
</table>
In-Patient Management

- Consideration must be given to the provision of adequate hydration, oxygenation, nutrition, antipyretics and pain control.

- Monitoring should include:
  - Respiratory rate
  - Work of breathing
  - Temperature
  - Heart rate
  - Oxygen saturation (if available)
  - Findings on auscultation.
Criteria for Intensive Care

- The patient is failing to maintain an oxygen saturation of > 92% in FiO2 of > 0.6.
- The patient is in shock.
- There is a rising respiratory rate and rising pulse rate with clinical evidence of severe respiratory distress and exhaustation, with or without a raised arterial carbon dioxide tension (PaCO2).
- There is recurrent apnea or slow irregular breathing.
Antibiotic treatment for bacterial pneumonia depends on the clinical scenario.

In children less than 5 years old with a positive chest x-ray or suggestive clinical findings, the most likely bacterial pathogen is *S pneumonieae* and the antibiotic of choice is amoxicillin for outpatient management.

The suggested dose is 80–100 mg/kg.
Treatment

- Second-generation cephalosporins are recommended for children allergic to penicillin, or a macrolide can be effective.
- Children older than 5 years are more likely to have atypical pneumonia and so the clinical scenario and the chest x-ray may help direct the therapy.
- When possible, therapy can be guided by the antibiotic sensitivity pattern of the organisms isolated.
Treatment

- Whether a child should be hospitalized depends on his or her age, the severity of illness, the suspected organism, and the anticipated reliability of adherence to the treatment regimen at home.

- All children younger than 3 months of age are generally admitted to the hospital for treatment of bacterial pneumonia.
**Treatment**

- Children older than 3 months of age with febrile pneumonias, infants generally—and toddlers often—require admission.
- Moderate to severe respiratory distress, apnea, hypoxemia, poor feeding, clinical deterioration on treatment, or associated complications (large effusions, empyema, or abscess) indicate the need for immediate hospitalization.
- Careful follow-up within 12 hours to 5 days is often indicated in those not admitted.
**Treatment**

- Additional therapeutic considerations include oxygen, humidification of inspired gases, hydration and electrolyte supplementation, and nutrition.
- Removal of pleural fluid for diagnostic purposes is indicated initially to guide antimicrobial therapy.
- Removal of pleural fluid for therapeutic purposes may also be indicated.
Supportive Treatment

- Oxygen therapy
- If fever (=>39°C) causing distress, give paracetamol
- If wheeze is present, give a rapid-acting bronchodilator
- Gentle suction any thick secretions in the throat, which the child cannot clear.
Supportive Treatment

- Ensure that the child receives daily maintenance fluids for the child's age - avoid overhydration.
- Encourage breastfeeding and oral fluids.
- If the child cannot drink, insert a NG tube and give maintenance fluids in frequent small amounts.
  - *If the child is taking fluids adequately by mouth, do not use a NG tube as it increases the risk of aspiration pneumonia.*
  - If oxygen is given by nasopharyngeal catheter at the same time as NG fluids, pass both tubes through the same nostril.
- Encourage the child to eat as soon as food can be taken.
For the immunocompetent host in whom bacterial pneumonia is adequately recognized and treated, the survival rate is high.

For example, the mortality rate from uncomplicated pneumococcal pneumonia is less than 1%.
Prognosis

- If the patient survives the initial illness, persistently abnormal pulmonary function following empyema is surprisingly uncommon, even when treatment has been delayed or inappropriate.
- Vaccination with pneumococcal vaccine will aid in the prevention of pneumonia.
Viral Pneumonia

Typical Features

- Upper respiratory infection prodrome (fever, coryza, cough, hoarseness).
- Wheezing or rales.
- Myalgia, malaise, headache (older children).
General Considerations

- Most pneumonias in children are caused by viruses.
- RSV, parainfluenza (1, 2, and 3) viruses, influenza (A and B) viruses, and human metapneumovirus are responsible for the large majority of cases.
General Considerations

- Severity of disease, severity of fever, radiographic findings, and the characteristics of cough or lung sounds do not reliably differentiate viral from bacterial pneumonias. Furthermore, such infections may coexist.

- However, substantial pleural effusions, pneumatoceles, abscesses, lobar consolidation with lobar volume expansion, and "round" pneumonias are generally inconsistent with viral disease.
Symptoms and Signs

- An upper respiratory infection frequently precedes the onset of lower respiratory disease due to viruses.

- Although wheezing or stridor may be prominent in viral disease, cough, signs of respiratory difficulty (tachypnea, retractions, grunting, and nasal flaring), and physical findings (rales and decreased breath sounds) may not be distinguishable from those in bacterial pneumonia.
Laboratory Findings

- The peripheral white blood cell count can be normal or slightly elevated and is not useful in distinguishing viral from bacterial disease.

- Rapid viral diagnostic methods—such as fluorescent antibody tests or enzyme-linked immunosorbent assay—should be performed on nasopharyngeal secretions to confirm this diagnosis in high-risk patients and for epidemiology or infection control.

- Rapid diagnosis of RSV infection does not preclude the possibility of concomitant infection with other pathogens.
Imaging Studies

- Chest radiographs frequently show perihilar streaking, increased interstitial markings, peribronchial cuffing, or patchy bronchopneumonia.
- Lobar consolidation or atelectasis may occur, however, as in bacterial pneumonia.
- Patients with adenovirus disease may have severe necrotizing pneumonias, resulting in the development of pneumatoceles.
- Hyperinflation of the lungs may occur when involvement of the small airways is prominent.
The differential diagnosis of viral pneumonia is the same as for bacterial pneumonia.

Patients with prominent wheezing may have:

- asthma,
- airway obstruction caused by foreign body aspiration,
- acute bacterial or viral tracheitis, or
- parasitic disease.
Complications

- Viral pneumonia or laryngotracheobronchitis may predispose the patient to subsequent bacterial tracheitis or pneumonia as immediate sequelae.
- Bronchiolitis obliterans or severe chronic respiratory failure may follow adenovirus pneumonia.
- Bronchiolitis or viral pneumonia may contribute to persistent asthma in some patients.
Complications

- Bronchiectasis, chronic ILD, and unilateral hyperlucent lung (Sawyer-James syndrome) may follow measles, adenovirus, and influenzal pneumonias.

- Plasma cell granuloma may develop as a rare sequela to viral or bacterial pneumonia.
Treatment

- General supportive care for viral pneumonia does not differ from that for bacterial pneumonia.
- Patients can be quite ill and should be hospitalized according to the level of their illness.
- Because bacterial disease often cannot be definitively excluded, antibiotics may be indicated.
Treatment

- Patients at risk for life-threatening RSV infections (eg, those with BPD or other severe pulmonary conditions, congenital heart disease, or significant immunocompromise) should be hospitalized and ribavirin should be considered.

- Rapid viral diagnostic tests may be a useful guide for such therapy (see Bronchiolitis Obliterans section, earlier, regarding prevention).
Treatment

- These high-risk patients and all children 6 months to 5 years of age should be immunized annually against influenza A and B viruses.

- When available epidemiologic data indicate an active influenza A infection in the community, rimantadine, amantadine hydrochloride, or oseltamivir phosphate should be considered early for high-risk infants and children who appear to be infected.

- Children with suspected viral pneumonia should be placed in respiratory isolation.
**Prognosis**

- Worsening asthma, abnormal pulmonary function or chest radiographs, persistent respiratory insufficiency, and even death may occur in high-risk patients such as newborns or those with underlying lung, cardiac, or immunodeficiency disease.

- Patients with adenovirus infection or those concomitantly infected with RSV and second pathogens such as influenza, adenovirus, cytomegalovirus, or *P jiroveci* also have a worse prognosis.
Atypical Pneumonias: Chlamydial Pneumonias

Typical Features

- Cough, pharyngitis, tachypnea, rales, few wheezes, fever.
- Inclusion conjunctivitis, eosinophilia, and elevated immunoglobulins in some cases.
Chlamydial Pneumonias –
General Considerations

- In children *C pneumoniae* is a common respiratory pathogen and may cause 5–20% of all community-acquired pneumonias.
- Often these lower respiratory tract illnesses are mild or asymptomatic, although this can occasionally be a serious pathogen.
- Pulmonary disease due to *C trachomatis* usually evolves gradually as the infection descends the respiratory tract.
Infants may appear quite well despite the presence of significant pulmonary illness. Infant infections are now at epidemic proportions in urban environments worldwide.

*C pneumoniae* is now recognized as a common cause of respiratory infections in adults and children.
Chlamydial Pneumonias – Symptoms and Signs

- Cough is usually present.
- It can have a staccato character and resemble the cough of pertussis.
- The infant is usually tachypneic.
- Scattered inspiratory rales are commonly heard, wheezes rarely.
- Significant fever suggests a different or additional diagnosis.
About 50% of infants with *C. trachomatis* pneumonia have active inclusion conjunctivitis or a history of it.

Rhinopharyngitis with nasal discharge or otitis media may have occurred or may be currently present.

Female patients may have vulvovaginitis.
Chlamydial Pneumonias – Laboratory Findings

- Although patients may frequently be hypoxemic, carbon dioxide retention is not common.
- Peripheral blood eosinophilia (400 cells/mL) has been observed.
- Serum immunoglobulins are usually abnormal.
- IgM is virtually always elevated, IgG is high in many, and IgA is less frequently abnormal.
Chlamydial Pneumonias – Laboratory Findings

- *C trachomatis* can be identified in nasopharyngeal washings using fluorescent antibody or culture techniques.
- *C pneumoniae* isolation can be difficult and the diagnosis is often made by serologic testing.
- These tests can be performed to confirm this diagnosis in difficult to diagnose or high-risk patients and for epidemiology or infection control.
Chlamydial Pneumonias – Imaging Studies

- Chest radiographs may reveal diffuse interstitial and patchy alveolar infiltrates, peribronchial thickening, or focal consolidation.
- A small pleural reaction can be present.
- Despite the usual absence of wheezes, hyperexpansion is commonly present.
Chlamydial Pneumonias – Differential Diagnosis

- Bacterial, viral, and fungal (*P. jiroveci*) pneumonias should be considered in the differential diagnosis.
- Premature infants and those with BPD may also have chlamydial pneumonia.
- *C. pneumoniae* is often accompanied by coinfection with other pathogens, particularly *S. pneumoniae* and *M. pneumoniae*. 
Chlamydial Pneumonias – Treatment

- A macrolide or sulfisoxazole therapy should be administered.
- Hospitalization may be required for children with significant respiratory distress, coughing paroxysms, or posttussive apnea.
- Oxygen therapy may be required for prolonged periods in some patients.
Chlamydial Pneumonias – Prognosis

- An increased incidence of obstructive airway disease and abnormal pulmonary function tests may occur for at least 7–8 years following infection.
Atypical Pneumonias: Mycoplasmal Pneumonia

Typical Features

- Fever.
- Cough.
- Most common in children older than age 5 years.
Mycoplasma Pneumonia –
General Considerations

- *M. pneumoniae* is a common cause of symptomatic pneumonia in older children although it may be seen in children younger than 5 years of age.
- Endemic and epidemic infection can occur.
- The incubation period is long (2–3 weeks), and the onset of symptoms is slow.
- Although the lung is the primary infection site, extrapulmonary complications sometimes occur.
Fever, cough, headache, and malaise are common symptoms as the illness evolves. Although cough is usually dry at the onset, sputum production may develop as the illness progresses.
Mycoplasmal Pneumonia – Symptoms and Signs

- Sore throat, otitis media, otitis externa, and bullous myringitis may occur.
- Rales are frequently present on chest examination.
- Decreased breath sounds or dullness to percussion over the involved area may be present.
The total and differential white blood cell counts are usually normal.

The cold hemagglutinin titer can be determined and may be elevated during the acute presentation.

A titer of 1:64 or higher supports the diagnosis.
Mycoplasmal Pneumonia – Laboratory Findings

- Acute and convalescent titers for *M. pneumoniae* demonstrating a fourfold or greater rise in specific antibodies confirm the diagnosis.
- Diagnosis of mycoplasmal pneumonia by polymerase chain reaction is becoming more readily available.
Mycoplasmal Pneumonia – Imaging Studies

- Chest radiographs usually demonstrate interstitial or bronchopneumonic infiltrates, frequently in the middle or lower lobes. Pleural effusions are extremely uncommon.
Mycoplasmal Pneumonia – Complications

- Extrapulmonary involvement of the blood, central nervous system, skin, heart, or joints can occur.
- Direct Coombs–positive autoimmune hemolytic anemia, occasionally a life-threatening disorder, is the most common hematologic abnormality that can accompany *M pneumoniae* infection.
- Coagulation defects and thrombocytopenia can also occur.
Mycoplasmal Pneumonia – Complications

- Cerebral infarction, meningoencephalitis, Guillain-Barré syndrome, cranial nerve involvement, and psychosis all have been described.

- A wide variety of skin rashes, including erythema multiforme and Stevens-Johnson syndrome, can occur.

- Myocarditis, pericarditis, and a rheumatic fever–like illness can also occur.
Mycoplasmal Pneumonia – Treatment

- Antibiotic therapy with a macrolide for 7–10 days usually shortens the course of illness.
- Ciprofloxacin is a possible alternative.
- Supportive measures, including hydration, antipyretics, and bed rest, are helpful.
In the absence of the less common extrapulmonary complications, the outlook for recovery is excellent.

The extent to which *M pneumoniae* can initiate or exacerbate chronic lung disease is not well understood.