

In the name of God

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Sub in: pediatric infectious disease

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Sep. 2026

What is the Pneumonia ???

Inflammation of the Lung parenchyma

Recurrent pneumonia

- 1- **2 or more** episodes in a **single year** **or**
- 2- **3 or more** episodes **ever**,
with **radiographic clearing**
between occurrences.



underlying disorder



Pneumonia Etiology

Microorganisms

Noninfectious causes :

1- Aspiration

2- Hypersensitivity reactions,

3- Drug -induced pneumonitis.

4 - Radiation-induced pneumonitis.

The cause of pneumonia



often difficult to determine

1- Direct culture of lung tissue ?

Invasive

rarely performed.

2- Cultures performed on specimens
from the

upper respiratory tract or sputum

do not accurately reflect the cause of

Lower respiratory tract infection.

3- PCR

40-80% of children

{community-acquired pneumonia.}

The **most common bacterial** pathogens :

1- *Streptococcus pneumoniae* (pneumococcus)
in children 3 wk to 4 yr of age

2- *Mycoplasma pneumoniae*

3- *Chlamydophila pneumoniae*
in children age 5 yr and older.

4- Group A streptococcus (*Streptococcus pyogenes*)

5- ***Staphylococcus aureus***

often complicates an illness caused by

Influenza viruses.



Major causes of

Hospitalization and death

from bacterial pneumonia:

1- *S. pneumoniae*,

2- *H. influenzae*,

3- *S. aureus*

in children with HIV infection,

- ▶ *Mycobacterium tuberculosis*
- ▶ Atypical mycobacteria
- ▶ *Salmonella*
- ▶ *Escherichia coli*
- ▶ *Pneumocystis jiroveci*

the most consistent
clinical manifestation of
pneumonia ?????

Clinical Manifestation

- ▶ several days of symptoms of URI
- ▶ typically **rhinitis** and **cough**.
- ▶ **Tachypnea** is the most consistent
- ▶ clinical manifestation of pneumonia.
- ▶ **fever** is usually present

Clinical Manifestation

- ▶ Increased work of breathing
- ▶ intercostal, subcostal, and suprasternal **retractions**,
- ▶ **nasal flaring**, and use of accessory muscles is common.
- ▶ Severe infection especially in infants :
 **cyanosis** and **lethargy**,

Clinical Manifestation

▶ Bacterial pneumonia in adults and older children :

Typically begins **suddenly** with :

▶ High fever,

▶ Cough,

▶ Chest pain.

▶ Other symptoms :

▶ Drowsiness with intermittent periods of :

Clinical Manifestation

- ▶ Restlessness;
- ▶ Rapid respirations;
- ▶ Anxiety; and, occasionally,
- ▶ Delirium.
- ▶ Splinting on the affected side to minimize pleuritic pain and improve ventilation
- ▶ such children may lie on one side with the knees drawn up to the chest.

Physical findings

- ▶ Gastrointestinal disturbances :
- ▶ Vomiting,
- ▶ Anorexia,
- ▶ Diarrhea,
- ▶ Abdominal distention secondary to a paralytic ileus.

Clinical Manifestation

Not possible to distinguish
viral pneumonia from
Mycoplasma and
other bacterial pathogens.

Physical findings

- ▶ depend on the stage of pneumonia.

- Early in the course of illness :

- ▶ Diminished breath sounds,

- ▶ Scattered crackles,

- ▶ Rhonchi

Physical findings

- ▶ With the development of increasing consolidation or
- ▶ complications of pneumonia such as
Pleural effusion or empyema,
- ▶ Breath sounds may be diminished.
- ▶ Dullness on percussion

Physical findings

- ▶ Abdominal distention
 - ... Gastric dilation from swallowed air or ileus.
- ▶ *Abdominal pain is common in lower-lobe pneumonia.*
- ▶ Enlarged liver
- ▶ Downward displacement of the diaphragms
 - Secondary to hyperinflation of the lungs or superimposed congestive heart failure.

Physical findings

In infants :

- Prodrome of upper respiratory tract infection
 - Diminished appetite, ...

..... Abrupt onset of :

- Fever,
 - Restlessness,
 - Apprehension, and Respiratory distress.

Streptococcus pneumoniae

(Pneumococcal infections)

- acute otitis media,
 - sinusitis,
 - community-acquired pneumonia,
 - pediatric conjunctivitis;
 - pleural empyema,
 - mastoiditis,
 - periorbital cellulitis

Streptococcus pneumoniae

Most common cause of **bacterial meningitis**

in infants and children ages 2 months to 11 years

- Endocarditis,
- Pericarditis,
 - Peritonitis,
 - Pyogenic arthritis,
 - Osteomyelitis,
 - Soft tissue infection,
 - Neonatal septicemia.
 - Overwhelming septicemia in patients with splenic dysfunction
 - Hemolytic-uremic syndrome

Viral upper respiratory tract infections,

1 - influenza

2- respiratory syncytial virus,

predispose to pneumococcal :
infection and **transmission**.

Pneumococcal infections are most prevalent
during winter months.

incubation period :

- **can be as short as 1 day.**

DIAGNOSTIC TESTS:

Recovery of *S pneumoniae* from a normally sterile site **confirms** the diagnosis.

The finding of lancet-shaped gram-positive organisms and white blood cells in expectorated sputum (older children and adults) or pleural exudate **suggests** pneumococcal pneumonia.

Recovery of pneumococci by culture of an **upper respiratory** tract swab specimen is **not sufficient** to assign an etiologic diagnosis of pneumococcal disease involving the middle ear, upper or lower respiratory tract, or sinus.

Diagnosis

- ▶ Older children with suspected pneumonia
(cough, fever, localized crackles, or decreased breath sounds)
- ▶ who are well enough to be managed as outpatients.
- ▶ Some experts suggest that a chest radiograph may not be necessary.

Diagnosis

The radiographic appearance alone is not diagnostic, and other clinical features must be considered.

- An **infiltrate** on chest radiograph **supports** the diagnosis of pneumonia;
Complication such as a pleural effusion or empyema.

Diagnosis

Blood cultures are recommended :

- 1- those requiring hospitalization.
- 2- for those who fail to improve or have clinical deterioration,
- 3- in those with complicated pneumonia

positive in only 10%

- ▶ B/C are not recommended for nontoxic appearing children treated as an **outpatient.**

Diagnosis

- ▶ Chest Xray :
- ▶ Confluent lobar consolidation is typically seen.



- ▶ **Repeat chest** radiographs are not required
- ▶ for proof of cure for patients with **uncomplicated pneumonia.**

Diagnosis

Ultrasonography is highly sensitive and specific

Lung consolidations and air bronchograms or effusions.

WBC count can be useful in differentiating
viral from bacterial pneumonia.

WBC count  higher than 20,000/mm³

Diagnosis

- ▶ **Bacterial pneumonia :**
- ▶ WBC count, in the range of 15,000- 40,000/mm³, and a predominance of granulocytes.
- ▶ Large pleural effusion,
- ▶ Lobar consolidation,
- ▶ High fever at the onset of the illness

Community-Acquired Pneumonia

Leading cause of death

..... children **younger than age 5 yr,**

1.2 million (18% total) deaths annually

Treatment

- ▶ **based on the :**
- ▶ Presumptive cause
- ▶ age
- ▶ clinical appearance of the child.
- ▶ For mildly ill children who do not require hospitalization,
 - ▶ **amoxicillin (80-90 mg/kg/24 hr)**
- ▶ **alternatives include :**
- ▶ **cefuroxime axetil & amoxicillin/clavulanate.**

Treatment

The empiric treatment in a hospitalized child

Fully immunized against *H. influenzae* type b and

S.pneumoniae and are not severely ill should receive

ampicillin or penicillin G.

For children who do not meet these criteria,

ceftriaxone or cefotaxime should be used.

If clinical features suggest staphylococcal pneumonia

(pneumatocoles, empyema), :

Vancomycin or clindamycin.

Treatment

- ▶ However,
- ▶ Antibiotics until the patient has been **afebrile for 72 hr,**
- ▶ Total duration should not be less than 10 days
- ▶ Shorter courses (5-7 days) effective, for outpatient basis
- ▶ In severe pneumonia :
- ▶ Oral zinc (10 mg/day for <12 mo, 20 mg/day for ≥ 12 mo) reduces mortality.

Prognosis

- ▶ Typically, improvement in clinical
- ▶ symptoms (fever, cough, tachypnea, chest pain), within 48-96 hr.
- ▶ Radiographic evidence of improvement
- ▶ Lags substantially behind clinical improvement.

Prognosis

Poor response to therapy.

- ▶ 1) Complications, such as empyema
- ▶ 2) Bacterial resistance;
- ▶ 3) Nonbacterial etiologies such as
 - viruses
 - fungi
 - aspiration of foreign bodies or food;

Prognosis

- ▶ 4) bronchial obstruction from
 - endobronchial lesions,
 - foreign body,
 - mucous plugs;

Prognosis

► 5) preexisting diseases such as :

- immunodeficiencies,
- ciliary dyskinesia,
- cystic fibrosis,
- pulmonary sequestration,
 - congenital pulmonary airway malformation,
(formerly called cystic adenomatoid malformation)

Prognosis

- ▶ 6) other noninfectious causes :
- ▶ Bronchiolitis obliterans,
- ▶ Hypersensitivity pneumonitis,
- ▶ Eosinophilic pneumonia,
- ▶ Aspiration,
- ▶ Granulomatosis with Polyangiitis,
(formerly called Wegener granulomatosis).

Poor response to therapy.

- ▶ Repeat chest radiograph is the first step
- ▶ Bronchoalveolar lavage
- ▶ High-resolution CT scans
 - complications
 - an anatomic reason

Prognosis

- ▶ up to 45% of children have symptoms of **asthma** 5 yr after hospitalization for pneumonia;
 - 1- undiagnosed asthma at the time of presentation
 - 2- propensity for development of asthma after pneumonia.

Complications :

- 1- Direct spread of bacterial infection within the thoracic cavity :
 - Pleural effusion,
 - Empyema
 - Pericarditis

Complications :

2- Bacteremia and Hematologic spread :

- Meningitis

- Suppurative arthritis & osteomyelitis

- ▶ rare complications of hematologic spread of

- ▶ pneumococcal or *H. influenzae* type b infection.

Complications :

- ▶ *S. aureus*, *S. pneumoniae*, and *S. pyogenes* are the most common causes of parapneumonic effusions and empyema
- ▶ Nonetheless
- ▶ many effusions that complicate bacterial pneumonia are sterile.

- ▶ In developing countries ???
- ▶ in developed countries ???

In developing than in developed countries :
The **incidence** of pneumonia

..... **> 10-fold higher**

The number of **deaths** from pneumonia

..... **2,000 fold higher**



Antibiotics,



Vaccines,

Prevention

- ▶ Vaccination has reduced the incidence of pneumonia hospitalizations.



35% decrease

- By 2019,
9 years after the introduction of PCV13,
The incidence of
PCV13-type invasive pneumococcal infections



decreased by 98%

C. trachomatis Pneumonia :

- ▶ Very characteristic presentation in infancy :
 - 1- Onset usually occurs between 1 and 3 mo of age
 - 2- Often insidious,
 - 3- With persistent cough,
 - 4- Tachypnea,
 - 5- Absence of fever.
 - 6- Auscultation reveals rales; **wheezing is uncommon.**

► The absence of fever and wheezing
helps to distinguish :

C. trachomatis pneumonia

from :

Respiratory syncytial virus pneumonia.

Laboratory finding :

Presence of peripheral eosinophilia
(>400 cells/ μL)

..... distinctive

Chest radiograph finding :

The most consistent :

- Hyperinflation
- Minimal interstitial or alveolar infiltrates.

CLINICAL MANIFESTATIONS:

1 - Asymptomatic

2 - mildly to moderately ill with :

- **pneumonia,**

- acute bronchitis,

- prolonged cough,

3 - Less commonly:

- pharyngitis,

- laryngitis,

- otitis media,

- sinusitis.

Chest radiography :

- pleural effusion
- bilateral infiltrates
- a single patchy subsegmental infiltrate.

★ Illness can be prolonged,

★ cough can persist for

.... 2 to 6 weeks or longer.

TREATMENT:

► Macrolides :

1 - Azithromycin

2 - Erythromycin

3 - Clarithromycin

1- Erythromycin :

(50 mg/kg/day in 4 divided doses daily) for 14 days

2- Azithromycin :

Alternatively :



(20 mg/kg as a single daily dose) for 3 days. •

- Neonates with chlamydial ophthalmia neonatorum



- Topical antibiotic therapy alone **is inadequate**

- Oral erythromycin :

(50 mg/kg/day in 4 divided doses daily) for 14 days.

Data on azithromycin are **limited**;



- Topical antibiotic therapy :
unnecessary when systemic treatment is administered.

Efficacy of erythromycin

- for ophthalmia neonatorum
- or infant pneumonia



approximately 80%,



second course of therapy **might be required.**

- possible gonococcal infection.



An association between **orally TREATMENT** and
Infantile hypertrophic pyloric stenosis (**IHPS**)
has been reported in infants **younger than 6 weeks.**

H. influenzae pneumonia

- The signs and symptoms cannot be differentiated from those of pneumonia caused by many other microorganisms.
- **Other foci** of infection may be present concomitantly.

H. influenzae pneumonia :

- in Children younger than 12 mo of age

increased risk for bacteremia and its complications:



parenteral antimicrobial therapy initially

Uncomplicated pleural effusion

no special intervention.

Empyema

surgical drainage



P. aeruginosa Pneumonia

In Community-acquired pneumonia :

- in children : not a frequent cause
- in adults : increasingly important cause

In nosocomial pneumonia : especially VAP

- In patients of all ages : increasingly important cause

P. aeruginosa :

contaminate ventilators, tubing, and humidifiers.

Such contamination is uncommon because of :

- Disinfection practices
- Routine changing of equipment.

Nevertheless, colonization of

- the upper respiratory tract &
- the gastrointestinal tract



aspiration of *P. aeruginosa* contaminated secretions,



severe pneumonia.

Prior use of broad-spectrum Ab.



Antibiotics :

a **Risk factor** for colonization with
antibiotic-resistant strains of ***P. aeruginosa***.

in intubated patients :

Distinguishing between
Colonization & Pneumonia

One of the most challenging situations

P. aeruginosa in newborns :

an occasional cause of nosocomial bacteremia

2-5% of positive blood culture results in NICU

A frequent focus preceding bacteremia

is **conjunctivitis**.

P. aeruginosa in Older infants :

occasionally present with community-acquired sepsis

this circumstance is uncommon.

P. aeruginosa infection is rarely clinically distinctive.

Ventilator-Associated Pneumonia (VAP)

The pathophysiology of (VAP) is multifactorial :

- 1- Aspiration of oral and/or gastric secretions,
- 2- Colonization of ETs,
- 3- Suppression of cough reflexes with sedation .

▶ Diagnosis of VAP

- ▶ New-onset fever
- ▶ Leukocytosis
- ▶ Infiltrative process by chest radiographs



- 1- Worsened gas exchange,
- 2- Increased duration of ventilation,
- 3- and even death.

Two means of reducing the risk for VAP :

- 1- Elevation of the head of the bed to 30 degrees
after initiation of mechanical ventilation.
- 2- Use of a protocol for oral decontamination
during mechanical ventilation.

The most effective strategy to minimize any of the
aforementioned complications :

- 1-Regular assessment of extubation readiness
- 2- liberation from mechanical ventilation
as soon as clinically possible.

Pneumocystis pneumonia

The classic clinical presentation :

Acute onset of fever,

Tachypnea,

Dyspnea,

Marked hypoxemia;

in some children,

Hypoxemia may precede other clinical

or x-ray manifestations.

Pneumocystis pneumonia

Chest x-ray findings : Most common :

- Interstitial infiltrates
- Diffuse alveolar disease,
which rapidly progresses.

Occasionally :

Nodular lesions,
Streaky or lobar infiltrates,
Pleural effusions

Pneumocystis pneumonia

Diagnosis

Demonstration of *P. jiroveci*

with appropriate staining of

Induced sputum or

Bronchoalveolar fluid lavage;

Rarely, an open lung biopsy is necessary.

Mycoplasma pneumoniae

Frequent cause of upper and lower
respiratory tract infections in children;

- pharyngitis,
- acute bronchitis,
- pneumonia.
- Acute otitis media is uncommon.
 - Bullous myringitis



Unusual manifestations

Aseptic meningitis

Encephalitis,

Acute disseminated encephalomyelitis,

Cerebellar ataxia,

Transverse myelitis,

Peripheral neuropathy.

- Myocarditis,
- Pericarditis,
- Arthritis (particularly in Immunocompromised hosts),
- Erythema nodosum
- Polymorphous mucocutaneous eruptions:

- Hemolytic anemia,
 - Thrombocytopenic purpura,
 - Hemophagocytic syndromes,
 - Postinfectious glomerulonephritis

Severe pneumonia with pleural effusion

- Sickle cell disease,
 - Down syndrome,
 - Immunodeficiencies
 - Chronic cardiorespiratory disease.

Acute chest syndrome and pneumonia

in patients with sickle cell disease.

- Exacerbations of **asthma.**

Approximately 25% of infected school-aged children will develop pneumonia :

1- Cough

2- Rales

within days after onset of constitutional symptoms.

- Cough, initially nonproductive,
 - can become productive,
- persist for 3 to 4 weeks,
- and be accompanied by wheezing.

Approximately 10% of children with
M pneumoniae infection
will exhibit a rash,
which most often is maculopapular

Stevens-Johnson syndrome

Reactive infection mucocutaneous eruption [RIME],
formerly referred to as

Mycoplasma-induced rash and mucositis [MIRM]

Radiographic abnormalities:

- Bilateral diffuse infiltrates
- Focal abnormalities, such as consolidation,
 - Pleural effusion,
 - Hilar adenopathy,

M. pneumoniae :

disease **only in humans.**

Transmissible by respiratory droplets **during close contact.**

Outbreaks :

- Hospitals,
 - Military bases,
 - Colleges,
 - Summer camps.
- Occasionally, ventilator-associated pneumonia. (VAP)
- Pneumonia in school-aged children and young adults
- **Infrequent** cause of community-acquired pneumonia (CAP)
 - In children **younger than 5 years**

- ❖ Approximately 30% of household contacts develop pneumonia.
- ❖ Asymptomatic carriage after infection may occur for weeks to months.
- ❖ Immunity after infection is not long lasting.
- ❖ The incubation period usually is 2 to 3 weeks (range, 1–4 weeks), which can contribute to lengthy outbreaks.

DIAGNOSTIC TESTS:

- Nucleic acid amplification tests (NAATs)
- NAATs performed on respiratory tract specimens
 - nasal wash,
 - nasopharyngeal swab,
 - oropharyngeal swab,
 - sputum,
 - bronchoalveolar lavage fluid

Diagnosis

- ▶ *M. pneumoniae* infections :

Cold agglutinins at titers $>1 : 64$

in the blood in $\approx 50\%$ of patients with.

- ▶ Cold agglutinin findings nonspecific (influenza viruses)

- ▶ Acute infection caused by *M. pneumoniae* :

- ▶ **PCR** or seroconversion in an **IgG assay.**

Treatment

- ▶ school-age children
- ▶ infection with *M. pneumoniae*
- ▶ infection with *C. pneumoniae*
- ▶ a macrolide antibiotic such as **azithromycin** is an appropriate choice.
- ▶ Alternative In adolescents,
- ▶ Levofloxacin,
- ▶ Moxifloxacin.

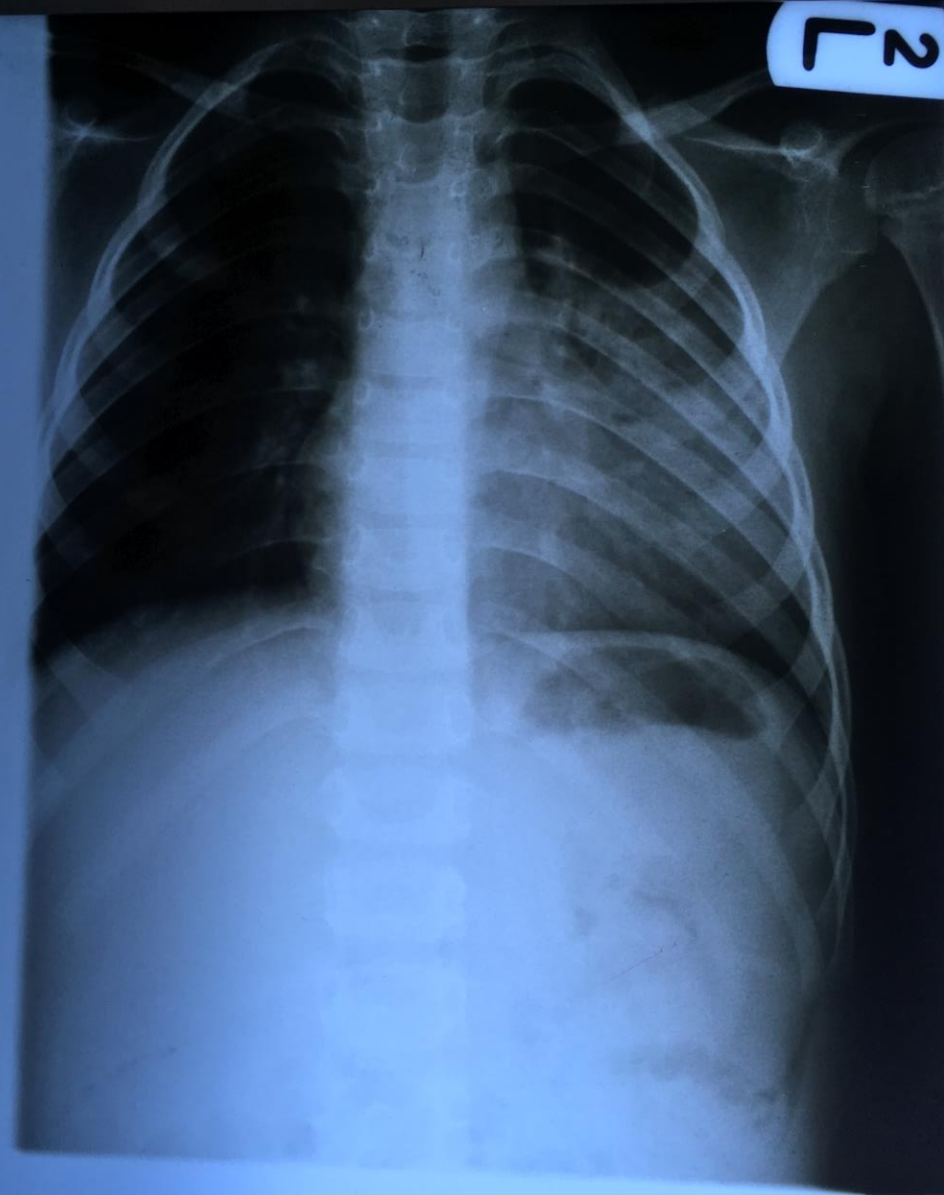
TREATMENT of M. pneumonia.

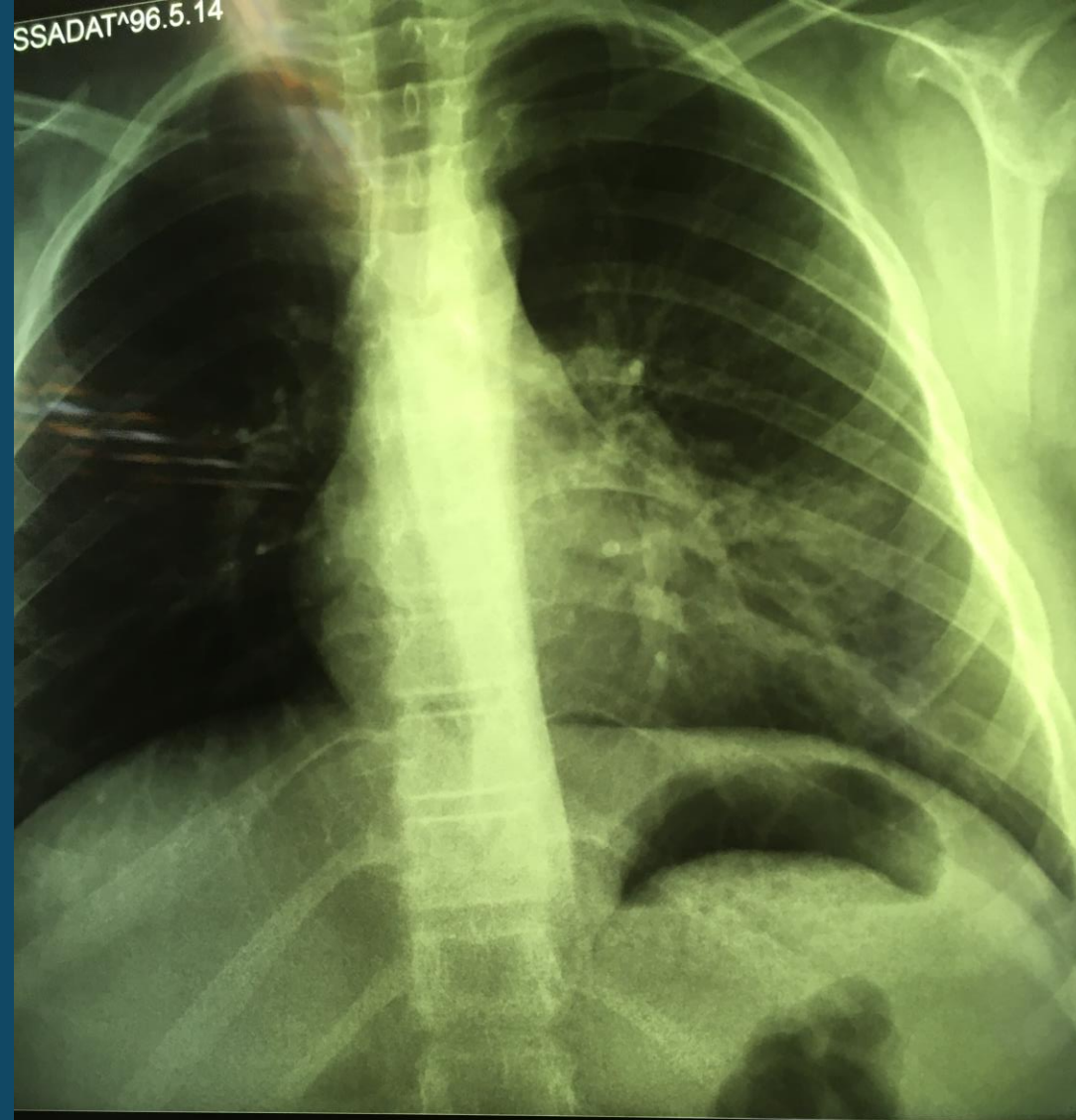


The usual course of antimicrobial therapy for pneumonia
7 to 10 days,

except for **azithromycin**, for which it usually is 5 days.

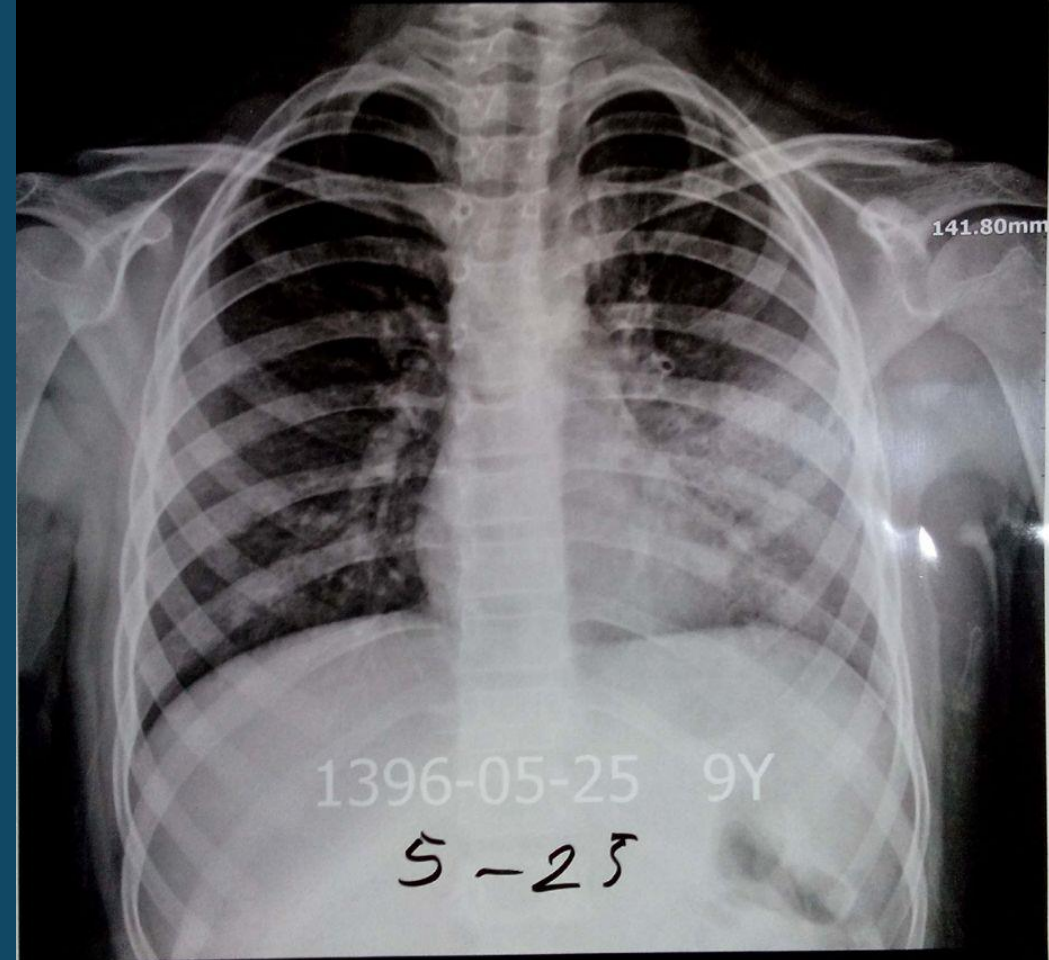
Antimicrobial therapy is not routinely recommended for preschool-aged children with CAP, because viral pathogens are responsible for the great majority of cases.





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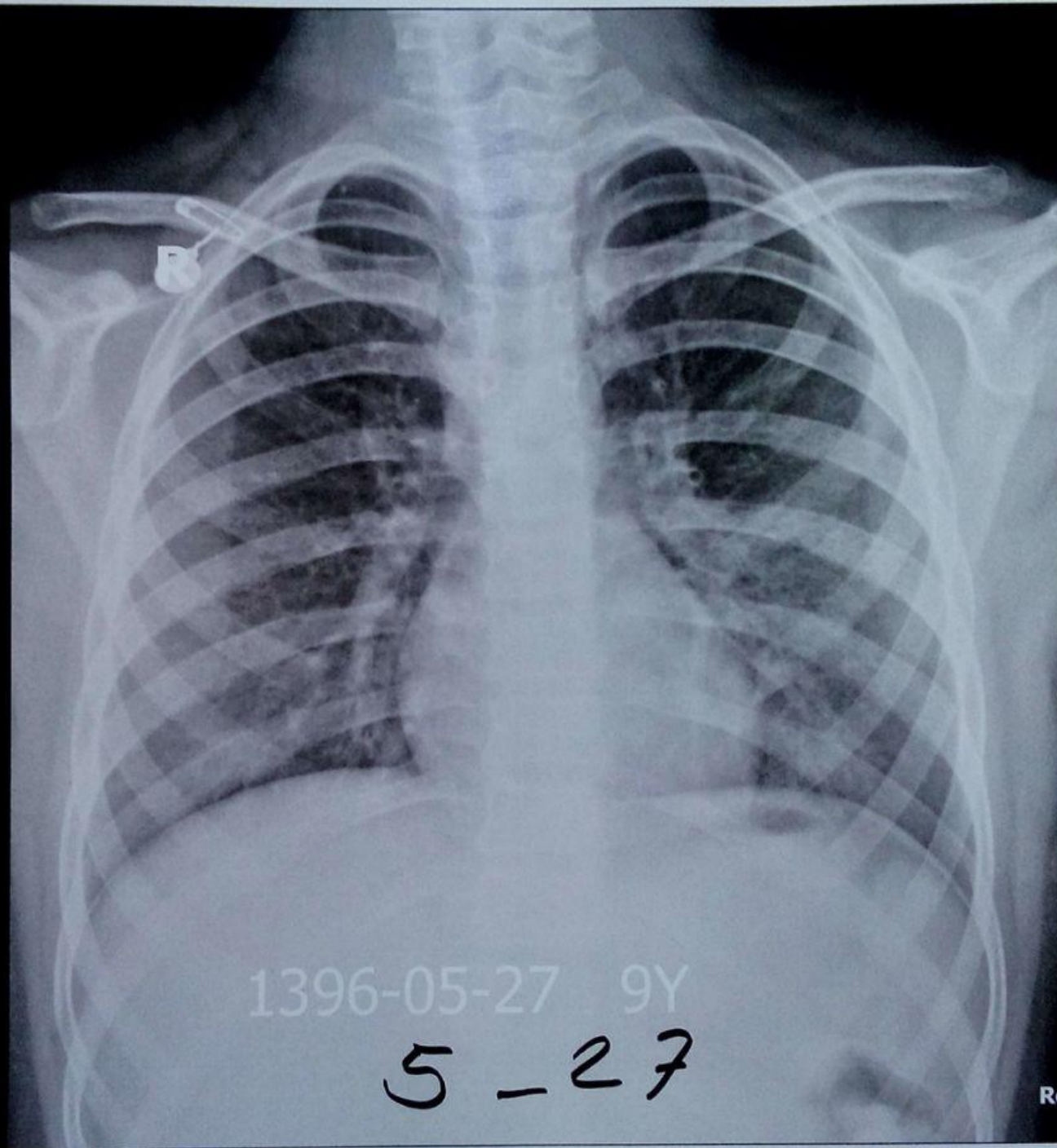
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PARS Hospital
Radiology

Referring Physician : NA
Print Zoom : N/A

