



Management of Pneumonia in Paediatric

Seyedeh Zalfa Modarresi

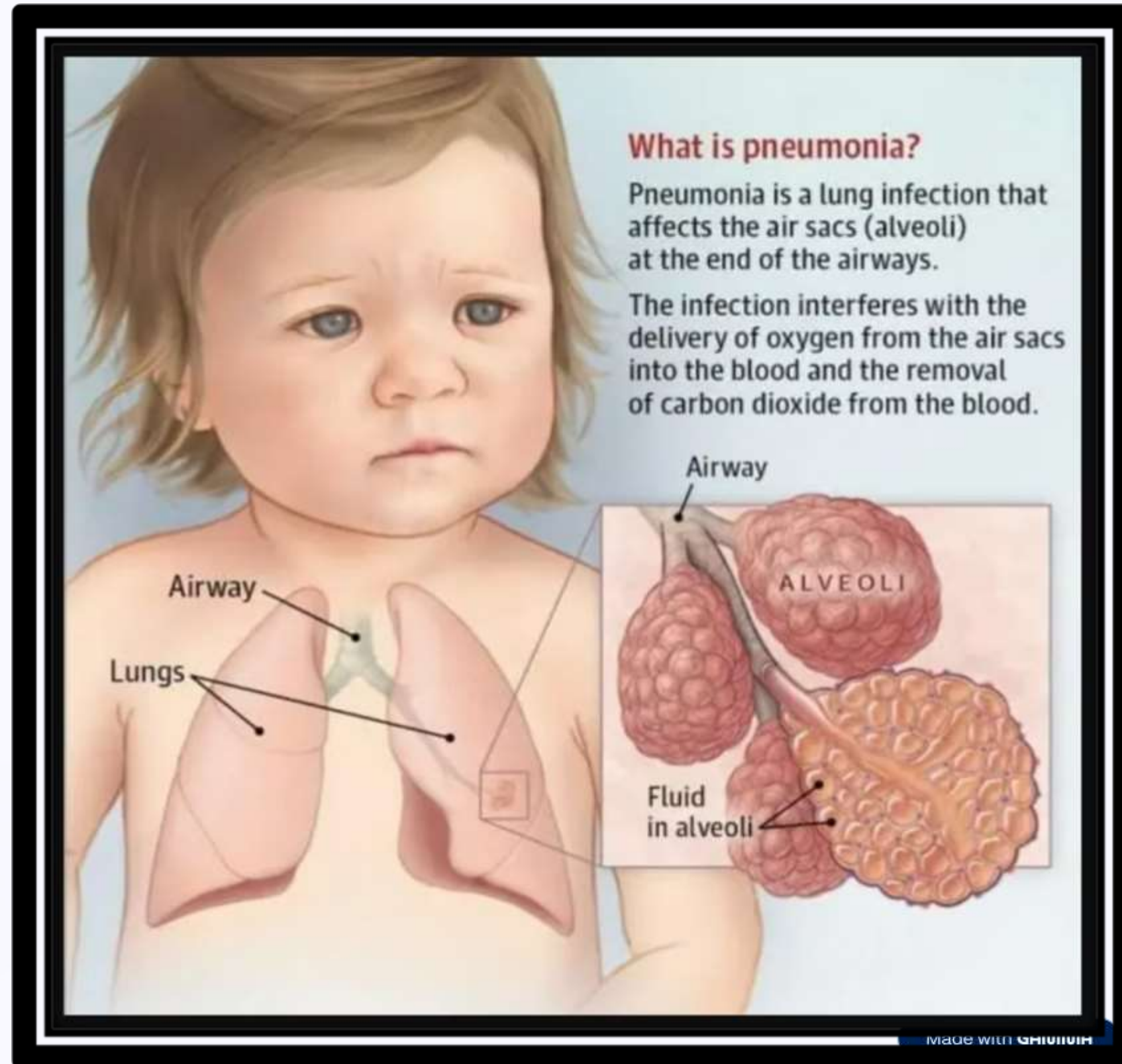
Pediatric Pulmonologist

Shahid Sadoughi University of Medical Sciences

PNEUMONIA

Infection of the lung parenchyma leading to
Inflammation of the lungs

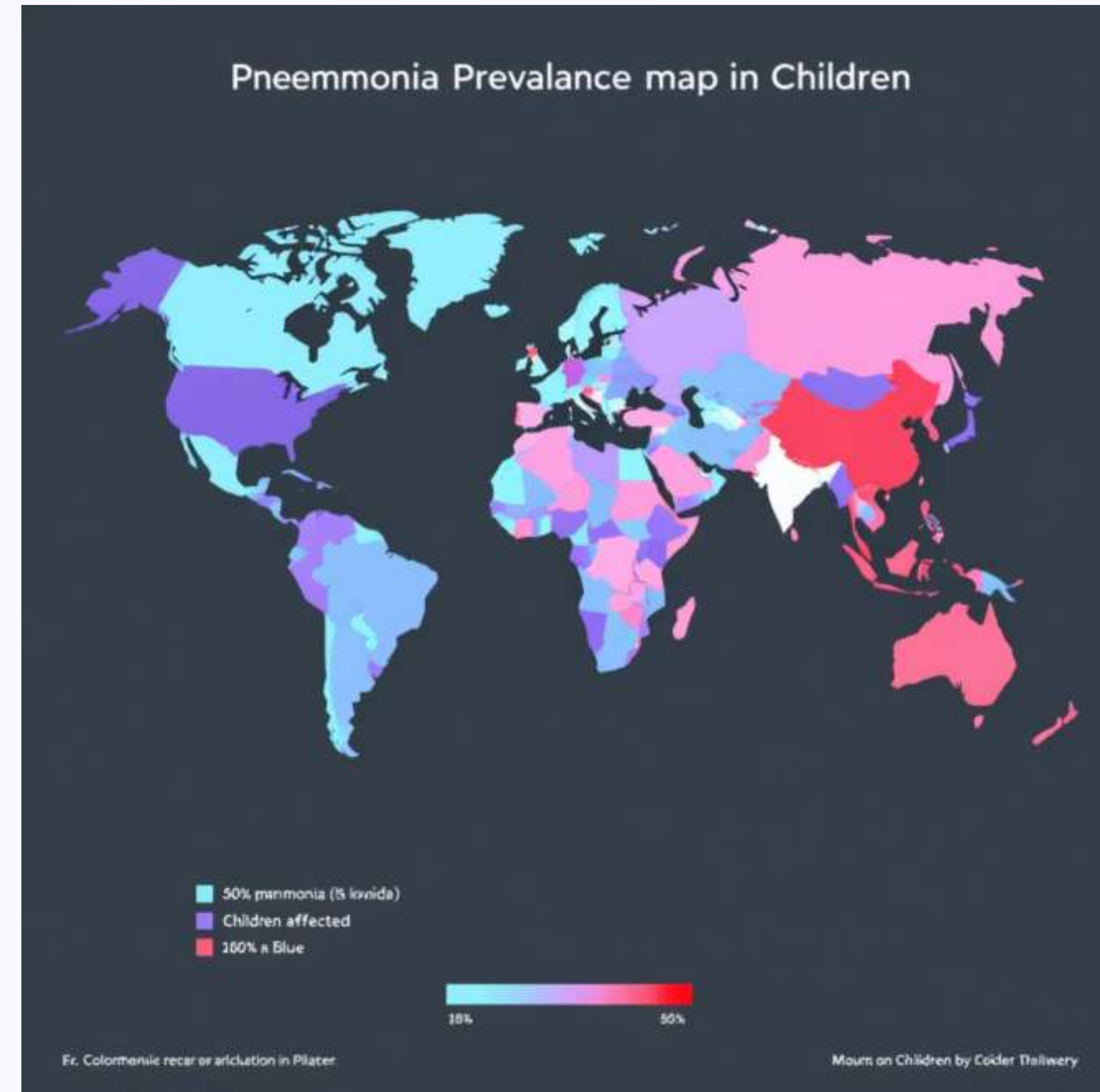
Impairing gas exchange



The Global Impact of Paediatric Pneumonia

- Still second most common cause of childhood mortality worldwide
- Pneumonia accounts for 14% of all deaths of children under 5 years old.
- >80% of all childhood pneumonia deaths occur in children <2 years old
- Incidence of severe pneumonia higher in children < 5 years of age
- Mortality rate 8.7% severe pneumonia
- Incidence higher in boys

✔ Most pneumonia deaths are preventable through early diagnosis, appropriate treatment, and effective prevention strategies.



Etiology



Viral agents:

RSV, Influenza, human metapneumovirus, Parainfluenza, and Adenovirus

most prevalent cause of CAP in childhood particularly during infancy



Bacterial agents:

Streptococcus pneumoniae, most common bacterial cause of CAP

Haemophilus influenzae type b, was a frequent cause of CAP before Hib immunisation

Staphylococcus aureus, an acute severe illness, pneumatoceles and empyema

Group A streptococcal : associated with more severe illness particularly empyema



Atypical organisms:

Mycoplasma pneumoniae and *Chlamydophila pneumoniae*,

More common in older children

The predominant pathogen depends on the **child's age**, immunization status, and exposure history.



Bacterial vs. Viral Etiology

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Typical Bacterial Pneumonia

- Abrupt onset of symptoms
- Fever, chills, cough, focal chest pain
- Some degree of respiratory distress
- Focal lung examination findings

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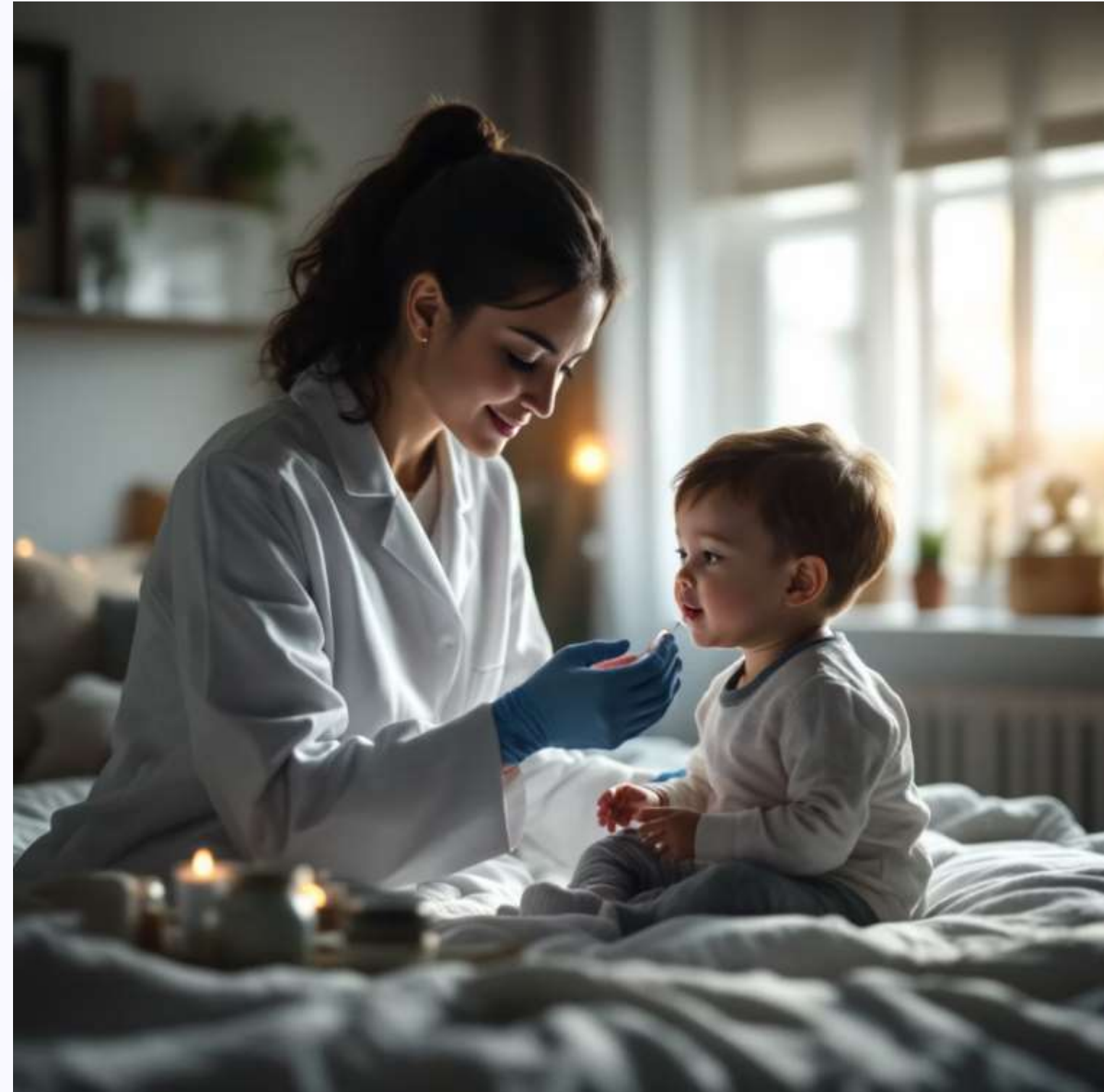
Atypical Bacterial Pneumonia

- Gradual onset of fever, headache, malaise, sore throat
- Cough (usually nonproductive) that gradually worsens
- Often accompanied by wheezing and/or rales
- Fever and illness severity often milder

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Viral Pneumonia

- More common in younger children
- Often preceded by upper respiratory symptoms
- May have diffuse findings on examination
- Wheezing may be present



Aetiology by Age Group

Age	Common Pathogens
Neonates	Group B Strep, E. coli, Listeria monocytogenes
Children <5 years	Viral: RSV, Influenza, Parainfluenza Bacterial: <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>S. Areus</i>
Children >5 years	<i>Mycoplasma pneumoniae</i> , <i>Chlamydophila pneumoniae</i> <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>S. Areus</i>

Viruses are the most common cause in children under 5, but bacterial pneumonia prevalence increases with age.

Clinical Presentation

No single symptom or sign is pathognomic for CAP in children

Fever

Cough

Tachypnoea: relatively specific but not sensitive

- associated with hypoxaemia in infants (>70 bpm)

Respiratory Distress: nasal flaring, chest retractions, grunting

- highly specific for pneumonia

May also present with abdo pain and/or vomiting +/- headache

- Chest examination
- Crackles on auscultation
- Wheeze more common with CAP due to atypical bacteria and virus
- Signs of consolidated lung

vocal resonance, vocal fremitus, reduced breath sounds,
dullness to percussion



Diagnostic Approach



History and Physical Exam

Clinical diagnosis based on cough, tachypnoea, and danger signs. Auscultation may reveal crackles, bronchial breath sounds, or diminished air entry.



Pulse Oximetry

Essential tool in all settings. SpO₂ <92% indicates moderate to severe pneumonia.



Laboratory Tests

Acute phase reactants (C reactive protein, procalcitonin, WBC) may help distinguish viral vs. bacterial, but are nonspecific

Blood cultures in severe cases or infants

- **Microbiological diagnosis:**

with severe pneumonia sufficient to require PICU

with complications of CAP

- blood culture, nasopharyngeal and/or nasal swabs for PCR viral detection, serology for viruses & atypical bacteria, pleural fluid for microscopy, culture and/or PCR



Chest X-ray

Not required for mild, outpatient cases.

Useful in:

hospitalised cases,

Unclear diagnosis,

Suspected complications.

with hypoxaemia

with significant respiratory distress

Hospitalization Criteria

Age Considerations

Infants younger than 3-6 months of age, unless viral etiology or Chlamydia trachomatis is suspected without hypoxemia.

Respiratory Status

Moderate to severe respiratory distress:

<12 months= RR >70 b/min

older children= >50 b/min

Retractions;

Nasal flaring;

Difficulty breathing;

Apnea;

Grunting.

Other Factors

Hypoxemia (SpO₂<90% in room air)

Dehydration

Toxic appearance

Underlying conditions

Caregivers who cannot provide appropriate care.

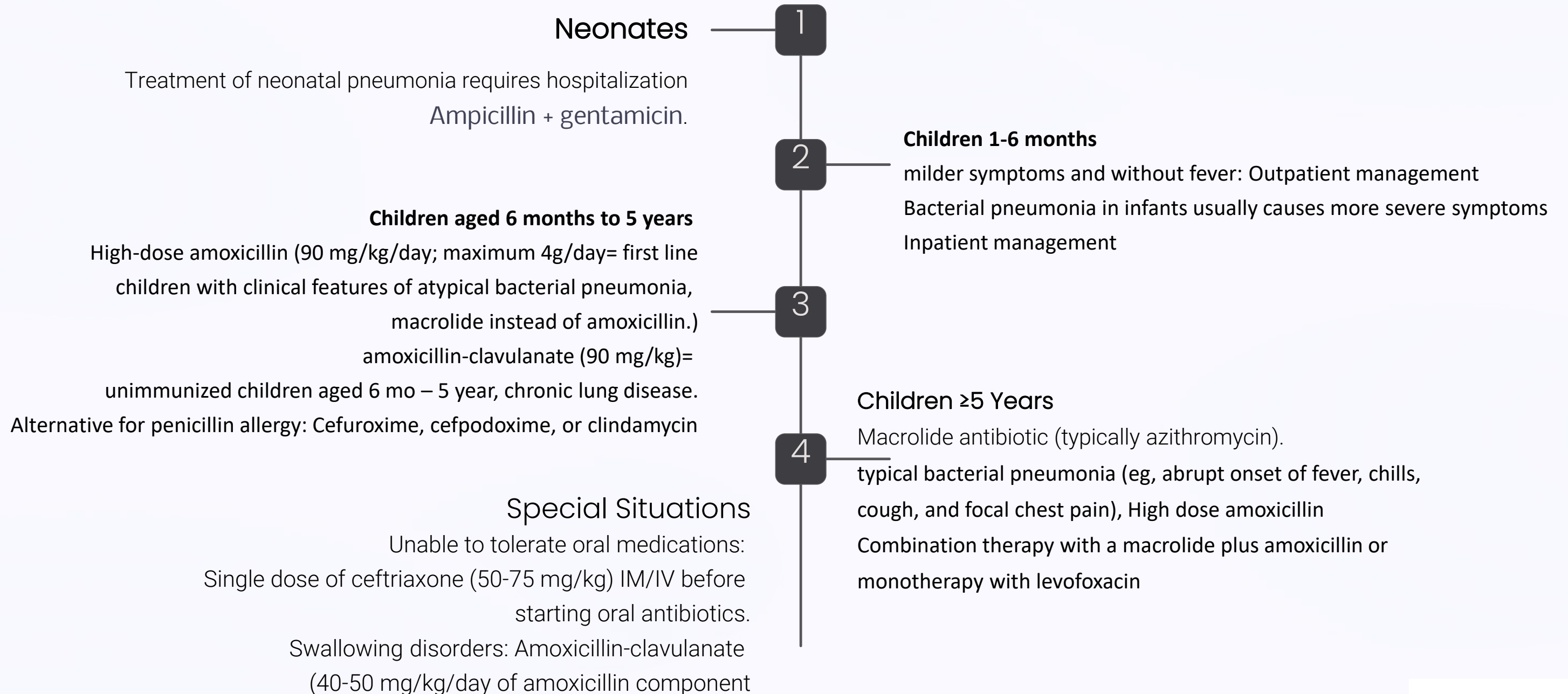
Outpatient if:

- Child is alert, feeding well
- No hypoxia or danger signs
- Age >3 months

The decision to hospitalise a child with community-acquired pneumonia must be individualized based on these factors.

Children with complications, failure of outpatient therapy, or infections with virulent pathogens like Staphylococcus aureus may require intensive care.

Antibiotic Selection by Age Group; outpatient





Supportive Care



Antipyresis & Analgesia

Acetaminophen or ibuprofen to manage fever and pleuritic chest pain, which can lead to shallow breathing and impaired coughing.
Avoid antitussives.



Respiratory Support

Supplemental oxygen for $\text{SpO}_2 < 92-95\%$ to maintain saturation $\geq 95\%$ during respiratory distress. Supported sitting position helps expand lungs.
Monitor for hypercarbia in severely ill patients



Fluid Management

IV fluids for children who cannot maintain adequate oral intake. Monitor for SIADH with serum electrolytes, fluid balance, and urine specific gravity.
Use isotonic fluids if SIADH suspected



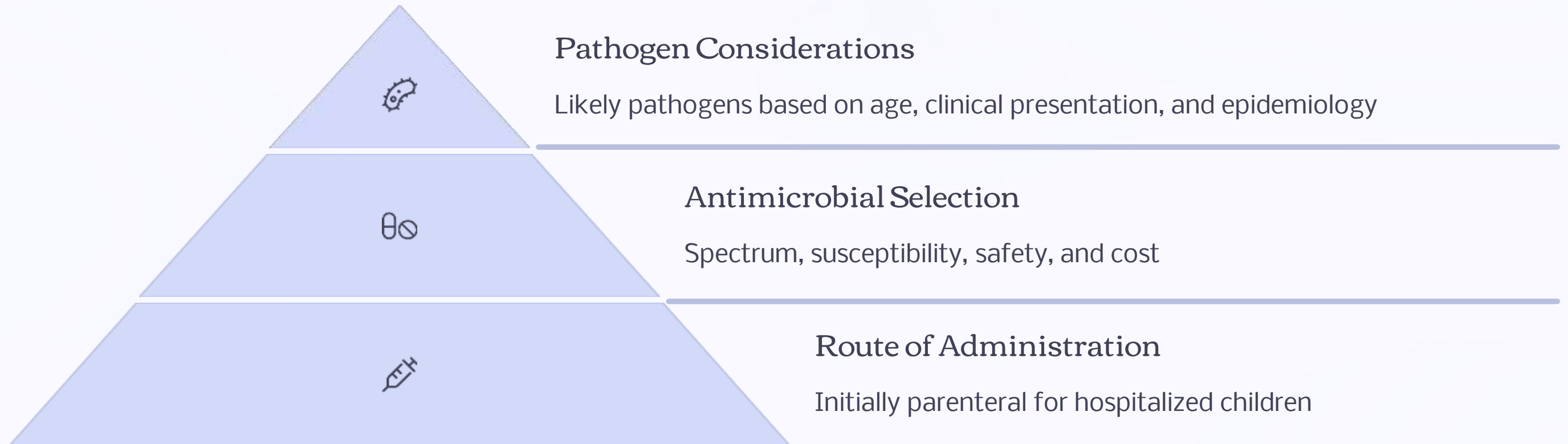
Nebulisers/Bronchodilators

Use **only if wheezing** or reactive airway symptoms are present.
Not routinely indicated for all pneumonia cases.

Supportive care is essential for children hospitalized with pneumonia.

Gentle bulb suction of the nares may help infants with blocked secretions.
Chest physiotherapy is not beneficial for uncomplicated CAP and is not recommended.

Empiric Antimicrobial Therapy



Prompt initiation of antimicrobial therapy is crucial in children with CAP. The initial treatment is empiric.

Duration: 5 - 10 days depending on severity and response. Switch from IV to oral antibiotics once the patient is clinically stable.



Empiric Antimicrobial Therapy

Uncomplicated Bacterial Pneumonia

- Ampicillin or penicillin G for fully immunized children in communities without substantial penicillin-resistant *S. pneumoniae*
- Third-generation cephalosporin (cefotaxime, ceftriaxone) for children <12 months, not fully immunized, or with more severe illness

Severe CAP Requiring ICU

- Vancomycin + third-generation cephalosporin + azithromycin
- Consider adding antiviral therapy during influenza season
- Nafcillin/oxacillin may be preferred if methicillin-susceptible *S. aureus* is likely
- Add vancomycin when MRSA is considered



Duration of Treatment & Response

Treatment Duration

- Uncomplicated cases: 5-7 day course of combined parenteral and oral therapy
- Complicated cases: 3-4 weeks total or 2 weeks after patient is afebrile with clinical improvement
- Switch to oral therapy when afebrile for 24-48 hours and not having emesis

Monitoring Response

- Respiratory status should improve within 48-72 hours
- Fevers may persist for several days despite appropriate therapy
- Consider treatment failure if no improvement after 48-72 hours
- Investigate complications or resistant organisms if failing to improve

Complications and Management

Parapneumonic effusion/ Empyema

Pleural effusion associated with lung infection.

The presence of septations within the effusion, which interfere with free flow of fluid.

Pus accumulation in pleural space requiring drainage and extended antibiotic therapy

Lung Abscess

Localized collection of pus within lung parenchyma requiring prolonged antibiotics

Necrotising Pneumonia

Tissue destruction with multiple small cavities, often requiring specialist intervention

Overview of Management Approach



Initial Assessment

Evaluate size of effusion, respiratory status, and presence of loculations with ultrasound. Determine if hospitalization is needed.



Antibiotic Therapy

All children receive antibiotics. Initial empiric therapy based on likely pathogens, later adjusted based on culture results.



Drainage Procedures

Small effusions may not require drainage. Moderate to large effusions typically need chest tube placement, especially if respiratory compromise exists.



Advanced Interventions

For loculated effusions or empyema, options include fibrinolytic therapy through chest tube or surgical intervention (VATS).

Both medical and surgical interventions have roles in management. The goals of therapy include sterilization of the pleural cavity, resolution of pleural fluid, and reexpansion of the lung. With appropriate treatment, outcomes are generally excellent.



Antibiotic Therapy Considerations

Choice of Agent

Based on likely pathogens for patient's age and community patterns. For community-acquired infections, ceftriaxone or cefotaxime plus clindamycin or vancomycin if *S. aureus* is suspected.

Microbial Diagnosis

Pleural fluid should be cultured when drainage is performed. Additional techniques like PCR may increase yield, especially after antibiotic initiation.



Duration

Individualized based on drainage adequacy and clinical response. Typically continue for at least 10 days after fever resolution; total course of 2-4 weeks is usually adequate.

Route

Initial IV therapy, can switch to oral when afebrile and without chest drain for 2-5 days. Oral antibiotics appear as effective as IV after discharge.

For ill-appearing children, it's particularly important to include vancomycin or clindamycin in the regimen because of the increasing frequency of parapneumonic effusions caused by community-associated methicillin-resistant *S. aureus* (CA-MRSA).

Chest Tube Management



Indications

Large amounts of free-flowing pleural fluid, compromised pulmonary function, loculated effusion, or lack of clinical improvement with antibiotics alone.



Drainage System

All chest tubes should be connected to a unidirectional drainage system, kept below the level of the patient's chest at all times.



Size Selection

Smaller chest tubes (e.g., <14F, including pigtail catheters) are now generally recommended over large-bore tubes to minimize patient discomfort.



Removal Criteria

The chest tube can be removed once there is clinical resolution and minimal drainage (less than 10-15 mL per 24 hours).

Large effusions should be drained gradually, with clamping after initial drainage of 10 mL/kg of fluid. Sudden cessation of fluid drainage may indicate kinking or blockage of the tube, which may be relieved by carefully flushing with normal saline.

Management of Loculated Effusion or Empyema

Fibrinolytic Therapy

Intrapleural fibrinolytic drugs (urokinase, alteplase, streptokinase) lyse fibrinous strands in loculated effusions. Successful in approximately 83% of children.



Video-Assisted Thoracoscopic Surgery (VATS)

Surgical option to remove thick fibrinous septations and drain pus under direct vision. Less invasive than open thoracotomy.

Treatment Decision

Either fibrinolytic therapy or VATS is acceptable as first-line therapy. Guidelines suggest trial of fibrinolytic therapy first, followed by VATS for those failing medical management.

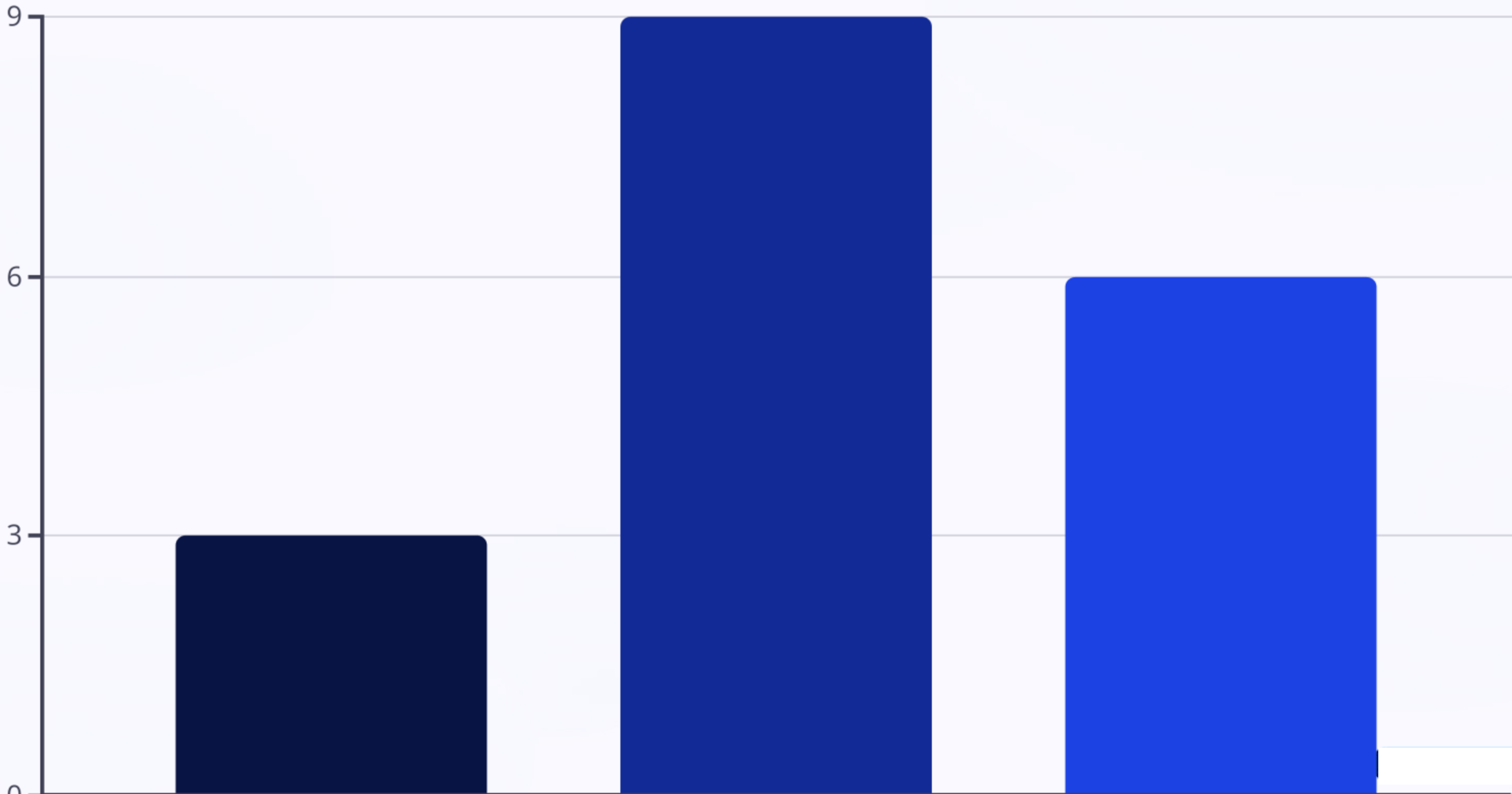


Cost Considerations

Fibrinolytic therapy typically has lower hospital costs than primary VATS, with similar clinical outcomes and length of stay.

Randomized trials have shown no difference in length of hospital stay between fibrinolytic therapy and VATS, but hospital costs were 25% higher for VATS. Long-term outcomes are excellent for both approaches.

Fibrinolytic Therapy Techniques



Prognosis and Long-Term Outcomes

90%

Complete Recovery

Majority of children make a complete recovery despite marked abnormalities at presentation

<10%

Residual Symptoms

Long-term follow-up studies show fewer than 10% of children have persistent symptoms

3.3%

Mortality Rate

For children treated with antibiotics and chest tubes; lower with fibrinolytic or surgical therapy

Children should be followed until they have recovered completely and their chest radiograph has returned to near normal, which usually occurs by three to six months but may take as long as 16 months. Patients may have residual dullness to percussion and diminished breath sounds over the affected areas due to pleural thickening.

Long-term studies show that while some children may have small abnormalities in lung function and exercise capacity shortly after recovery, these are usually of no clinical importance and return to normal within five years, regardless of whether they were managed with chest tube drainage or VATS.

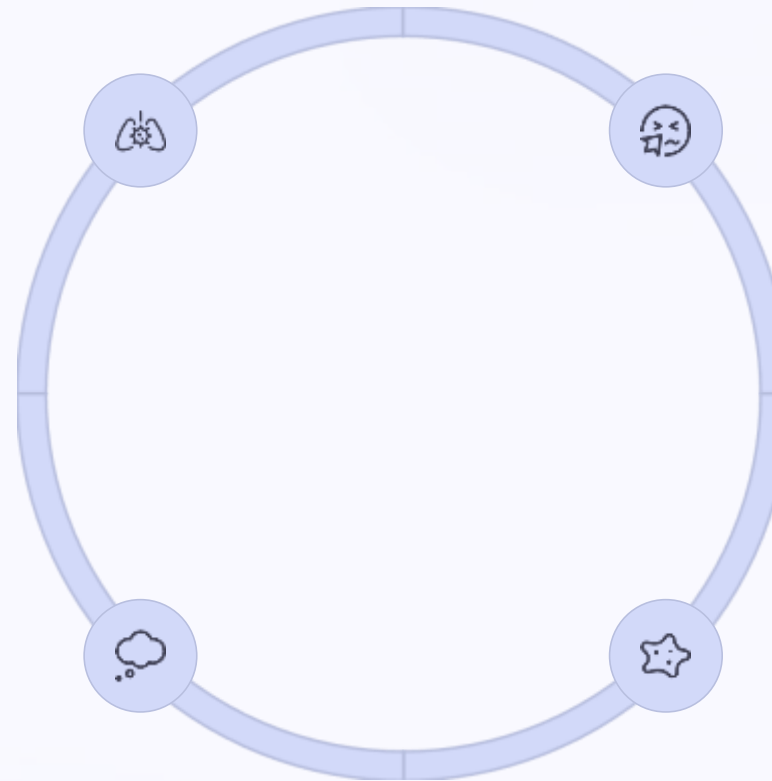
Complicated Pneumonia Management

Parapneumonic Effusion/Empyema

Requires drainage procedures and prolonged antibiotic therapy. Duration determined by clinical response.

Pneumatocele

Most involute spontaneously, though occasionally may result in pneumothorax requiring intervention.



Necrotizing Pneumonia

Requires 4 weeks of antibiotics or 2 weeks after patient is afebrile with clinical improvement. Interventional procedures should be performed cautiously.

Lung Abscess

3-4 weeks of antibiotics or 2 weeks after fever resolution. 80-90% resolve with antibiotics alone. Percutaneous drainage may be needed if no improvement after 72 hours.

Complicated CAP requires broader spectrum antibiotic coverage if etiologies other than *S. pneumoniae* are considered. Coverage for beta-lactam-resistant isolates including CA-MRSA, anaerobes, and gram-negative organisms may be necessary, especially for lung abscess.

Discharge & Follow-up

Discharge Criteria

Respiratory distress resolved, able to maintain oxygen saturation >90% on room air, able to tolerate oral intake, and caregivers can provide appropriate care at home.

Clinical Follow-up

Children should be seen by primary care provider soon after discharge. Cough may persist for weeks to months. Most children recover without sequelae.

Radiographic Follow-up

Not necessary for uncomplicated CAP. Consider for complicated CAP, recurrent pneumonia, persistent symptoms, unusual infiltrates (2-3 weeks after dis.

Outpatient parenteral antimicrobial therapy (OPAT) is an option for selected patients who require prolonged treatment but have stabilized clinically.

Response to Therapy and Follow-up

Monitoring Response

Track temperature, respiratory rate, heart rate, oxygen saturation, work of breathing, chest examination, mental status, and ability to maintain oral intake. Respiratory status should improve within 48-72 hours.

Treatment Failure Assessment

Consider ineffective antibiotic coverage, development of complications, alternative diagnoses, or underlying immunodeficiency. May require additional imaging or more aggressive diagnostic procedures.

Discharge and Follow-up

Discharge when vital signs improve, oral intake adequate, oxygen saturation $\geq 90\%$ in room air, respiratory status improved, and fever decreased for 24-48 hours. Follow-up with primary care soon after discharge.

Follow-up radiographs are not necessary in asymptomatic children with uncomplicated CAP. However, they may be helpful in children with complicated CAP, recurrent pneumonia, persistent symptoms, severe atelectasis, or unusually located infiltrates, typically obtained 2-3 weeks after discharge.

Prognosis and Outcomes

<1%

Overall Mortality

Pneumonia mortality rate in resource-abundant countries is less than 1 per 1000 per year

3%

Readmission Rate

Approximately 3% of children hospitalized with pneumonia are readmitted with pneumonia within 30 days

8%

All-Cause Readmission

8% are readmitted for any reason, more common among children <1 year and those with chronic conditions

Most otherwise healthy children with pneumonia recover without sequelae, even if the pneumonia is complicated.

Cough may persist for several weeks after bacterial pneumonia and up to 3-4 months after viral pneumonia or pertussis. Children may experience moderate dyspnea on exertion for 2-3 months during recovery.

The introduction of pneumococcal conjugate vaccines has resulted in a dramatic reduction (37-80%) in invasive disease and mortality rates



Infection Control Measures



Hand Hygiene

Hand washing is the single most important procedure to prevent the spread of infection in healthcare settings.



Respiratory Precautions

Mask within 3 feet (droplet precautions) for influenza, rhinoviruses, GAS, *S. aureus*, *B. pertussis*, and *M. pneumoniae*.



Contact Precautions

Gown and gloves for respiratory syncytial virus, parainfluenza, and human metapneumovirus. Both contact and droplet precautions for adenovirus.

CAP can be caused by various microbial agents requiring different infection-control measures. If possible, rapid diagnostic tests should be performed at admission to facilitate decisions regarding appropriate precautions. For simplicity with viral respiratory pathogens, placing all patients with suspected viral infection on both contact and droplet precautions is recommended.

Thanks for your attention