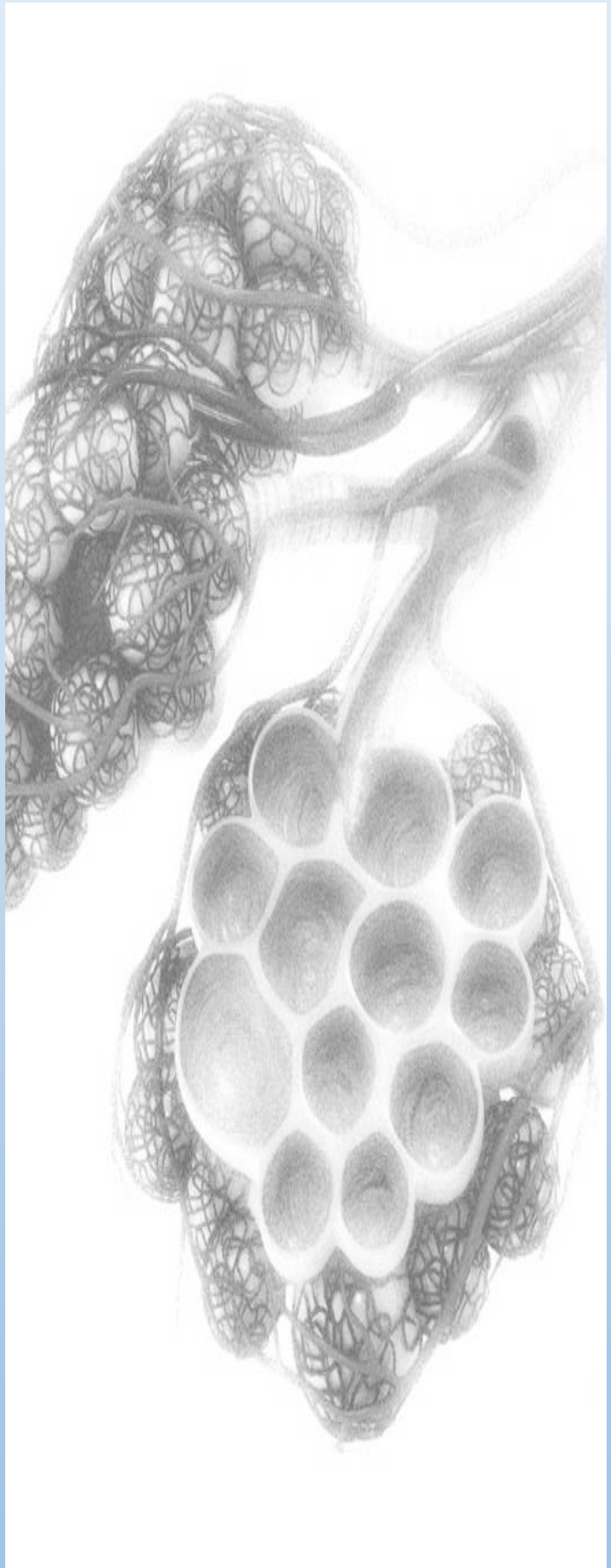


Acute Respiratory Tract Infections in Children

Dr. Ahmed Saeed
Consultant in Paediatrics
IGMH

Ministry of Health
Male' Republic of Maldicves
2022

Acute Respiratory Tract Infections

Author: Dr. Ahmed Saeed, Consultant in pediatric
Indhira Gandhi Memorial Hospital

Reviewers:
Dr. Ahmed Faisal, Consultant in Pediatrics IGMH
Dr. Sanjaya Shreshtha, Senior Consultant in Pediatrics ADK Hospital
Dr. Amit Bishwakarma, Consultant in Pediatrics Tree Top Hospital
Dr. Mohamed Abdel Wahab Areed, Consultant in Pediatrics IGMH

Published by: Quality Assurance and Regulations Division
Document number: MOH-QA/G/22/113-0
Ministry of Health
Male' Republic of Maldives

Table of content

Table of figures

1. Acute Nasopharyngitis (common cold)

A. Introduction

The common cold is a highly infectious viral upper respiratory illness caused by over 100s of different virus types. It is important that clinicians correctly identify the common cold syndrome in children and treat appropriately.

B. Clinical features

The minimal symptoms that define the common cold syndrome

- Nasal discharge, nasal stuffiness
- Throat irritation resulting in a cough

*A purulent nasal discharge **DOES NOT** necessarily indicate bacterial infection.*

Infants are more likely to have an associated fever (38C or more), experience feeding, and sleep difficulties. There is usually little or no fever in older children but they may complain of myalgia, lethargy and anorexia.

The uncomplicated cold has a uniformly excellent outcome with illness duration of about 7 days. A persistent fever with worsening symptoms beyond 7 days may indicate secondary bacterial infection.

C. Investigations

Generally, not required.

D. Management

Common cold is usually a self-limiting viral illness and no specific therapy is indicated.

1. Use of Cough and cold Medicines in children

In 2008, the FDA strongly recommended against giving over-the-counter cough and cold medicines to children **under the age of 2years.** Four different categories of drugs were listed in this recommendation.

- Cough suppressants (dextromethorphan)
- Cough expectorants (guaifenesin)
- Decongestants (pseudoephedrine and phenylephrine)
- Certain antihistamines (Chlorpheniramine maleate, and Diphenhydramine)

2. Home Remedies for cough and Cold

a. Saline Drops

Stuffy and congested nose cause discomfort with breathing, sleeping, eating. Saline nasal drops help with nasal decongestion of nasal mucosa and clearing of mucus

b. Maintain adequate hydration.

During illness children require to drink more fluids to keep them hydrated adequate this helps to prevent nasal stuffiness and thinning air way secretions and easy clearance.

Infants under 6 months are best to be exclusively breastfed.

Most drinks like water, fresh fruit juice, milk, etc. are fine. Warm liquids like chicken soup, juice and ginger have smoothening effects

c. Honey

It soothes sore throats and eases coughs. Give 1/2 to 1 teaspoon of honey before bedtime.

Should not be given to children under 1 year of age.

d. Humidifier

Moisture in the air makes it easier to breathe,

Cool-mist models are safer than those that produce steam.

e. Serve Easy to swallow Foods

Infants and toddlers with nasal congestion and sore throats often refuse to accept feeds. Feed them soft, smooth foods that go down more easily.

f. Adequate rest

To ease congestion, keep the child's head elevated when resting.

g. Camphor and menthol

These are natural ingredients that are long being used for treatment of cough. They usually come in an ointment you rub on your throat and chest. Their strong-smelling vapors help to ease cough, but it should be used cautiously

h. **Avoidance of environmental and tobacco smoke. Steam inhalation is generally not advisable, as risk of burn injury is high.**

Table. 1 Table Symptomatic treatment for common cold

	Drug	Dose	Caution
Fever	Paracetamol	10-15mg/kg/dose 6-8hrly	No Aspirin/NSAID
Decongestion (local)	Saline drops (for infant <12m) Oxymethazoline 0.001% (1-2yr) Oxymethazoline 0.002% (>2 yr)	1-2 drops 4-6hrly and SOS 1-2 drops TDS for 3 to 5 days 1-2 drops TDS for 3 to 5 days	Use only topical form. Avoid prolonged use
Rhinorrhea/cough	Cetirizine (age > 6mo) Fexofenadine 6-12months 1-2years 2-10 years	0.1-0.2mg/kg HS 10-15mg BD 15-30mg BD 30-60mg BD	Generally, avoid sedating antihistamines in <2yrs age.
	Dextromethorphan	6-12yrs 15mg TDS >12 yrs 30mg TDS	Generally no medicine required.

2. Acute upper respiratory tract infections

A. Introduction

Acute upper respiratory tract infections (URTI) are uncommon in children less than 1 year of age. The incidence increases to a peak at 4-7 years. Viruses remain the most common cause for URTI. Group A beta-hemolytic Streptococcus (GABHS), the most important bacterial cause of sore throat is accountable for 10-20 percent of children with sore throat.

B. Clinical features

Clinical features strongly suggestive of a **viral etiology**

- Conjunctivitis, rhinitis, cough, hoarseness, coryza
- Stomatitis, oral ulcers and rash
- Diarrhoea and vomiting

Clinical features strongly suggestive of **streptococcal pharyngitis**

- Fever, diffuse redness of the tonsils and pharyngeal exudates
- Tender, enlarged anterior cervical lymph nodes

When a membranous exudate is present on the tonsils, consider diphtheria especially in the under-immunized child, and infectious mononucleosis.

A syndrome of purulent nasal discharge, pharyngitis and persistent fever may be associated with secondary infection with S. pneumococcus or H. influenza

C. Investigations

Generally, no investigation required

D. Management

1. General measures

Provide a full explanation of the likely course of the illness to the parents.

Children can be treated at home unless he/she is unable to drink, has stridor, or develops complications.

Ensure adequate oral hydration.

Adequate analgesia with paracetamol is usually all that is required

2. **Antibiotic therapy**

Antibiotic therapy should not be routinely prescribed for all children with sore throat. However, antibiotics should not be withheld if the clinical condition is severe or GABHS is suspected.

If GABSH pharyngitis is suspected, a 10-day course of penicillin group antibiotic is the treatment of choice

Recommended oral antibiotic therapy in GABHS pharyngitis

- Amoxicillin 25mg/kg every 8 hours daily for10 days or
- Ampicillin 25mg/kg every 6 hours daily for 10 days

Other antibiotics namely macrolides and Cephalosporins have also been shown to be effective and may be given for a shorter duration. (Please refer to table 11)

3. **Adjunctive therapy** (refer to table 1)

- Relieve nasal congestion.
- Oral antihistamines
- Cough suppressants. (Use of codeine preparation is strongly discouraged in children and young infants)

4. **Complications**

The complication rate is low in viral infection but secondary purulent bacterial otitis media may occur.

- Sinusitis, otitis media
- Cervical adenitis
- Peritonsillar abscess (quinsy), retropharyngeal abscess
- Pneumonia.

Acute glomerulonephritis and rheumatic fever may follow streptococcal infections. It is important to treat suspected GABHS pharyngitis with adequate dose and duration of the appropriate antibiotics as acute rheumatic fever and rheumatic valvular heart disease can be health problems later in life

3. Croup

A. Introduction

Croup affects children between 6 months to 6 years with the peak incidence between the age of 1-2 years. Common etiological agents are parainfluenza virus, respiratory syncytial virus, influenza virus, adenovirus, enterovirus, measles, mumps and rhinoviruses. Corynebacterium Diptheriae may cause the croup, especially in unvaccinated children

B. Clinical features

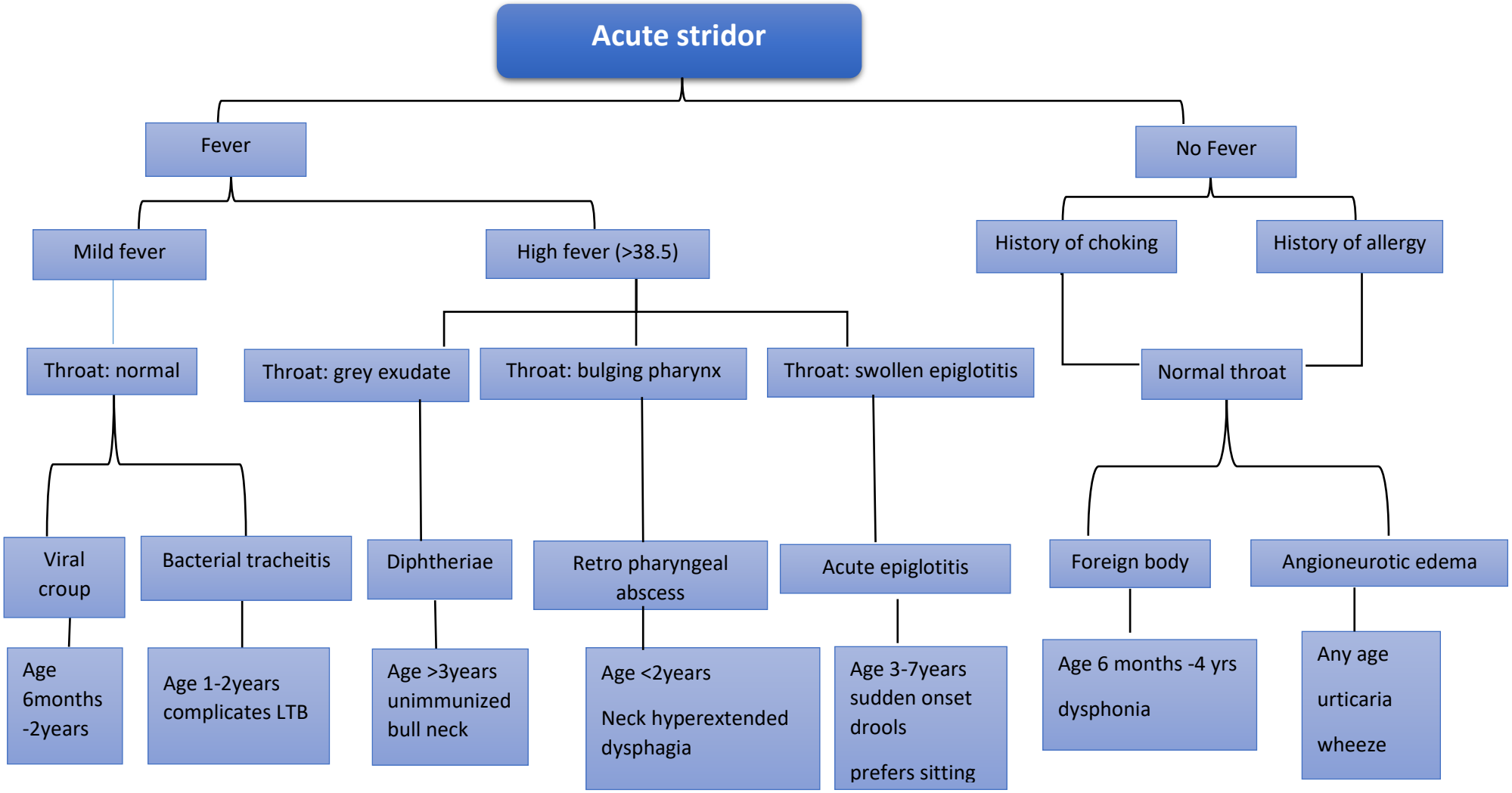
- The illness begins with a low-grade fever and a prodrome of cough and coryza for 12-72 hours
- Increasingly bark-like cough and hoarseness
- Stridor that may occur when excited, at rest or both
- Respiratory distress of varying degree

C. Investigations

The diagnosis is most importantly made on clinical grounds.

Routine blood investigation and neck radiograph is not necessary, unless the diagnosis is in doubt, such as in the exclusion of a foreign body.

Flowchart 1. Approach to the differential diagnosis of acute onset stridor



A. Differential diagnosis

Viral croup is the commonest cause of acute onset stridor. However other conditions have to be considered in the differential diagnosis

- Acute epiglottitis
- Bacterial tracheitis
- Foreign body aspiration

B. Management

Table. 2 Assessment of severity of viral croup

Mild	**Stridor with excitement and not at rest, with no respiratory distress**
Moderate	Stridor at rest with intercostal, subcostal or sternal recession
Severe	Stridor at rest with marked recession, decreased air entry and altered level of consciousness

The management of croup requires a calm and reassuring approach

1. Indications for hospital admission

- Moderate and severe croup.
- Toxic looking
- Poor oral intake
- Age less than six months

2. Corticosteroid therapy

Oral dexamethasone and nebulized budesonide are equally effective and may even be additive in their efficacy when given together There is significant improvement in the following outcomes:

- Dexamethasone 0.15mg/kg PO or IV STAT
- Prednisolone 1-2mg/kg PO OD 3-5 days
- Budesonide 2mg nebulize single dose only

3. Nebulized Adrenaline

- Only for severe cases.

- The recommended dose is 0.5 mg/kg, to a maximum of 5mg of 1:1000 adrenaline.
- Normal saline can be used as a diluent.
- The effect comes on within 30 minutes and lasts for about 2 hours.

Caution!

Nebulized adrenaline should generally not be given to children with congenital cyanotic heart disease especially those with right outflow obstruction.

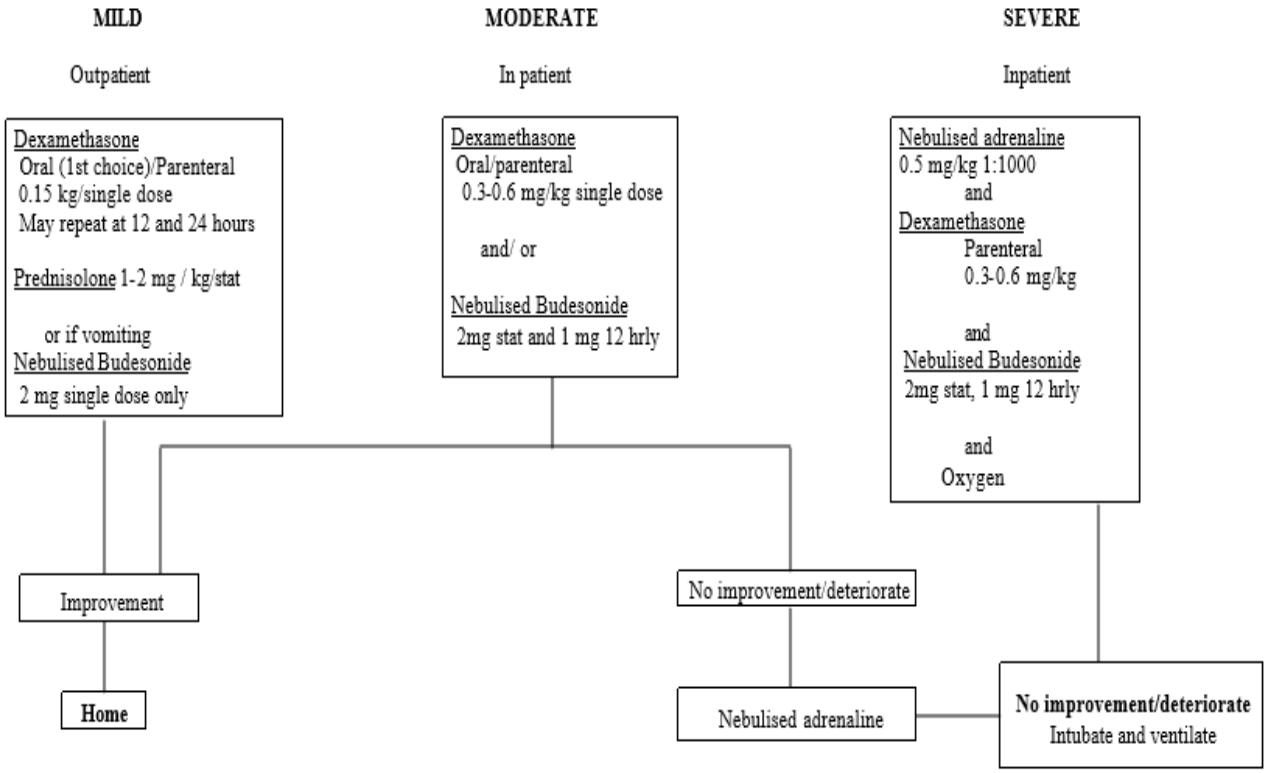
4. Oxygen Therapy

- For Severe croup
- When SpO2 < 92%

5. Antibiotic

It is not recommended unless secondary bacterial infection is strongly suspected or if the patient is very ill and toxic-looking.

Flowchart 2. Management of viral croup.



6. Complications

Croup is essentially a benign self–limiting condition.

Complications occur in about 15% of patients and include:

- Otitis media
- Secondary bacterial tracheitis
- Pneumonia
- Respiratory failure

7. Prevention

- Exclusive breastfeeding for 6 months
- Continuation of breastfeeding till 2 years of age
- Annual influenza vaccination

4. Bronchiolitis

A. Introduction

It is defined by AAP as "a constellation of clinical symptoms and signs including a viral upper respiratory prodrome followed by increased respiratory effort and wheezing.

Common in children less than two years of age.

Respiratory Syncytial Virus remains the commonest cause.

Diagnosis is purely clinical, based on typical history and examination.

Clinical manifestations closely resemble those of an older child with asthma

Risk factors for more serious illness

- age at presentation less 3 months
- underline chronic lung and heart disease
- chronic neurological conditions
- immunodeficiency

B. Clinical features

Bronchiolitis typically presents with a mild coryza, low grade fever and cough followed by onset of respiratory distress and one or more of:

- Tachypnea
- Chest wall Retractions
- Widespread crackles or wheeze

Parents usually report that the infant may sound "chesty" especially at night and may appear breathless after feeding.

Infants with any of these risk factors are more likely to deteriorate rapidly and require escalation of care. Consider hospital admission even if presenting early in illness with mild symptoms.

1. Infants at high risk for severe respiratory distress

- History of prematurity less than 36 weeks gestation
- Congenital heart and lung diseases
- chronic neurological conditions
- Underlying immunodeficiency
- Age less than 3months

2. **Assessment of severity**

A quick and careful assessment the child is essential in order to stratify severity and guide level of treatment needed.

The more signs and symptoms the child has at presentation, the more likely that the is going to develop in to severe disease requiring admission.

Table. 3 Assessment of severity of bronchiolitis.

Clinical features	Mild	Moderate	Severe
Behavior	Normal	Intermittent irritability	Lethargy/fatigue
Respiration rate	Normal to mild tachypnea	Increased RR	Markedly increased or decreased RR
Use of accessory muscles	Nil or minimal chest wall retraction	Mod. Chest wall/ suprasternal retraction Nasal flaring	Marked chest wall/ suprasternal retraction Marked nasal flaring
Spo2 in room air	>92%	90-92%	<90%
Apneic episodes	none	May have brief apnea	Increasingly frequent and prolonged
Feeding	Normal	May have difficulty with feeding	Unable to feed

C. Differential diagnosis

- Airway obstruction (e.g., adenoidal hypertrophy croup, foreign body)
- Asthma,
- Pneumonia
- Congestive heart failure

D. Investigations

In most children with acute bronchiolitis investigations are generally not required.

Investigations should only be undertaken when there is diagnostic uncertainty.

1. Chest x -ray

Required for children with severe respiratory distress requiring intensive care.

Unusual clinical features.

Underlying cardiac or chronic respiratory disorder.

2. Blood gas

Helpful in severe respiratory distress to assess gas exchange and acidosis.

3. Nasopharyngeal aspirates

Virus isolation can support diagnosis and help with surveillance

E. Management

The cornerstone of bronchiolitis treatment remains supportive care.

Most infants with mild bronchiolitis require no specific treatment and can be successfully treated at home.

Infants with moderate to severe respiratory distress are often hospitalized.

Table 4. Management of bronchiolitis based on severity

	Mild	Moderate	Severe
Likelihood of admission	Suitable for discharge Consider risk factors	Likely admission. May be discharged after observation. (Should not be discharged without seen by pediatrician)	Requires admission, possibly in PICU
Monitoring RR, HR, T and SPO2	Adequate assessment in ER prior to discharge (at least four hourly)	One to two Hourly Once improving and not requiring O2 for 2 hours, discontinue	Continuous cardiorespiratory (including oximetry) monitoring and close nursing observation
Hydration/nutrition	Small frequent feeds	If not feeding adequately, administer NG hydration	unable to feed, administer NG hydration

SpO2/oxygen requirement	Nil	Administer O2 to keep SpO2 >92%.	Administer O2 to keep SpO2 >92%.
Respiratory support	Nil	Begin with NPO2 HFNC to be used only if NPO2 has failed	Consider HFNC or CPAP
Disposition/escalation	review if child develops increasing severity after discharge	Consider to admit (clinical assessment+ risk factors)	Consider PICU admissions if Condition not improve, persistent desaturation recurrent apnea
Parental education	Course of illness When to return (worsening symptoms and inability to feed adequately)	Course of illness When to return (worsening symptoms and inability to feed adequately)	Course of illness When to return (worsening symptoms and inability to feed adequately)

The decision to determine hospitalization in viral bronchiolitis is essentially clinical

Table. 5. Criteria Guideline for Hospital Admission in Viral Bronchiolitis

Clinical features	Home Management	Hospital management
Age < than 3 months	No	Yes
Toxic – looking	No	Yes
Chest recession	Mild	Moderate/Severe
Central cyanosis	No	Yes
Wheeze	Yes	Yes
Crepitation on auscultation	Yes	Yes
Feeding	Well	Difficult
Apnea	No	Yes
Oxygen saturation	>95%	<92%
High risk group	No	Yes

1. Supplemental oxygen

- Careful assessment of the respiratory status and oxygenation are the most critical aspects of caring for children with viral bronchiolitis.
- Arterial oxygenation as ascertained by pulse oxymetry and maintained above 93%.
- Oxygen therapy should be instituted when oxygen saturations are persistently less than 90%
- Heated humidified high flow oxygen via nasal cannula can be considered if SpO2 <90%.
- Oxygen can be discontinued, once improving and not requiring oxygen for 2 hours.
- Continue other observations 2-4 hourly and reinstate intermittent oxygen monitoring if deterioration occurs

2. Monitor for signs of impending respiratory failure

- Inability to maintain satisfactory SpO2 on inspired oxygen of more than 40%
- Rising PCO2.
- Very young infants are at risk of apnoea

3. Nutrition

- Infants admitted with viral bronchiolitis frequently have poor feeding, are at risk of aspiration and may be dehydrated.
- If an infant can breastfeed, this should be highly encouraged, as it contributes to hydration and confers immunologic advantages.
- Small frequent feeds if tolerated can be allowed in children with mild to moderate respiratory distress.
- When non-oral hydration is required nasogastric (NG) hydration is the route of choice

4. IV Fluid therapy

Given to children with severe respiratory distress, cyanosis and apnoea.

Should be restricted to two-thirds maintenance requirement, in the absence of dehydration.

Should be isotonic with added glucose

5. Nebulized Bronchodilators

There is no definitive evidence to support the routine use of nebulized bronchodilators in the treatment of viral bronchiolitis.

Nebulized racemic adrenaline, which has both alpha and ß2 agonist effects, appears superior to salbutamol.

The efficacy of anticholinergic agents i.e., ipratropium bromide in viral bronchiolitis has been disappointing

6. IV Corticosteroid therapy

The role of corticosteroid therapy in acute bronchiolitis remains unresolved.

Use of systemic corticosteroid has possible benefits in severe bronchiolitis resulting in a reduction in the clinical scores and length of hospital

- Dexamethasone 0.15mg/kg OD 3days

7. Nasal suction

Children with bronchiolitis often suffer from copious, thick nasal secretions.

Superficial nasal suction may be considered in those with moderate disease to assist feeding

Nasal saline drops may be considered at time of feeding

Nasal suction is not routinely recommended.

8. Mucolytic therapy

Nebulized hypertonic (3%) saline is thought to improve mucociliary clearance by causing osmotic movement of water.

Nebulization with 3% saline had a significantly shorter mean length of hospital stay and improved clinical severity scores compared to those who received nebulized normal saline

Dose: 3% solution 4ml inhaled every 2 hours for 3 doses, followed by 4hourly 5 doses and continued 6hourly till discharge

9. Antibiotic therapy

Although secondary infection is uncommon, dual infection with RSV and bacteria or other organisms should be considered in the presence of atypical clinical or radiological features. Antibiotic therapy is recommended for all infants with

- Recurrent apnea and circulatory impairment
- Possibility of septicemia
- Acute clinical deterioration
- High white cell count
- Progressive infiltrative changes on chest radiography.

10. Sedation

It should not be used unless the infants is intubated and receiving positive pressure ventilation.

11. Mechanical ventilation

When supportive cares fail to improve clinical condition of the child with moderate to severe respiratory distress, and respiratory failure is imminent, assisted ventilation is the next step.
Endotracheal intubation and mechanical ventilation is the time-honored intervention.

12. Indications for referral.

- Severe bronchiolitis (see above)
- Risk factors for more severe illness
- Recurrent apnea
- Children requiring care above the level of comfort of the local hospital
- Children whose O2 requirement is >50%

13. Discharge criteria

- Children can be discharged when they are
- Maintaining adequate oxygenation in room air
- No respiratory distress
- Maintaining adequate oral intake

14. Prevention

a. Breastfeeding

- Breast milk has been shown to have neutralizing activity against RSV, containing RSV immunoglobulins A and G, as well as interferon-*α.*
- Hence, exclusive Breastfeeding for 6 months and continuing breastfeeding till 2 years of age should be the very fundamental preventive measure.

b. Hand hygiene

- Frequent, thorough, and consistent hand hygiene has been shown to reduce the nosocomial spread of RSV.
- This is a key infection-control principle both in the health care setting and in the home.

5. Community acquired bacterial pneumonia

A. Introduction

Community-acquired pneumonia (CAP) is one of the most important health problems affecting children worldwide and is the leading single cause of mortality in children younger than 5 years of age Pneumonia cause up to 5 million deaths annually among children less than 5 years old in developing nations. Low birth weight, malnutrition, poor environmental factors and tobacco smoke are risk factors for developing pneumonia. This section discusses bacterial pneumonias acquired in the community environment in children beyond the neonatal period

1. Case definitions of pneumonia

Pneumonia is defined clinically as the presence of persistent or repetitive fever, cough and tachypnea at rest (and retractions in younger children) when clinical wheezing syndromes have been ruled out.

"Complicated pneumonia" occurs when there is a complication such as para-pneumonic effusion, empyema, lung abscess, or necrotising pneumonia.

Bronchopneumonia is a febrile illness with cough, respiratory distress with evidence of localized or generalized patchy infiltrates on chest x-ray.

Lobar pneumonia is similar to bronchopneumonia except that the physical findings and radiographs indicate lobar consolidation.

2. Etiology

Viral pneumonia cannot be distinguished from bacterial pneumonia based on a combination of clinical findings.

The majority of lower respiratory tract infections that present for medical attention in young children are viral in origin such as respiratory syncytial virus, influenza, adenovirus and parainfluenza virus.

Table 6. Pathogens causing pneumonia

Age	Bacterial Pathogens
Newborns	Group B streptococcus, Escherichia coli, Klebsiella species, Enterobacteriaceae
1- 3 months	Chlamydia trachomatis, *Ureaplasma urealyticum, Bordetella pertussis* and Viruses

3 to 12 Month	Viruses, *Streptococcus pneumonia, H-influenza, Staphylococcus aureus Moraxella catarrhalis*
1 to 5 years	Viruses, *S. pneumonia, M. pneumonia, C. pneumonia,* H-influenzae type B, Staphylococcal aureus, Pseudomonas aeruginosa
>5years	Mycoplasma pneumoniae, Chlamydia pneumonia, *S. pneumoniae*

B. History:

- Persistent fever
- Tachypnea at rest
- Cough
- Increased work of breathing/respiratory distress
- Lethargy/ unwell appearance

Examination:

- Hypoxemia (<92%) on pulse oximetry
- Crackles and bronchial breathing on auscultation
- Increased respiratory rate for age
- Chest wall indrawing, retractions, grunting, nasal flaring
- Apnea
- Absent breath sounds and a dull percussion note suggest a pleural effusion

Table 7. Definition of Tachypnea

Age	Respiratory rate
0-2months	>60breaths/min
2-11months	>50breaths/min
1-5years	>40breaths/min

Table 8. Classification of the severity of pneumonia

Signs or symptoms	Classification	Treatment
Cough or difficulty in breathing with at least 1 of the following: **1. Central cyanosis or SPO2 <90%** **2. Severe respiratory distress (e.g grunting very severe chest indrawing)** **3. Sing of pneumonia with danger sign (poor feeding, lethargy, decreased level of conscious ness, convulsion)**	Severe Pneumonia	Admit to hospital Manage airway as appropriate Give O2 to keep SPO2 >90% Antibiotics (see tables
Fast breathing (Ref table tachypnea) **Chest indrawing**	Non-severe Pneumonia	Admit if age <2months Home care if age >2months Give appropriate antibiotic (refer tables) Follow after 3 days Advise to return immediately if symptoms of severe pneumonia
Cold, cough **No sign of pneumona/severe pneumonia**	No pneumonia	Home care Symptomatic treatment Follow up after 5 days if not improving If cough last more than 14days, evaluate for chronic cough

C. Differential diagnosis

Pneumonia should be suspected in every child presenting with fever, cough, tachypnea, respiratory distress, and crackles on chest auscultation. Other differential diagnosis may include;

- Bronchiolitis
- Asthma
- Cardiogenic causes of tachypnea

- Chemical pneumonitis, especially secondary to aspiration syndromes
- Tuberculosis
- COIVD 19/MISC

D. Investigations

Children with bacterial pneumonia cannot be reliably distinguished from those with viral disease on the basis of any single parameter; clinical, laboratory or chest radiograph findings.

1. Chest radiograph

Chest radiographs are standard practice in both hospitalized and OPD children for whom a diagnosis of pneumonia is being considered

2. Complete white blood cell and differential count

- This test may be helpful as an increased white blood count with predominance of polymorphonuclear cells along the high C-reactive protein are seen in children with bacterial pneumonias.
- However, there is great overlap with viral pneumonia, meaning that these findings are of little help clinically in the individual child

3. Serum electrolytes

Pneumonia can be complicated by hyponatremia secondary to SIADH ecretion

4. Blood culture

Blood culture remains the non-invasive gold standard for determining the precise aetiology of pneumonia. However the sensitivity of this test is very low. Blood culture should be performed in severe pneumonia or when there is poor response to the first line antibiotics.

5. Other tests

Bronchoalveolar lavage is usually necessary for the diagnosis of Pneumocystis carini infections primarily in immunosuppressed children. It is only to be done when facilities and expertise are available.

6. Serological studies

M. pneumoniae, C. pneumoniae, S. pneumoniae, Legionella and Moxarella catarrhalis are difficult organisms to culture, and thus should be performed in children with suspected atypical pneumonia.

E. Management

1. Outpatient management

- Infants and children with non-severe pneumonia can be safely cared for at home.
- Oral antibiotics at an appropriate dose for an adequate duration is effective for treatment.
- The mother should be adequate counselled how to observe and monitor for danger signs is advised to return in in 48hours for reassessment or earlier if the child appears to deteriorate/danger signs develops.

2. Inpatient management

a. Criteria for hospitalization

It is crucial to identify indicators of severity in children who may need admission as failure to do so may result in death.

The following indicators can be used as a guide for admission.

- Children aged <2 months whatever the severity of pneumonia.
- Refusal to feed and vomiting
- Rapid breathing with or without cyanosis
- Systemic manifestation
- Failure of previous antibiotic therapy
- Recurrent and severe pneumonia
- Severe underlying disorders (i.e. immunodeficiency, chronic lung disease)

b. General management

- All hospitalized children may require oxygen to keep saturation above 92%, antipyretics, and IV fluids if hydration is affected by severe respiratory distress or fatigue.
- Fluid intake should be carefully monitored because pneumonia can be complicated by hyponatremia secondary to SIADH secretion

c. Choice of antibiotics therapy

- When treating pneumonia clinical, laboratory and radiographic findings should be considered.

- The age of the child, local epidemiology of respiratory pathogens and sensitivity of these pathogens to particular microbial agents and the emergence of antimicrobial resistance also determine the choice of antibiotic therapy
- The majority of childhood infections are caused by viruses and do not require any antibiotic.
- However, it is also very important to remember that we should be vigilant to choose appropriate antibiotics especially in the initial treatment to reduce further mortality and morbidity.

Table 9. Choice of antibiotic for CAP when causative organism is identified

Pathogen	First choice	Second choice
Streptococcus pneumonia	Penicillin, Ampicillin, high dose Amoxicillin	Cefuroxime, Cefotaxime, Azithromycin, Vancomycin
HiB	Ampicillin, amoxicillin	Cefuroxime, Augmentin, Cefotaxime
Staphylococcus aureus	Cloxacillin	Vancomycin
M. pneumoniae	Macrolides such as erythromycin and Azithromycin	Cefuroxime
Chlamydia	Macrolides such as erythromycin and Azithromycin	Cefuroxime
Bordetella pertussis	Macrolides such as erythromycin, Clarithromycin and Azithromycin	

Table 10. Choice of antibiotic treatment for CAP according to age

Age	Inpatient	Outpatient
<1 month	Ampicillin + Amikacin	-
1-3months	Cephalosporine, Amikacin+/- Macrolides	-
>3months	Cephalosporine / Amoxicillin + Clavulanate Acid +/- Macrolides. If not responding, consider upgrading antibiotics.	Amoxicillin + Clavulanate Acid +/- Macrolides

Table 11. Suggested Antibiotic dosages for the treatment of community acquired pneumonia

Antibiotics	Dosages	Route	Frequency (Hourly)	Duration (Days)
Amoxycillin-Clavulanate	20mg/kg/dose (of amoxicillin}	PO	12	5-7
Ampicillin	12.5mgkg/dose 25-50mg/kg/dose	PO IV	6 6	5-7 7-10
C. Penicillin	25,000-50,000U/kg/dose	IV	6	7-10
Cefuroxime	15 mg/kg/dose 50mg/kg/dose	PO IV	12 8	5-7 7-10
Cefotaxime	50mg/kg/dose	IV	8	7-10
Ceftriaxone	50-75mg/kg/day	IV	Once a day	7-10
Cloxacilline	25-50mg/kg/dose	IV	6	14-21
cefpodoxime	10mg/kg/dose	PO	12	5-7
Azithromycin	10mg/kg/dose	PO	Once a day	3-5
Clarithromycin	7.5mg/kg/dose	PO	12	5-7
Erythromycin	10mg/kg/dose	PO	6	5-7
Vancomycin	10-15mg/kg/dose	IV	6	7-14
Amikacin	15mg/kg/day	IV	Once a day	7-10

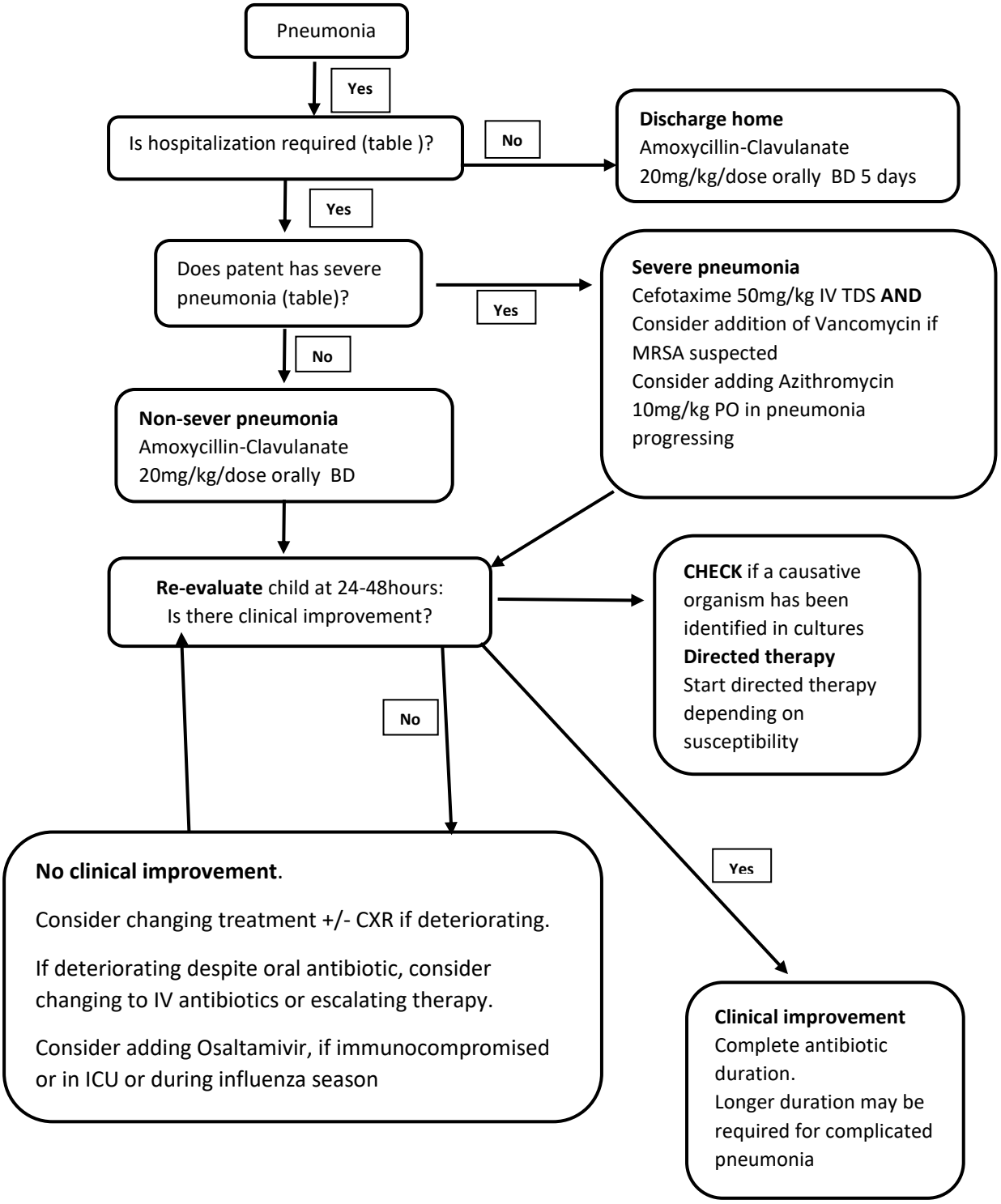
Table 12. Escalating Antibiotic therapy for CAP

1st line	Beta lactams drugs: Ampicillin, Amoxycillin-Clavulanate, Cephalosporins : Cefotaxime, Ceftriaxone, Cefuroxime,
2nd line	Ceftazidime, Vancomycin, Piperacillin-Tazobactam
3rd line	Carbapenem: Meropenem
Others	Aminoglycosides: Amikacin

- A child admitted to hospital with severe community acquired pneumonia must receive parenteral antibiotics.
- As a rule, in severe cases of pneumonia, combination therapy using a second or third generation cephalosporins and macrolide should be given.
- If there are no signs of recovery; especially if the patient remains toxic and ill with spiking temperature for more than 48 hours, a 2nd or 3rd line antibiotic therapy need to be considered.

- If Mycoplasma or Chlamydia species are the causative agents, a macrolide is the appropriate choice.

Flow 3. Chart for management of Pneumonia in children



d. Complications of pneumonia

i. Slowly resolving pneumonias

- This term refers to persistence of either clinical or radiologic findings of pneumonia after giving treatment for the expected duration.
- It is generally accepted that between 48 and 96 hours after empiric adequate" antimicrobial treatment, patients with CAP should show significant clinical improvement.
- During this period, it is not recommended that antimicrobials be changed unless there is clear evidence that other microorganisms not covered by the initial empiric choice of therapy are involved (e.g. *S. aureus* with developing pleural effusion).

Causes

- Inappropriate choice of drugs
- Unexpectedly resistant microorganisms,
- Inadequate dosage
- Poor compliance, if on oral

ii. Necrotizing pneumonia

- Necrotizing pneumonia is characterized by necrosis and liquefaction of consolidated lung tissue, which may be further complicated by bronchopleural fistulas, pneumatoceles, and intrapulmonary abscesses.
- Necrotizing pneumonia is usually secondary to pneumococcus, *Staphylococcus aureus,* or, less commonly, *Pseudomonas aeruginosa* and MRSA infection.
- Treatment includes escalating antibiotics.

iii. Pleural effusion and empyema

- Pleural effusion occurs when an inflammatory response to pneumonia causes an increase in permeability of the pleura with accumulation of fluid into the pleural space and empyema occurs bacteria enter this fluid filled space.

- Streptococcus *species,* Staphylococcus aureus, Haemophilus influenzae, Pseudomonas aeruginosa, are the most common pathogens that can cause empyema

Treatment

- All children with parapneumonic effusion and empyema should be admitted to the hospital.
- Treatment includes supplemental oxygen and IV fluids when necessary, antipyretics, IV antimicrobials and drainage of the effusion

iv. Lung abscess

- An abscess is a thick-walled cavity in the lung parenchyma that contains purulent material.
- Abscesses are associated with a primary pulmonary infection, especially due to Gram-positive cocci *(S. pneumoniae, S. aureus, S. pyogenes),* or *Pseudomonas aeruginosa* and *Klebsiella.*

Treatment

- The mainstay of treatment is high dose parenteral antibiotic, usually recommended for 2 to 3 weeks, followed by 4 to 8 weeks of oral antibiotics.
- Cephalosporin or Piperacillin-tazobactam is the choice to cover the most prevalent pathogens
- Add vancomycin if MRSA is suspected.
- In most cases, CT-guided aspiration for abscesses becomes necessary.
- Consider chest drain if needed

e. Vaccination

- The two leading pathogens causing bacterial pneumonia in children 1 month to 5 years of age are *Streptococcus pneumoniae* and *Haemophilus influenza* type b.
- Other preventable causes of pneumonia are pertussis and measles. Vaccines against these agents have been available for several decades

References

1. Diagnosis and management of bronchiolitis. *Pediatrics*. 2006 Oct. 118(4):1774-93.
2. Azizi H, Norzila Z, Clinical Practice Guidelines on Pneumonia and Respiratory Tract Infections in Children,
3. Dornelles CT, Piva JP, Marostica PJ. Nutritional status, breastfeeding, and evolution of Infants with acute viral bronchiolitis. *J Health Popul Nutr*. 2007 Sep. 25(3):336-43.
4. Guidelines for the management of common childhood illnesses, Second edition 2013, WHO
5. Johnson JE, Gonzales RA, Olson SJ, Wright PF, Graham BS. The histopathology of fatal untreated human respiratory syncytial virus infection. *Mod Pathol*. 2007 Jan. 20(1):108-19.
6. Kendig and Chernick's Disorders of the Respiratory Tract in Children, 8E 2012
7. Lassi ZS et al. Systematic review on antibiotic therapy for pneumonia in children less than 59 months of age. Archives of Diseases in Childhood. 2014;99:687–93
8. Levine DA, Platt SL, Dayan PS, Macias CG, Zorc JJ, Krief W, et al. Risk of serious bacterial infection in young febrile infants with respiratory syncytial virus infections. *Pediatrics*. 2004 Jun. 113(6):1728-34.
9. McNamara PS, Flanagan BF, Baldwin LM, et al. Interleukin 9 production in the lungs of infants with severe respiratory syncytial virus bronchiolitis. *Lancet*. 2004 Mar 27. 363(9414):1031-7.
10. McNamara PS, Flanagan BF, Hart CA, Smyth RL. Production of chemokines in the lungs of infants with severe respiratory syncytial virus bronchiolitis. *J Infect Dis*. 2005 Apr 15. 191(8):1225-32
11. Nsona H et al. Scaling up integrated community case management of childhood illness: Update from Malawi. American Journal of Tropical Medicine and Hygiene. 2012;87:54–60.
12. Recommendations for management of common childhood conditions, Geneva: World Health Organization;2012 (http://www.who.int/maternal_child_adolescent/documents/management_childhood_conditions/en).
13. Ronald B, turner and Gregory F, The common cold, Nelson Text of Pediatrics, 19th Edition.
14. Titus MO, Wright SW. Prevalence of serious bacterial infections in febrile infants with respiratory syncytial virus infection. *Pediatrics*. 2003 Aug. 112(2):282-4.
15. Unger S, Cunningham S. Effect of oxygen supplementation on length of stay for infants hospitalized with acute viral bronchiolitis. *Pediatrics*. 2008 Mar. 121(3):470-5