CHAPTER 15

RESPIRATORY SYSTEM

ACUTE LOWER RESPIRATORY TRACT INFECTIONS IN YOUNG CHILDREN

The term acute lower respiratory tract infection is used here to embrace acute viral bronchiolitis as well as acute viral and bacterial pneumonia. Antibiotics are indicated in the empiric treatment of pneumonia and are not usually indicated for the treatment of bronchiolitis.

If it is not possible to confidently diagnose acute viral bronchiolitis clinically or if there are concerns about bacterial co-infection it is recommended that the World Health Organisation (WHO) treatment guidelines should be followed.[1]

Nebulize all wheezing children with a β_2-agonist and if a good clinical response is noted and wheezing is recurrent, a diagnosis of asthma should be considered.

15.1 COUGH WITH PREDOMINANT FEVER AND TACHYPNOEA

15.1.1 PNEUMONIA

J18.9

DESCRIPTION

Infection of the lung parenchyma characterized by inflammation and consolidation of lung tissue. Management depends on the clinical assessment and classification of severity.

For bacterial pneumonia

Empiric antibiotics are indicated in all cases of pneumonia, as delay in treatment is associated with poor outcome. Antibiotic choice is based on an assessment of severity and likely aetiology.

Common bacterial causes of pneumonia include:
Neonates:

- Group B beta-haemolytic Streptococci.
- *Klebsiella spp.*
- *E. coli.*
- Chlamydia.
- *S. aureus.*

Children:
» *S. pneumoniae.*
» *H. influenzae.*
» *S. aureus.*
» *M. catarrhalis.*
» *M. pneumoniae.*

Staphylococcal pneumonia should be suspected if there is empyema, pulmonary cavitation or pneumatocoele formation or the presence of extrapulmonary pyogenic infections.

Complications of pneumonia include:
» respiratory failure,
» empyema,
» pleuritis,
» pleural effusion,
» pneumothorax,
» bronchiectasis.

DIAGNOSTIC CRITERIA

» Tachypnoea is age dependent.

Age	Respiratory rate
< 60 days	> 60/minute
2–12 months	> 50/minute
1–5 years	> 40/minute
5–12 years	> 25/minute

Categories of pneumonia (WHO classification)

Category	Characteristics
1. Severe pneumonia or very severe disease	Diagnose in an infant under 2 months of age with: » A general danger sign *or* » Lower chest wall indrawing *or* » Tachypnoea (> 60 breaths per minute)
	Diagnose in an HIV-exposed infant or HIV-infected, immune-compromised or malnourished child with lower chest indrawing.
2. Pneumonia	Diagnose in an immune-competent child over 2 months with lower chest wall indrawing *or* tachypnoea.
	Tachypnoea is defined as: » > 50 breaths per minute for infants 2–12 months » > 40 breaths per minute for children 1–5 years
3. No pneumonia	No signs of pneumonia or severe pneumonia, i.e. upper respiratory tract infection.
4. Danger signs	Diagnose in a child aged 2 months to 5 years with any ***general danger sign***: » Inability to drink » Convulsions » Abnormal sleepiness » Persistent vomiting

Investigations

» Chest X-ray only when there is failure to respond to therapy, in children with severe pneumonia in whom complications or tuberculosis are suspected, and for admissions. Perform a lateral and AP or PA view if possible. TB work-up if tuberculosis suspected (e.g. TB contact), see Chapter 10: Tuberculosis, section 10.2: Tuberculosis, pulmonary.

» In children with severe and very severe disease, perform a blood culture, preferably before initiating antibiotics.

GENERAL AND SUPPORTIVE MEASURES

» Bed rest.

» Clear nasal and oral passages of thick secretions.

» Monitor:
  > respiratory rate,
  > heart rate,
  > SaO_2,
  > temperature,
  > hydration,
  > blood pressure.

» Hypoxia (SATS monitor) and/or hypercapnia (blood gas) are indications for ventilatory support.

» Maintain nutrition: continue breast and oral feeds.
  > Consider small frequent feeds by oro/nasogastric tube or IV fluids if respiratory rate > 60/minutes or enteral feeds are not tolerated.

MEDICINE TREATMENT

- Oxygen at 1–2 L/min, humidified, by nasal prongs is preferred.
  - Continue oxygen until respiratory distress and hypoxia resolves (a saturation of ≥ 92% off oxygen).

To relieve discomfort:

- Paracetamol, oral/NGT, 15 mg/kg, 6 hourly as required.

If a significant degree of wheezing is present:

- Salbutamol, inhalation, 100–200 µg, as required using a metered-dose inhaler with a spacer device or a nebulizer until symptoms are relieved.

Empiric antibiotic therapy

Choice of antibiotic depends on the severity of the condition, the age of the child and the presence of co-morbidity.

Reconsider choice of antibiotic when the results of cultures become available or the child does not improve.

<u>Pneumonia (non-severe):</u>

- Amoxicillin, oral, 45 mg/kg/dose, 12 hourly for 5 days.

<u>Severe or very severe disease:</u>

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Switch to oral as soon as there is a response:

- Amoxicillin/clavulanate, oral, 45 mg/kg/dose of amoxicillin component 12 hourly to complete 10 days total.

MODIFICATION OF ANTIMICROBIAL THERAPY

If there is a poor response to first line empiric therapy and in the absence of positive cultures consider the possibility of infection with Methicillin Resistant *S. aureus* (MRSA), or an extended spectrum beta lactamase (ESBL) producing organism, or atypical pathogen.

If mycoplasma is considered, do blood polymerase chain reaction for the specific pathogen.

If nosocomial pneumonia suspected, refer to section 15.1.1.4 Nosocomial pneumonia. Re-evaluate for possible co-morbidity (foreign body, immunodeficiency, heart disease).

Change to:

- Piperacillin/tazobactam, IV, 100 mg/kg/dose 8 hourly.

PLUS

- Amikacin, IV, 15 mg/kg/dose, daily.

If an MRSA pneumonia is confirmed:

- Vancomycin, IV, 15 mg/kg/dose 6 hourly infused over 1 hour for 14 days.

For Mycoplasma pneumonia and other atypical pneumonias:

- Macrolide, e.g.:
- If severely ill initiate:
  - Azithromycin, IV, 10 mg/kg/dose daily for 2 days

    THEN
  - Azithromycin, oral, 5 mg/kg/dose daily for 3 days.

    OR
  - Azithromycin, oral, 5 mg/kg/dose daily for 5 days.

For management of complications

» To relieve a tension pneumothorax, do needle aspiration followed by intercostal drain placement.

» Small or asymptomatic pneumothoraces in infants and children (excluding neonates) usually do not require treatment other than close observation, but identify and treat the underlying cause of the pneumothorax.

» For symptomatic pleural effusion, do needle aspiration; if an empyema, insert a chest tube for drainage. See section 15.2.1: Effusion and empyema.

REFERRAL

» Patients not improving within 48–72 hours of initiating second-line therapy should be discussed with a paediatrician.
» For possible ICU care if not maintaining saturation in the normal range on oxygen or if clinical features of fatigue.

15.1.1.1 PNEUMONIA, VIRAL INFECTION

J12.9

DESCRIPTION

The commonest cause of pneumonia in children is viral infection. Respiratory syncytial virus, adenovirus, cytomegalovirus, influenza, parainfluenza, adenovirus, herpes, human metapneumovirus and measles are the common viruses responsible for infections of the respiratory tract. Children present with fever, cough, rhinorrhoea and chest indrawing. Scattered fine crackles may also occur.

Common viral causes in infancy and early childhood include:

» influenza virus,
» measles virus,
» respiratory syncytial virus,
» para-influenza virus,
» cytomegalovirus,
» adenovirus.

Measles is recognized by the typical features of cough, coryza, koplik spots, a maculopapular rash and its other systemic manifestations.

DIAGNOSTIC CRITERIA

» As for pneumonia, see section 15.1.1: Pneumonia, above.
» It is not possible to discriminate viral from bacterial pneumonia on clinical or radiological grounds.
» Chest X-ray is not routinely indicated.

GENERAL AND SUPPORTIVE MEASURES

» Maintain nutrition.
» Maintain hydration.

MEDICINE TREATMENT

Only if saturation < 92%:

- Oxygen, humidified, 1–2 L/min via nasal prongs or nasal cannula.

To relieve discomfort:

- Paracetamol, oral, 15 mg/kg/dose 6 hourly.

There is no role for routine antiviral therapy.

For Measles Pneumonia:
Treat as severe pneumonia, and refer to Chapter 8: Infectious Diseases, section 8.10: Measles.

Complications
Monitor for secondary bacterial infection and institute empiric antibiotics for pneumonia if suspected. Do a blood culture.

REFERRAL
» Patients not improving within 48–72 hours of admission should be discussed with a paediatrician.
» For possible ICU care if not maintaining saturation in the normal range on oxygen or if clinical features of fatigue are present.

15.1.1.2 PNEUMONIA DUE TO ANAEROBIC INFECTION

DESCRIPTION
Often seen in comatosed patients with aspiration syndromes or children who inhaled a foreign body that has been misdiagnosed for a period of time.

DIAGNOSTIC CRITERIA
» Putrid odour from mouth and foul smelling sputum.

Investigations
» Sputum and blood culture using anaerobic media.

MEDICINE TREATMENT
Empiric antibiotic therapy for at least 7 days.

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Change antibiotics according to culture and sensitivity results. Watch for complications. Some patients may require longer antibiotic duration.

15.1.1.3 PNEUMONIA IN HIV-EXPOSED OR HIV-INFECTED CHILDREN

DESCRIPTION
In additional to common bacterial and viral pathogens causing pneumonia, opportunistic micro-organisms in a ‘polymicrobial mix’ are common in these children. Many of these children may fail to respond to the standard antibiotic treatment for pneumonia. Micro-organisms commonly involved are:

- » *P. jiroveci* (PJP),
- » Mycobacteria, e.g. *M. tuberculosis*
- » Candida,
- » Cytomegalovirus.

In addition, S. pneumonia, S. aureus and gram negative bacteria, e.g. *Klebsiella pneumoniae* and Non-Typhoid Salmonella cause a significant proportion of HIV-related pneumonia in early childhood.

P. jiroveci (PJP)

- » PJP is a common fungal infection of the lung in infants from 2–6 months.
- » Presents as an acute onset of respiratory distress with minimal/absent chest signs in a child who is HIV-exposed or HIV-infected.
- » Hypoxaemia and cyanosis are common features in severe disease.
- » Chest X-ray shows a range of abnormalities including bilateral perihilar interstitial changes.

Other fungal pneumonias

- » Candida albicans and other species, Cryptococcus neoformans and Aspergillus fumigatus may cause pneumonia in immunocompromised children.
- » Skin and CNS manifestation may be helpful in suggesting the specific diagnosis.

Cytomegalovirus associated pneumonia in HIV-infected infants

- » Presents as an interstitial pneumonitis with acute hypoxic respiratory failure.
- » It may present as a multisystem sepsis-like syndrome, with hepatitis, neutropenia, pneumonitis, colitis and thrombocytopenia.
- » Often occurs in children who are severely immunosuppressed (CDC Immune category 3) and carries a significant mortality.
- » Risk of CMV transmission through breastfeeding is low and, therefore, breastfeeding is not contraindicated.
- » CMV co-infection occurs commonly as polymicrobial infection with PJP and bacteria.

Tuberculosis in HIV infected children

- » Occurs in children at all ages.
- » Presents as acute or chronic illness.
- » Multisystem disease.

HIV-infected children with chronic lung disease

- » Often presents with lymphoid interstitial pneumonitis and bronchiectasis.
- » Secondary infection with bacteria similar to those seen in acute pneumonia are commonly isolated from these children.

DIAGNOSTIC CRITERIA

Investigations

In addition to investigations for pneumonias:

» Screen for HIV infection:
  > See Chapter 9: Human Immunodeficiency Virus infection, section 9.1: Human Immunodeficiency Virus infection, for guidance on testing.
» Investigate for PJP:
  > Immunofluorescence on induced sputum sample.
» Fungal infection:
  > Request MCS for fungi (blood or sputum).
» Screen children with very severe pneumonia immediately for CMV using CMV viral load, where available.
  > A viral load of > 10 000 copies/mL suggests CMV disease: treat.
  > A viral load below 10 000 copies/mL is regarded as CMV infection: no therapy recommended.
» Tuberculosis:
  > See Chapter 10: Tuberculosis, section 10.2: Tuberculosis pulmonary, for guidance on testing.

GENERAL AND SUPPORTIVE MEASURES

» Appropriate infection prevention and control measures.
» Adequate nutrition.
» Monitor oxygen saturation.
» Restrict fluid intake.

MEDICINE TREATMENT

If saturation < 92%:

- Oxygen, via nasal prongs or nasal cannula.

Treat for very severe bacterial pneumonia. See section 15.1.1: Pneumonia.

In all infants between 2 and 6 months with pneumonia **consider PJP** and, **ADD**

- Co-trimoxazole, IV/oral, 5 mg trimethroprim/25 mg sulphamethoxazole /kg/dose, 6 hourly for 21 days.
  - Continue co-trimoxazole prophylaxis at the end of this treatment period until CD4 count recovers to normal.

Children who remain hypoxic on oxygen with proven or highly suspected PJP:

- Prednisone, oral, 1–2 mg/kg, daily for 7 days.
  - Taper dose over the next 7 days.

For suspected or confirmed fungal pneumonia (other than PJP):

- Amphotericin B deoxycolate, IV, 0.6–1.0 mg/kg as a single daily dose infused over 4 hours for at least 14 days.

Note: Pre-hydrate before administering amphotericin to prevent renal impairment:

- Sodium chloride 0.9%, IV, 20 mL/kg **plus** potassium chloride, 20 mmol/L infused over 2–4 hours.

OR

- Fluconazole, IV/oral, 10 mg/kg as a single daily dose for at least 14 days.

For confirmed CMV disease:

- Ganciclovir, IV, 5 mg/kg 12 hourly until oral is tolerated

THEN

- Valganciclovir, oral, 16 mg/kg 12 hourly to complete the first 21 days of therapy

THEN

- Valganciclovir, oral, 16 mg/kg daily to complete 42 days of therapy.

For Mycobacterium Tuberculosis:

See Chapter 10: Tuberculosis.

Ensure follow-up for antiretroviral therapy.

REFERRAL

» Not responding to therapy.
» In cases of CMV disease under 6 months of age for follow-up for hearing deficit.

15.1.1.4 PNEUMONIA, NOSOCOMIAL

J18.9

DESCRIPTION

Children acquiring pneumonia 48–72 hours after hospitalisation.
The common pathogens are:

» ß-lactamase producing pathogens,
» Extended spectrum ß-lactamase producing *Klebsiella pneumoniae*, *P. aeruginosa*,
» Multidrug resistant Acinetobacter species,
» Methicillin resistant *S. aureus*,
» Respiratory viruses, i.e. respiratory syncytial virus, adenovirus, influenza, herpes, parainfluenza.

GENERAL AND SUPPORTIVE MEASURES

» Sepsis screen including blood cultures.

MEDICINE TREATMENT

Empirical antibiotic therapy

» Broad spectrum antibiotics should be administered according to local susceptibility patterns and underlying predisposing factors.

» Review antibiotic choice once culture and sensitivity results become available.

For bacterial infections:

Empiric therapy in the absence of local data:

- Piperacillin/tazobactam, IV, 100 mg/kg/dose 8 hourly

PLUS

- Amikacin, IV, 15 mg/kg/dose, daily.

Adjust therapy according to sensitivities.

Reconsider empirical antibiotic therapy and duration of therapy daily.

For methicillin resistant *S. aureus* pneumonia:

- Vancomycin, IV, 15 mg/kg/dose 6 hourly infused over 1 hour.

15.1.1.5 RECURRENT PNEUMONIA

J18.9

DESCRIPTION

Recurrence of parenchymal and bronchial airways infection clinically and radiologically after a similar episode had completely resolved during that year. Must be distinguished from persistent pneumonia where there is clinical non-recovery of parenchymal ± bronchial infection after a period of 10 days.

Common aetiologies of recurrent pneumonia include immunosuppression from corticosteroid use, inappropriate antibiotic use, primary and secondary immune-suppression, congenital and structural lung abnormalities, e.g. congenital cystic adenomatous malformation, bronchiectasis, lymphoid interstitial pneumonitis etc.

Common pathogens are community acquired and include *Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus,* respiratory syncytial virus (RSV), influenza, candida. Nosocomial pathogens are uncommon, even in HIV-infected patients.

DIAGNOSTIC CRITERIA

» Confirmation of the presence and resolution of the previous pneumonia radiologically.

» Confirmation of the current pneumonia clinically, on chest radiograph ± microbiologically (see section 15.1.1: Pneumonia).

GENERAL AND SUPPORTIVE MANAGEMENT

» Identify the underlying cause and exclude HIV and TB.
» Oxygen if saturation <93%.
» Fluid and feeds according to severity of illness.
» Blood transfusion if haemoglobin < 7 g/dL.

MEDICINE TREATMENT

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Adjust antibiotics according to cultures and sensitivity.

If non-responsive: exclude foreign body and mycobacterium tuberculosis.

REFERRAL

» Underlying systematic chronic disease for consideration of prophylaxis.
» Deterioration

15.1.2 BRONCHIOLITIS

J21.9

DESCRIPTION

Bronchiolitis is an acute viral infection of the small airways of the lower respiratory tract affecting children between 4 months and 2 years of age. The most common pathogen is the respiratory syncytial virus. Recurrent episodes of wheeze associated with bronchiolitis may occur, and some of these children may develop asthma.

Risk factors for severe bronchiolitis:

» Age less than 3 months.
» Ex-preterm infants.
» Chronic lung disease.
» Congenital heart disease.

DIAGNOSTIC CRITERIA

» Prodrome of viral infection: irritability and rhinorrhoea.
» A wheeze that is slowly responsive or non-responsive to bronchodilators.
» Crepitations and signs of hyperinflation of the chest.
» Chest X-ray should be reserved for clinically severe or complicated cases.
» Tachypnoea is age dependent.

»

Age	Respiratory rate
< 60 days	> 60/minute
2–12 months	> 50/minute
1–5 years	> 40/minute
5–12 years	> 25/minute

Bronchiolitis (mild)
» Cough and fast breathing (tachypnoea).

Bronchiolitis (moderate)
Above plus one of the following:
» lower chest wall in-drawing,
» nasal flaring,
» grunting.

Bronchiolitis (severe)
Above plus at least one of the following:
» central cyanosis, oxygen saturation < 90% in room air;
» inability to feed,
» convulsions, lethargy or decreased level of consciousness,
» severe respiratory distress (e.g. very severe chest wall indrawing).

GENERAL AND SUPPORTIVE MEASURES

» Isolate from other infants, if possible.
» Mild cases without risk factors are managed as outpatients. Provide counselling to the caregiver and devise a plan for the eventuality that the child deteriorates or does not improve. Mild cases with risk factors, moderate and severe cases require admission.
» Patients with signs of moderate or severe disease or associated complications or underlying cardiorespiratory disorders should be hospitalised for monitoring of:
  > breathing pattern (apnoea monitoring if < 3 months of age),
  > heart rate and respiratory rate,
  > temperature,
  > SaO_2,
  > hydration and nutrition,
  > IV maintenance fluid if oral/nasogastric feeds/fluids are not tolerated. Avoid over hydration.

MEDICINE TREATMENT

For all hospitalised patients

Only if saturation < 92%:

- Oxygen, humidified, 1–2 L/min via nasal prongs or nasal cannula.
  - Ensure clear nasal passages and correctly position the nasal prongs.

In children with recurrent wheezing, nebulise with a β_2-agonist; if there is a response, consider asthma, see section 15.4: Conditions with predominant wheeze.

Antibiotic therapy
Routine antibiotic therapy is not indicated. Only use antibiotics if there is concern about bacterial co-infection.

For bacterial co-infection:
- Amoxicillin, oral, 45 mg/kg/dose, 12 hourly for 5 days.

REFERRAL
» Discuss all severe cases with a paediatrician.

15.2 PLEURAL DISEASE

15.2.1 EFFUSION AND EMPYEMA
J90

DESCRIPTION
A pleural effusion is an accumulation of fluid between the visceral and parietal pleura. The fluid can be an exudate or a transudate (see Lights criteria: https://www.mdcalc.com/lights-criteria-exudative-effusions).

Common causes for exudates are infections, inflammation and malignancy. Common causes of a transudate are cardiac failure, renal failure and hepatic failure. A straw-coloured or haemorrhagic effusion is indicative of tuberculosis. A cloudy or frankly purulent fluid indicates an empyema.

DIAGNOSTIC CRITERIA
» Decreased breath sounds and stony dull on percussion.
» Pleural rub early in disease.
» Chest X-ray shows uniform opacities in a lamellar distribution at the costophrenic angles.

GENERAL AND SUPPORTIVE MEASURES
» Treat small effusions conservatively.
» Drain other effusions by either chest drain (preferably valved) or needle aspiration.
» Send samples for protein, glucose, cytology, microscopy and culture. If pus is identified, insert a chest drain.
» Transudates do not require drainage unless respiration is significantly compromised by the size of the effusion.
» More aggressive surgical procedures such as open drainage or decortication are rarely indicated in children.

MEDICINE TREATMENT

For purulent effusion:

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component for 10 days).

OR

- Cefazolin, IV, 25 mg/kg 8 hourly.

If there is evidence of good clinical response, change to:

- Cephalexin, oral, 6.25–12.5 mg/kg/dose 6 hourly.

OR

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component 12 hourly.

If pathogens are cultured in blood from sanctuary sites, e.g. bone, heart valves, etc., treat according to sensitivity for prolonged period of 21–42 days.

For straw-coloured or haemorrhagic effusion:

» Start anti-tuberculosis therapy, see Chapter 10: Tuberculosis.

REFERRAL

If no response to any of the above therapy.

15.3 CHRONIC LUNG INFECTIONS

15.3.1 BRONCHIECTASIS

J47

DESCRIPTION

Irreversible dilatation of the subsegmental airways, inflammatory destruction of bronchial and peribronchial tissue, and accumulation of exudative material in dependent bronchi that occurs as a result of recurrent bacterial infections and aspiration pneumonia. There is bronchial luminal obstruction; ciliary dyskinesia; thick, tenacious secretions and lung tissue damage.

Complications include pulmonary hypertension, cor-pulmonale and respiratory failure. Predisposing conditions include HIV, TB, cystic fibrosis, primary ciliary dyskinesia and primary immunodeficiency syndromes.

DIAGNOSTIC CRITERIA

» Chronic cough, usually with mucopurulent sputum and occasional haemoptysis.
» Clubbing and halitosis.
» Recurrent and persistent lower respiratory tract infections.

» A bout of coughing on physical activity or change in posture, particularly while reclining.
» Fever, malaise, anorexia, poor weight gain.
» Respiratory failure, cyanosis.
» Pulmonary hypertension and cor-pulmonale.
» Chest X-ray showing cystic dilatation and tram-tracking.
» If diagnosis is uncertain or where localised disease on chest X-ray is suspected, perform high-resolution computed tomography. Features include cystic dilatation, 'signet ring' sign and tram-tracking.
» Usual pathogens are community acquired, including *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae, Staphylococcus aureus*. Must exclude tuberculosis and fungal infections.

GENERAL AND SUPPORTIVE MEASURES

» Identify and treat the underlying disorder or bacterial source.
» Clear secretions effectively with postural drainage and physiotherapy.
» Eliminate all foci of infection.
» Nutritional support.

Method of sputum induction

Precaution: If undertaking this procedure in an acutely sick child with respiratory compromise, be prepared to manage acute bronchospasm, as this may be an associated adverse effect.

- Nebulise with sodium chloride 0.9% or sodium chloride 3% (hypertonic saline) to aid sputum expectoration. Mix 3 mL of 5% sodium chloride with 2 mL sterile water to make a 3% solution.

In the acutely sick child:
Nebulise with a bronchodilator:

- Salbutamol, solution, 0.15–0.3 mg/kg/dose in 2–4 mL of sodium chloride 3% delivered at a flow of 5 L/minute with oxygen for 20 minutes.

» Perform physiotherapy.
» Encourage patient to cough up sputum or if infant or small child, obtain nasopharyngeal aspirate post physiotherapy.
» Send sample for culture and cytology as indicated.

MEDICINE TREATMENT

Acute lung infections: worsening cough accompanied by increased dyspnoea or tachypnoea and/or signs of sepsis.
Empiric antibiotic therapy for acute lung infections:

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Change antibiotics according to culture and sensitivity results.

If poor response and no culture to guide antibiotic choice, consider infection due to *S. aureus*, TB or fungal infection.

If there is evidence of good clinical response, change to:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component 12 hourly.
  - Total antibiotic duration of 10 days.

Note: These antibiotic regimens **do not** apply to children with cystic fibrosis, seek specialist advice.

In the acute phase if wheeze is present:

- Salbutamol solution, 5 mg/mL, nebulise 4 hourly.
  - 5 mg salbutamol in 2–4 mL sodium chloride 0.9%.

- Annual influenza vaccination.

- Pneumococcal vaccine (conjugated), 2 additional doses 8 weeks apart.

SURGICAL TREATMENT

- Consider surgery in localised severe disease or progressive disease despite adequate medical treatment.

ROLE OF CHEMOPROPHYLAXIS

- Azithromycin, oral, 5 mg/kg/dose daily for 3 alternate days per week for 3 months duration and then repeat after 6 months.

REFERRAL

» All patients for confirmation of the diagnosis, assessment of severity and evaluation of the underlying condition.
» Poor response to therapy, increased frequency of exacerbations, poor lung function.
» For early surgical intervention of localised disease.

15.3.2 LUNG ABSCESS

J85

DESCRIPTION

A suppurative process that results from destruction of the pulmonary parenchyma and formation of a cavity. The cavity may be single, e.g. after aspiration, or multiple, e.g. staphylococcal disease and cystic fibrosis.

Lung abscess may follow pneumonia caused by:

- » *S. aureus,*
- » anaerobic organisms,
- » *H. influenza,*
- » *K. pneumoniae,*
- » *S. pneumoniae,*
- » *M. tuberculosis.*

Metastatic lung abscesses due to septicaemia or septic emboli may also occur.

Complications include:

- » bronchiectasis,
- » rupture into the bronchial tree or pleural cavity or vessels,
- » bronchopleural fistula.
- » empyema,
- » pulmonary osteo-arthropathy,
- » brain abscess,

DIAGNOSTIC CRITERIA

» Intermittent or recurrent fever, malaise, weight loss, anorexia and productive, purulent cough with halitosis and haemoptysis.
» Clubbing and amphoric breathing over the cavity may be present.
» Chest X-ray will confirm cavity/cavities with or without an air-fluid level.

GENERAL AND SUPPORTIVE MEASURES

» Identify the underlying cause and exclude inhalation of a foreign body.
» Physiotherapy and postural drainage.
» Correct anaemia.
» Nutritional support.

MEDICINE TREATMENT

Empiric antibiotic therapy for at least 14 days.

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component).

Change antibiotics according to culture and sensitivity results.
If there is a poor response and no culture to guide antibiotic choice: consider local surveillance of pathogens and change accordingly.
If there is evidence of good clinical response, change to:

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose of amoxicillin component 12 hourly.

SURGICAL TREATMENT

Consider surgical drainage of abscess and/or resection if medical treatment fails.

REFERRAL

» Complicated lung abscess not responding to therapy.
» Lung abscess where the underlying cause has not been established.

15.4 CONDITIONS WITH PREDOMINANT WHEEZE

15.4.1 ASTHMA ATTACK, ACUTE

J46

DESCRIPTION

Acute exacerbation of wheezing that is unresponsive to bronchodilator therapy that is usually effective in a child who had been previously diagnosed with asthma.

DIAGNOSTIC CRITERIA

Clinical signs include:

- » intense wheezing,
- » hyperinflation,
- » tachypnoea,
- » hypoxaemia,
- » restlessness,
- » difficulty or inability to talk or feed,
- » decreased air entry,
- » dyspnoea,
- » tachycardia,
- » anxiety,
- » palpable pulsus paradoxus,
- » reduced peak flow rate.

The following are danger signs in acute, severe asthma and require referral:

- » restlessness,
- » disturbance in level of consciousness,
- » rising P_aCO_2,
- » silent chest with auscultation,
- » PEFR < 60% of predicted value,
- » decreasing oxygen saturation < 85%,
- » palpable pulsus paradoxus,
- » chest pain (air leaks).

Classification of Severity of Acute Asthma Exacerbations

	Mild	Moderate	Severe
Oxygen saturation ***(performed off oxygen)***	> 95%	92–95%	< 92%
PEFR*	70–90%	50–70%	< 50%
Arterial P_aCO_2	< 35 mmHg < 3.7 kPa	< 40 mmHg < 5.3 kPa	> 40 mmHg > 5.3 kPa
Pulsus paradoxus	< 10 mmHg < 1.3 kPa	10–20 mmHg 1.3–2.7 kPa may be palpable	20–40 mmHg 2.7–5.3 kPa palpable
Wheezing	expiratory	expiratory and inspiratory	breath sounds soft
Respiratory rate	< 40/minute	> 40/minute	> 40/minute

	Mild	Moderate	Severe
Additional signs		» speaks normally » difficulty with feeding » chest indrawing	» unable to speak » confusion » cyanosis » use of accessory muscles
Management	• Short-acting ß$_2$-agonist, e.g. salbutamol, inhalation **PLUS** • Prednisone, oral	• Oxygen, • Short-acting ß$_2$-agonist, e.g. salbutamol, inhalation • ± Ipratropium bromide, inhalation • Prednisone, oral	• Oxygen, • Short-acting ß$_2$-agonist, e.g. salbutamol, inhalation stat • Ipratropium bromide, inhalation, • Hydrocortisone, IV If no response: ± $MgSO_4$, IV bolus stat **OR** ± Salbutamol, IV bolus stat **AND** Consider ICU care

*Peak expiratory flow rate (PEFR) – as percentage of predicted value.

GENERAL AND SUPPORTIVE MEASURES

» Admit child to a high care unit, if available.
» Monitor:
  > heart rate,
  > respiratory rate,
  > PEFR,
  > pulse oximetry.
  > blood pressure,
  > acid-base status,
  > blood gases,
» Ensure adequate hydration:
  > Encourage intake of normal maintenance volume of oral fluids; avoid overhydration.
» If unable to drink, give 0.45% sodium chloride/5% dextrose IV. Patients with prolonged severe asthma may become dehydrated as a result of poor intake or vomiting. It is, however, inadvisable to overhydrate patients with acute asthma: do not exceed the recommended IV fluid volume in children, i.e. 50 mL/kg/24 hours.
» Monitor potassium levels in a patient on continuous ß$_2$-agonist.

Note:

» Physiotherapy, antihistamines, antibiotics and sedation are not beneficial in the acute setting.

» Agitation and restlessness are signs of severe hypoxia.

MEDICINE TREATMENT

Mild exacerbation of asthma

- Bronchodilator, i.e. short-acting ß2-agonist.
  - Salbutamol, inhalation, using a metered-dose inhaler with a spacer device.
    - 200–400 µg (2–4 puffs of 100 µg/puff) repeated every 20–30 minutes depending on clinical response.

  OR
  - Salbutamol, solution, 0.15–0.3 mg/kg/dose nebulised at 20 minute intervals for 3 doses.
    - Maximum dose: 5 mg/dose.
    - 5 mg salbutamol in 4 mL sodium chloride 0.9% delivered at a flow of 5 L/minute with oxygen.

PLUS

- Prednisone, oral, 1–2 mg/kg, daily immediately up to a maximum of:
  - 20 mg: Children < 2 years for 5 days.
  - 30 mg: Children 2–5 years for 5 days.
  - 40 mg: Children 6–12 years for 5 days.

Moderate or severe asthma

Step 1:

To maintain arterial oxygen saturation ≥ 95%:

- Oxygen, at least 4–6 L/minute by face mask **or** 1–2 L/minute by nasal cannula.

PLUS

- Short-acting $ß_2$-agonist:

  Severe disease:
  - Salbutamol, inhalation, using a metered-dose inhaler with a spacer device, 10 puffs (100 µg/puff) = 1 mg per administration, repeated every 20–30 minutes depending on clinical response.

  Moderate severity:
  - Salbutamol, 400–600 µg (4–6 puffs of 100 µg/puff) repeated every 20–30 minutes depending on clinical response.

OR

- Salbutamol, solution, 0.15–0.3 mg/kg/dose nebulised at 20 minute intervals for 3 doses.
  - Maximum dose: 5 mg/dose.
  - 5 mg salbutamol in 4 mL sodium chloride 0.9% delivered at a flow of 5 L/minute with oxygen.

PLUS

- Ipratropium bromide, solution, 0.25 mg, nebulised immediately.
  - If severe, follow with 0.25 mg every 20–30 minutes for 4 doses over 2 hours.
  - Maintenance dose: 0.25 mg 6 hourly.
  - 0.25 mg (2 mL) ipratropium bromide in 2 mL sodium chloride 0.9%.

- Ipratropium bromide may be mixed with a ß$_2$-agonist.

PLUS

- Prednisone, oral, 1–2 mg/kg, immediately up to a maximum of:
  - 20 mg: Children < 2 years for 5 days.
  - 30 mg: Children 2–5 years for 5 days.
  - 40 mg: Children 6–12 years for 5 days.

Step 2:

Assess response to treatment in step 1 by using the following table:

	Responder	**Non-responder**
PEFR	Improvement > 20% OR > 80% (best/predicted)	Improvement < 20% OR < 80% (best/predicted)
Respiratory rate	< 40/minute	> 40/minute
Retraction	absent	present
Speech	normal	impaired
Feeding	normal	impaired

Responder: patient who maintains an adequate response for at least 1 hour.
Non-responder: patient who fails to respond adequately to treatment in step 1.

Proceed to step 3.

Step 3:

Responder:

Review current treatment, possible precipitating or aggravating factors and commence:

- Prednisone, oral, 2 mg/kg as a single daily dose for 5 days.
  - To a maximum of:
    - 20 mg: Children < 2 years for 5 days.
    - 30 mg: Children 2–5 years for 5 days.
    - 40 mg: Children 6–12 years for 5 days.

PLUS

- Short-acting ß$_2$-agonist:
  - Salbutamol, inhalation, 200 µg (2 puffs of 100 µg/puff) as required using a metered-dose inhaler with a spacer device.

Review maintenance asthma therapy at follow-up.

Non-responder:

Intensify treatment as follows:

Continue

- Short-acting ß$_2$-agonist:
  - Salbutamol, solution, 0.15–0.3 mg/kg/dose nebulised at 20 minute intervals for 3 doses.
    - Maximum dose: 5 mg/dose.

- 5 mg salbutamol in 4 mL sodium chloride 0.9% delivered at a flow of 5 L/minute with oxygen.

AND

- Ipratropium bromide, solution, 0.25 mg, nebulised immediately.
  - If severe, follow with 0.25 mg every 20–30 minutes for 4 doses over 2 hours.
  - Maintenance dose: 0.25 mg 6 hourly.
  - 0.25 mg (2 mL) ipratropium bromide in 2 mL sodium chloride 0.9%.
  - Ipratropium bromide may be mixed with a $ß_2$-agonist.

PLUS

Continue corticosteroid:

- Prednisone, oral, 2 mg/kg as a single daily dose.
  - To a maximum of:
    - 20 mg: Children < 2 years for 5 days.
    - 30 mg: Children 2–5 years for 5 days.
    - 40 mg: Children 6–12 years for 5 days.

OR

- Hydrocortisone, IV, 2 mg/kg/dose 6 hourly.

Consult paediatrician for use of:

- Magnesium sulphate, IV bolus, 25–75 mg/kg administered over 20 minutes.

OR

- Salbutamol, IV, 15 µg/kg as a single dose administered over 10 minutes.

AND

- Need for intensive care.

Step 4: *(Assess response to treatment in Step 3.)*

If non-responsive, admit to intensive care unit for consideration of:

- Magnesium sulphate, IV bolus, 25–75 mg/kg administered over 20 minutes (if not already given).

AND

- Salbutamol, IV.
  - Loading dose: 15 µg/kg (do not give if stat dose already given).
  - Follow with: 1 µg/kg/minute.
  - If necessary, increase dose by 1 µg/kg every 15 minutes.
  - Maximum dose: 5 µg/kg/minute.
  - Monitor electrolytes and side effects.

No further response

In cases of life threatening asthma in the intensive care unit:

- Aminophylline, IV, 5 mg/kg, loading dose administered over 20–30 minutes. Omit loading dose in children receiving maintenance oral theophylline.
  - Follow with: 1 mg/kg/hour continuous infusion.
  - ECG monitoring is mandatory.

REFERRAL
» Acute exacerbation not responding to treatment.

15.4.2 ASTHMA, CHRONIC
J45

DESCRIPTION
Asthma is a chronic inflammatory airways disease in which many cells and cellular elements play a role. Susceptible individuals present with recurrent episodes of early morning wheezing, breathlessness, chest tightness and cough.

There is widespread variable airflow obstruction that is reversible either spontaneously or with treatment. A variety of stimuli, e.g. allergens, viral infections, weather changes, emotional upsets or other irritants precipitate inflammation that is associated with increased bronchial hyper-responsiveness.

DIAGNOSTIC CRITERIA
» Chronic, persistent/recurrent cough and/or wheezing that responds to a bronchodilator.
» Objective evidence of reversible airway obstruction, as measured by > 15% improvement of the peak flow or > 12% improvement in the forced expiratory volume in 1 second (FEV_1) 20 minutes after administration of an inhaled bronchodilator, confirms the diagnosis.
» A family history of atopy, night or exercise-induced coughing and/or wheezing.

Control of asthma
The severity of asthma can vary with time and regular reassessments (at least every 3 months) are necessary.

On treatment, chronic asthma is classified as:
» controlled,
» partially controlled, or
» uncontrolled.

The following criteria are used to classify control:

	Controlled	Partially controlled (Any present in any week)	Uncontrolled
Daytime symptoms	None (2 or less/ week)	More than twice/week	3 or more features of partly controlled asthma present in any week
Limitations of activities	None	Any	
Nocturnal symptoms/ awakening	None	Any	
Need for 'rescue'/ 'reliever' treatment	None (2 or less/ week)	More than twice/week	
Lung function (PEF or FEV_1)	Normal	< 80% predicted or personal best (if known) on any day	
Exacerbation	None	One or more/year	

Partially controlled or uncontrolled cases require escalation in therapy while cases controlled for > 4 months require gradual reduction in therapy.

Assessment of severity and classification of chronic asthma
Before initiating treatment, classify the grade of severity of patient illness according to the presence of the most severe feature. This assists in choosing the most appropriate initial maintenance therapy.

Infrequent asthma: less than one acute exacerbation in 4–6 months.
Persistent asthma: mild, moderate or severe.

Criteria	Mild	Moderate	Severe
Day time symptoms	2–4/week	> 4/week	continuous
Night time symptoms	2–4/month	> 4/month	frequent
Prior admission to hospital for asthma	None	one previous admission	> one previous admission or admission to ICU
PEFR*	> 80%	60–80%	< 60%

*Peak expiratory flow rate (PEFR) – patient's best as percentage of predicted value.

GENERAL AND SUPPORTIVE MEASURES

» Environmental control, avoid triggers, e.g.:
  > exposure to cigarette smoke,
  > preservatives such as sulphites and benzoates,
  > house pets such as cats and dogs,
  > house-dust mite sensitisation: use plastic mattress covers, and remove bedroom carpets.
» Wash bedding covers in hot water (> 70 °C).
» Educate children, parents, caregivers and teachers.

MEDICINE TREATMENT

Medicine delivery systems

Use spacer devices with a metered dose inhaler. Prime all spacers with 2 doses of inhaled medication prior to first use. The size of the spacer is dependent on the tidal volume of the child:

	Spacer volume	Face mask/ mouthpiece	Valve
Infants	150–250 mL	face mask	mandatory
Children < 5 years **Children > 5 years**	500 mL	face mask mouthpiece	recommended
Adolescents	750 mL	mouthpiece	not necessary

The technique of using the spacer varies with age:

» Infants and young children: use tidal breathing of 10 long, deep, slow breaths.
» Older children and adolescents: breathe out fully, actuate the inhaler, inhale the entire contents in one long, slow breath and hold breath for 10 seconds.

Inhaled corticosteroid use

» Inhaled corticosteroids are indicated for all cases of persistent asthma.
» Spacer devices increase the efficacy of inhaled corticosteroids.
» Rinse the mouth after inhalation of inhaled corticosteroids to reduce systemic absorption and adverse effects.
» Wash face if a face mask is used.
» Use the lowest possible effective dose of steroids.

15.4.2.1 INFREQUENT ASTHMA

Although infrequent asthma is thought not to exist in the adolescent and adults, it is still considered in the classification for children up to 12 years of age.

To relieve symptoms:

- ß$_2$-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 µg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

Note: Failure to respond to 2 doses of an inhaled bronchodilator given 20 minutes apart is an indication of an **acute exacerbation** of asthma. See section 15.4.1: Asthma, acute attack.

15.4.2.2 PERSISTENT ASTHMA

Mild persistent asthma
When needed for acute exacerbations:

- ß2-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 µg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

PLUS
For daily maintenance treatment:

- Low dose inhaled corticosteroids, e.g.:
  - Beclomethasone **or** budesonide, inhalation, 50–100 µg, 12 hourly using a metered-dose inhaler with a spacer device.

Moderate persistent asthma
To relieve symptoms:

- ß2-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 µg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

PLUS

- Regular anti-inflammatory treatment with medium-dose inhaled corticosteroids:
  - Beclomethasone **or** budesonide, inhalation, 100–200 µg, 12 hourly using a metered-dose inhaler with a spacer device.

OR

- In children > 6 years with multiple allergies on other steroid formulations, low-dose inhaled corticosteroids plus long-acting beta agonist (LABA), e.g.:
  - Fluticasone plus salmeterol by inhalation, 12 hourly. Specialist initiated.
    Metered dose inhaler:
    - Fluticasone/salmeterol, 25/50 MDI, 2 puffs 12 hourly.

    OR
    - Fluticasone/salmeterol 25/125 MDI, 2 puffs, 12 hourly.

    OR
    Accuhaler:
    - Fluticasone/salmeterol 50/100, 1 inhalation, 12 hourly.

OR

- Fluticasone/salmeterol 50/250, 1 inhalation, 12 hourly.

Severe persistent asthma

To relieve symptoms:

- $ß_2$-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 µg, as required 3–4 times daily using a metered-dose inhaler with a spacer device until symptoms are relieved.

PLUS

- Low-dose inhaled corticosteroids plus LABA, e.g.:
  - Fluticasone plus salmeterol, inhaled, 12 hourly. Specialist Initiated.

    Metered dose inhaler:
    - Fluticasone/salmeterol, 25/50 MDI, 2 puffs, 12 hourly.

    OR
    - Fluticasone/salmeterol 25/125 MDI, 2 puffs, 12 hourly.

    OR

    Accuhaler:
    - Fluticasone/salmeterol 50/100, 1 inhalation, 12 hourly.

    OR
    - Fluticasone/salmeterol 50/250, 1 inhalation, 12 hourly.

REFERRAL

» Diagnostic uncertainty.
» After a life-threatening episode.
» Unstable or difficult to control asthma.
» Asthma interfering with normal life, despite treatment.
» Severe persistent asthma not responding to therapy.

Suggested reference peak expiratory flow (PEF) values for children:

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
100	127	142	120	126
101	131	145	124	130
102	135	149	128	133
103	138	152	131	137
104	142	156	135	140
105	146	159	139	144
106	150	163	143	148
107	154	166	147	151
108	158	170	151	155
109	162	174	155	159
110	166	178	159	163
111	170	182	163	167
112	175	185	168	171
113	179	189	172	175
114	184	193	176	179

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
115	188	197	181	184
116	193	202	186	188
117	197	206	190	192
118	202	210	195	197
119	207	214	200	201
120	212	218	205	206
121	217	223	210	210
122	222	227	215	215
123	227	232	220	220
124	232	236	226	225
125	237	241	231	230
126	243	245	236	235
127	248	250	242	240
128	254	255	248	245
129	259	259	253	250
130	265	264	259	255
131	271	269	265	260
132	276	274	271	266
133	282	279	277	271
134	288	284	283	277
135	294	289	289	282
136	300	294	295	288
137	307	299	302	293
138	313	304	308	299
139	319	309	315	305
140	326	315	322	311
141	332	320	328	317
142	339	325	335	323
143	345	331	342	329
144	352	336	349	335
145	359	342	356	342
146	366	348	363	348
147	373	353	371	354
148	380	354	378	361
149	387	365	386	368
150	395	371	392	374
151	402	377	401	381
152	410	382	409	388
153	417	388	417	395
154	425	394	425	402
155	433	401	433	409
156	440	409	441	416
157	448	413	442	423
158	456	419	458	430
159	464	426	466	437
160	473	432	475	445
161	481	438	484	452

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
162	489	445	492	460
163	498	451	501	468
164	506	458	510	475
165	515	465	520	483
166	524	471	529	491
167	533	478	538	499
168	542	485	548	507
169	551	492	557	515
170	560	499	567	523
171	569	506	577	532
172	578	513	587	540
173	588	520	597	548
174	597	527	607	557
175	607	534	617	566
176	617	541	627	574
177	626	549	638	583
178	636	556	648	592
179	646	563	659	601
180	657	571	670	610

**Based on African American data.*

For optimal control, 80% of the predicted peak flow is required.

15.5 UPPER AIRWAY DISEASES

15.5.1 EPIGLOTTITIS

J05.1

DESCRIPTION

Life-threatening upper airway obstruction at the level of the supraglottic structures (epiglottis and arytenoids). The condition is rare since *H. influenzae* type b vaccination has been introduced.

DIAGNOSTIC CRITERIA

» Acute onset, high fever, sore throat, dysphagia, refusal to eat or swallow, drooling and muffled voice.
» Position of comfort to protect the upper airway: sitting upright, head forward, open mouth, neck in extension.

GENERAL AND SUPPORTIVE MEASURES

» Do not interfere with the protective mechanism of the patient. Allow the child to remain sitting up.
» Avoid all measures that could agitate the patient:
  > make no attempt to see the epiglottis,
  > do not routinely perform X-rays of neck and chest.

» Secure the airway before IV line insertion and blood sampling.
» Monitor oxygen saturation (pulse oximeter).

Acute airway obstruction

Caution
Epiglottitis is an upper airway emergency.
Total upper airway obstruction is imminent by the time stridor appears.
Prepare equipment for bag-mask ventilation, endotracheal intubation, needle cricothyroidotomy and tracheostomy.

» If the airway obstructs completely or respiratory arrest occurs, attempt to establish an airway: ventilate with bag and mask.
» If unable to ventilate: intubate.
» If unable to intubate: perform needle or surgical cricothyroidotomy.

Total airway obstruction may occur suddenly and quite unpredictably; the patient should ideally be intubated before referral. Intubation should preferably be performed under general anaesthesia in an operating theatre.

If intubation prior to referral is not possible, transfer patient as an emergency, advising transfer staff to avoid lying the child down. Inform the receiving hospital before departure.

During transport, if the child decompensates, attempt bag and mask ventilation.
After an open airway has been secured:
» take blood for cultures,
» swab epiglottis for microscopy, culture and sensitivity,
» monitor heart rate, respiratory rate, blood pressure and SaO_2,
» ensure adequate nutrition and hydration.

MEDICINE TREATMENT
- Oxygen, humidified, if needed.
- Ceftriaxone, IV, 50 mg/kg/dose, once daily for 7 days.

REFERRAL
» All, once airway is secured.

15.5.2 LARYNGOTRACHEOBRONCHITIS, ACUTE VIRAL (CROUP)
J05.0

DESCRIPTION
Potentially life-threatening airway obstruction in children and one of the most common causes of stridor in children aged between 6 months and 2 years.

The most important viruses causing laryngotracheobronchitis (LTB) include:
» para-influenza virus (most common),
» measles,
» herpes simplex,
» adenovirus.

DIAGNOSTIC CRITERIA

Clinical

» A previously healthy child who, a day or two after the onset of an upper respiratory tract infection, develops progressive airway obstruction with a barking cough and stridor.
» A mild fever may be present.
» Stridor becomes softer as airway obstruction becomes more severe.

The following features suggest a different diagnosis:
» acute onset of obstruction without prodromal features (foreign body or angioneurotic oedema),
» incomplete immunisation and a membrane in the upper airway (diphtheria),
» high fever, dysphagia, drooling or sitting position (epiglottitis, retro-pharyngeal abscess, bacterial tracheitis),
» recurrent upper airways obstruction (laryngeal papilloma).

Assessment of severity of airway obstruction in LTB

Severity	Inspiratory obstruction (Stridor)	Expiratory obstruction (Stridor)	Pulsus paradoxus
Grade 1	+		
Grade 2	+	+ passive expiration	
Grade 3	+	+ active expiration using abdominal muscles	+
Grade 4	cyanosis, apathy, marked retractions, impending apnoea		

GENERAL AND SUPPORTIVE MEASURES

» Monitor the nutritional status and fluid requirements.
» Monitor oxygen saturation, heart rate and respiratory rate.
» Avoid arterial blood gas estimations. Clinical criteria are more effective in determining severity.
» Depending on severity, admit child to high care or intensive care ward.

MEDICINE TREATMENT

Grade 1 obstruction

- Prednisone, oral, 2 mg/kg as a single dose.
  - To a maximum of:
    - 20 mg: Children < 2 years for 5 days.
    - 30 mg: Children 2–5 years for 5 days.
    - 40 mg: Children 6–12 years for 5 days.

OR

- Dexamethasone, IV/IM, 0.5 mg/kg as a single dose.

Note: Avoid steroids in patients with measles or herpes infection.

Grade 2 obstruction

As above

PLUS

- Adrenaline (epinephrine), 1:1000, nebulised with oxygen, every 15–30 minutes until expiratory obstruction is abolished.
  - 1 mL adrenaline (epinephrine) 1:1000 diluted in 1 mL sodium chloride 0.9%.

Grade 3 obstruction

As above:

» if improvement, treat as in grade 2 but reduce frequency of adrenaline (epinephrine) nebulisations with time,
» if no improvement within 1 hour, intubate, preferably under general anaesthetic,
» refer.

Grade 4 obstruction

As above, and:

» continue steroids,
» continue with adrenaline (epinephrine) nebulisation with 100% warm humidified oxygen,
» emergency intubation or intubation under general anaesthesia, if circumstances permit,
» if unable to intubate, bag and mask ventilate and refer urgently.

For suspected herpes:

- Aciclovir, IV, 10–15 mg/kg/dose 8 hourly for 5–7 days.

For suspected bacterial infection in children:

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose of amoxicillin component 8 hourly (do not exceed 10 mg/kg/day of clavulanate component) for 7 days.

REFERRAL

» Intubated children for ICU care. Intubate all children with grade 3 airway obstruction not responding to adrenaline nebulisations and all children with grade 4 airway obstruction before referral.
» Children with an uncertain diagnosis.

15.6 OBSTRUCTIVE SLEEP APNOEA

G47.3

DESCRIPTION

Affects all ages as either partial or complete airway obstruction that disrupts gas exchange and sleep patterns. Associated with truncal obesity and increased BMI, recurrent otitis media, allergic rhinitis/asthma and syndromic conditions e.g. Down syndrome, Treacher-Collins syndrome, Apert syndrome etc.

Presents with daytime (sleepiness, decreased cognition) and night (habitual snoring, paradoxical breathing, and sweating, breathing pauses) symptoms. Clinical signs include developmental delay, adenoidal facies, tonsillar and adenoidal hypertrophy, pulmonary hypertension and cor-pulmonale.

DIAGNOSTIC CRITERIA

» Lateral neck X-ray.
» Overnight pulse oximetry.
» FBC (polycythaemia), hypothyroidism (Down syndrome).
» ECG/ECHO (pulmonary hypertension/cor-pulmonale).
» Polysomnography (if available).
» Apnoea/hypopnoea index > 1.

GENERAL AND SUPPORTIVE MEASURES

» Avoid tobacco smoke exposure.
» Lose weight.

MEDICINE TREATMENT

Intranasal steroid, e.g.:

- Fluticasone 50 µg/spray.
  - < 12 years: 1 spray into each nostril daily.
  - > 12 years: 1 spray into each nostril twice daily.

Discuss with paediatrician for management of obesity.

Surgical management

Refer to ENT for consideration of surgical options.

Complications

» Neurodevelopmental regression, low self-esteem, aggressive, moody, ADHD.
» Decreased quality of life.
» Failure to thrive.

REFERRAL

Refer all patients.

References

[1] World Health Organisation. Revised WHO classification and treatment of childhood pneumonia at health facilities. Evidence Summaries. WHO Library. 2014. https://apps.who.int/iris/bitstream/handle/10665/137319/9789241507813_eng.pdf;jsessionid=DC9BAB4C398AE239AE3110330E619294?sequence=1