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 mcg, 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. A

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

- Amoxicillin/clavulanate, IV, 25 mg/kg/dose A 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 A of amoxicillin component 12 hourly to complete 10 days total. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

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. W

PLUS

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

If an MRSA pneumonia is confirmed:

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

For Mycoplasma pneumonia and other atypical pneumonias:

- Macrolide, e.g.:
- If severely ill initiate:
  - Azithromycin, IV, 10 mg/kg/dose daily for 2 days. W
    THEN
  - Azithromycin, oral, 5 mg/kg/dose daily for 3 days. W

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

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 A 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 in children, 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. A
  - 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. W

PLUS

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

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. W

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 A 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. A

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 A 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. A

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

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

OR

- Amoxicillin/clavulanic acid, oral, 45 mg/kg/dose A of amoxicillin component 12 hourly. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

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 A 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 A of amoxicillin component 12 hourly.

- Total antibiotic duration of 10 days.

(See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

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 W 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 A 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 A of amoxicillin component 12 hourly. (See annexure 1: Amoxicillin/Clavulanic weight band dosing table)

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 EXACERBATION, ACUTE

J45.0-1/J45.8-9/J46

DESCRIPTION

Acute asthma is an emergency and presents with one or more of the following:

» wheeze
» chest tightness
» shortness of breath
» cough
» respiratory distress

There are many other causes of wheezing in children, but they will be initially treated the same way in the acute setting if severe.

DIAGNOSIS

The following are danger signs in acute, severe asthma and require referral to high or intensive level of care:

» restlessness
» disturbed level of consciousness
» rising P_aCO_2
» silent chest with auscultation
» PEFR < 50% of predicted value
» decreasing oxygen saturation < 85%
» palpable pulsus paradoxus
» chest pain (air leaks)

Classify the patient according to the most severe clinical features present, e.g., if a patient has some features of mild-moderate exacerbation, but a single severe or life-threatening feature, manage them according to the higher severity assessment.

Table 15.1 Classification of Severity of Acute Asthma Exacerbations in Children ≤ 11 years

	Mild/Moderate	Severe	Life-Threatening
Oxygen saturation (room air)	Age ≤ 5 yrs: ≥ 94% Age 6-11 yrs: ≥ 94%	Age ≤ 5 yrs: < 94% Age 6–11 yrs: < 90-94	Age ≤ 5 yrs: < 90% Age 6–11 yrs: < 90%
PEFR*	Age 6-11 yrs: > 50%	Age 6–11 yrs: < 50%	Cannot blow
Arterial P_aCO_2	< 40 mmHg (5.3 kPa)	≥ 40 mmHg (5.3 kPa)	≥ 40 mmHg (5.3 kPa)
Wheezing	Present	Breath sounds soft	Silent chest
Respiratory rate	Age ≤ 5 yrs: ≤ 40/min Age 6-11 yrs: ≤ 30/min	Age ≤ 5 yrs: > 40/min Age 6-11 yrs: > 30/min	Poor respiratory effort
Heart rate	Normal or mildly elevated	Significant tachycardia	Significant bradycardia
Additional signs	Speaks in phrases Able to drink Chest indrawing	Speaks in words Not drinking well Use of accessory muscles	Difficulty speaking Unable to feed/drink Confusion/drowsiness Cyanosis

*Peak expiratory flow rate (PEFR) – as percentage of predicted value and not performed in children < 6 years.

LoE:IIIb[2]

LoE:IIIb[3]

Peak expiratory flow rate (PEFR) is expressed as percentage of predicted normal (or personal best if known). See PEF charts in Annexure 2: Asthma monitoring.

GENERAL MEASURES

» Assess the severity of the exacerbation and treat according to the management below.

» Admit children with severe asthma exacerbations to a high care unit, if available.

» Monitor:
- > heart rate
- > respiratory rate
- > peak expiratory flow rate
- > 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 0.9% sodium chloride/ 5% dextrose IV.
- Patients with a prolonged episode of a severe asthma exacerbation may become dehydrated due to poor intake or vomiting.

- Avoid overhydration in patients with acute asthma: do not exceed the recommended IV fluid volume in children, i.e., 50 mL/kg per 24 hours.

» Monitor potassium levels in a patient on continuous β_2-agonist therapy.
» Monitor response to treatment with repeated PEFR and clinical signs. Assess need to escalate therapy hourly, or sooner if worsening clinically.

Table 15.2: Assess response to initial management:

	Response	No response
Respiratory rate (breaths per minute)	< 40	> 40
Speech/Drinking	normal	impaired

Note:
» Physiotherapy, antihistamines, antibiotics and sedation are not beneficial in the acute setting.
» Agitation and restlessness are signs of severe hypoxia and require urgent assessment for respiratory support.
» See Annexure 3: Devices for Respiratory Conditions for guidance on inhaler, spacer and nebuliser device techniques.

MEDICINE TREATMENT

Mild/Moderate exacerbation of asthma

- Short-acting β_2-agonist, e.g.:
- Salbutamol, 100 mcg metered-dose inhaler (MDI) with a spacer device.
  - Administer 200–400 mcg (2–4 puffs).
  - A maximum of 10 puffs may be administered based on clinical response.
  - Repeat every 20 minutes for the first hour depending on clinical response.
  - Thereafter repeat every 2–4 hours if needed.

LoE:IIIb[4]

OR

- Salbutamol 0.5% (5 mg/mL), solution.
  - **Age < 6 years:** Administer 2.5 mg salbutamol 0.5% (5 mg/mL) solution, made to 4 mL nebuliser solution by mixing 0.5 mL salbutamol and 3.5 mL sodium chloride, 0.9% solution.
  - **Age 6–11 years:** Administer 5 mg salbutamol 0.5% (5 mg/mL) solution, made to 4 mL nebuliser solution by mixing 1 mL salbutamol and 3 mL sodium chloride, 0.9% solution.
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Repeat every 20 minutes for the first hour if needed.
  - Thereafter repeat every 2–4 hours if needed.

LoE:IIIb[5]

PLUS

- Prednisone, oral, 1 mg/kg, immediately up to a maximum of:
  - Children < 2 years: 20 mg (consider omitting steroids for children in this age group with episodic viral wheeze).
  - Children 2–5 years: 30 mg.

- Children 6–11 years: 40 mg.

<u>In patients who cannot tolerate oral therapy, are vomiting, or are suspected to have gastric atony:</u>

- Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated.

<u>If response is poor or clinical condition is worsening:</u>

Continue oxygen and salbutamol therapy, and add ipratropium bromide: *LoE:IIIb*[6]

Age < 6 years

- Salbutamol 0.5% (5 mg/mL) solution, 2.5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing 2.5 mg salbutamol (0.5mL of 5mg/mL solution) with ipratropium bromide 0.25mg (2 mL of 0.25mg/2mL solution). Make up to a total volume of 4 mL by adding 1.5 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours depending on clinical response
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 2.5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

LoE:IIIb[7]

Age 6-11 years:

- Salbutamol 0.5% (5 mg/mL) solution, 5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 5 mg (1mL of 5 mg/mL solution) with ipratropium bromide 0.25 mg (2mL of 0.25 mg/2 mL solution)Make up to a total volume of 4 mL by adding 1 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours, depending on clinical response.
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

<u>If response is poor after salbutamol/ipratropium bromide nebulisation:</u>

» Prioritise transfer to a high care- or intensive care-unit.
» Exclude upper airway obstruction.
» Treat as a severe asthma exacerbation.

<u>Once the patient has responded to therapy, continue oral corticosteroids:</u>

- Prednisone, oral, 1 mg/kg, daily up to a maximum dose of:
  - Children < 2 years: 20 mg for 5 days.
  - Children 2–5 years: 30 mg for 5 days.
  - Children 6–11 years: 40 mg for 5 days.

Severe exacerbation of asthma

- Oxygen to keep oxygen saturation ≥94%.

AND

- Salbutamol 0.5% (5 mg/mL) solution with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:

LoE:IIIb[8]

Age < 6 years

- Salbutamol 0.5% (5 mg/mL) solution, 2.5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 2.5 mg (0.5mL of 5mg/mL solution) with ipratropium bromide 0.25mg (2 mL of 0.25mg/2mL solution). Make up to a total volume of 4 mL by adding 1.5 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours depending on clinical response
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 2.5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

LoE:IIIb[9]

Age 6-11 years:

- Salbutamol 0.5% (5 mg/mL) solution, 5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 5 mg (1mL of 5 mg/mL solution) with ipratropium bromide 0.25 mg (2mL of 0.25 mg/2 mL solution).Make up to a total volume of 4 mL by adding 1 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours, depending on clinical response.
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

PLUS

- Prednisone, oral, 1 mg/kg, immediately up to a maximum of:
  - Children < 2 years: 20 mg.
  - Children 2–5 years: 30 mg.
  - Children 6–11 years: 40 mg.

<u>In patients who cannot tolerate oral therapy, are vomiting, or are suspected to have gastric atony:</u>

- Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated.

<u>If response is poor after salbutamol/ipratropium bromide nebulisation:</u>

» Prioritise transfer to a high care- or intensive care-unit.

» Consult paediatrician for magnesium sulfate use:

- Magnesium sulfate, IV bolus, 50 mg/kg in 20 mL sodium chloride 0.9%, as a single dose, administered over 20 minutes.

Life-threatening exacerbation of asthma

» Prioritise transfer to a high care- or intensive care-unit. Discuss management with specialist.

- Oxygen, to keep saturation ≥94%.

AND

All children aged ≤ 11 years: *LoE:IIIb*[10]

- Salbutamol 0.5% (5 mg/mL) solution 5 mg, with ipratropium bromide (0.25 mg/2 mL) solution, 0.5 mg, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 5 mg (1mL of 5 mg/mL solution) with ipratropium bromide 0.5 mg (4mL of 0.25 mg/2 mL solution).
  - Administer every 15 minutes until the asthma severity category improves from life-threatening to severe.
  - Recommended delivery at a flow rate of 8 L/min with oxygen.

PLUS

- Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated.

<u>If response is poor after salbutamol/ipratropium bromide nebulisation:</u>

» While awaiting transfer to high care or intensive care unit, consult paediatrician for magnesium sulfate use:

- Magnesium sulfate, IV bolus, 50 mg/kg in 20 mL sodium chloride 0.9%, as a single dose, administered over 20 minutes.

<u>If response is poor after magnesium sulfate:</u>

» Exclude upper airway obstruction.

» Prepare for intubation.

» Refer for respiratory support.

<u>In patients where nebulised treatment cannot be given effectively, e.g., silent chest, agitation with mask intolerance, repeated mask removal, or cyanosis:</u>

In a high care or intensive care setting where adequate monitoring is accessible, consult a specialist for use of:

- Salbutamol, IV, 1mg/mL injection for IV infusion.
  - Loading dose: Administer 5–10 mcg/kg per minute of 1 mg/ml solution over 1 hour.
  - Follow with continuous infusion at 1 mcg/kg per minute. If necessary, increase dose by 1 mcg/kg every 15 minutes, titrating according to clinical response and adverse effects.
  - Maximum dose: 5 mcg/kg per minute.
  - Continue nebulised bronchodilator therapy concurrently.
  - Monitor for tachycardia, arrhythmias, hypokalaemia, hyperglycaemia, and lactic acidosis (uncommon).

In cases of life-threatening asthma that are unresponsive to other measures:
Requires admission to intensive care unit for appropriate monitoring, e.g., ECG monitoring.

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

Once the patient has responded to therapy, continue short-acting β_2-agonists and oral corticosteroids:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.

AND

- Prednisone, oral, 1 mg/kg, daily up to a maximum dose of:
  - Children < 2 years: 20 mg for 5 days.
  - Children 2–5 years: 30 mg for 5 days.
  - Children 6–11 years: 40 mg for 5 days.

» On discharge, determine/review chronic asthma management and follow-up symptom control at next visit.

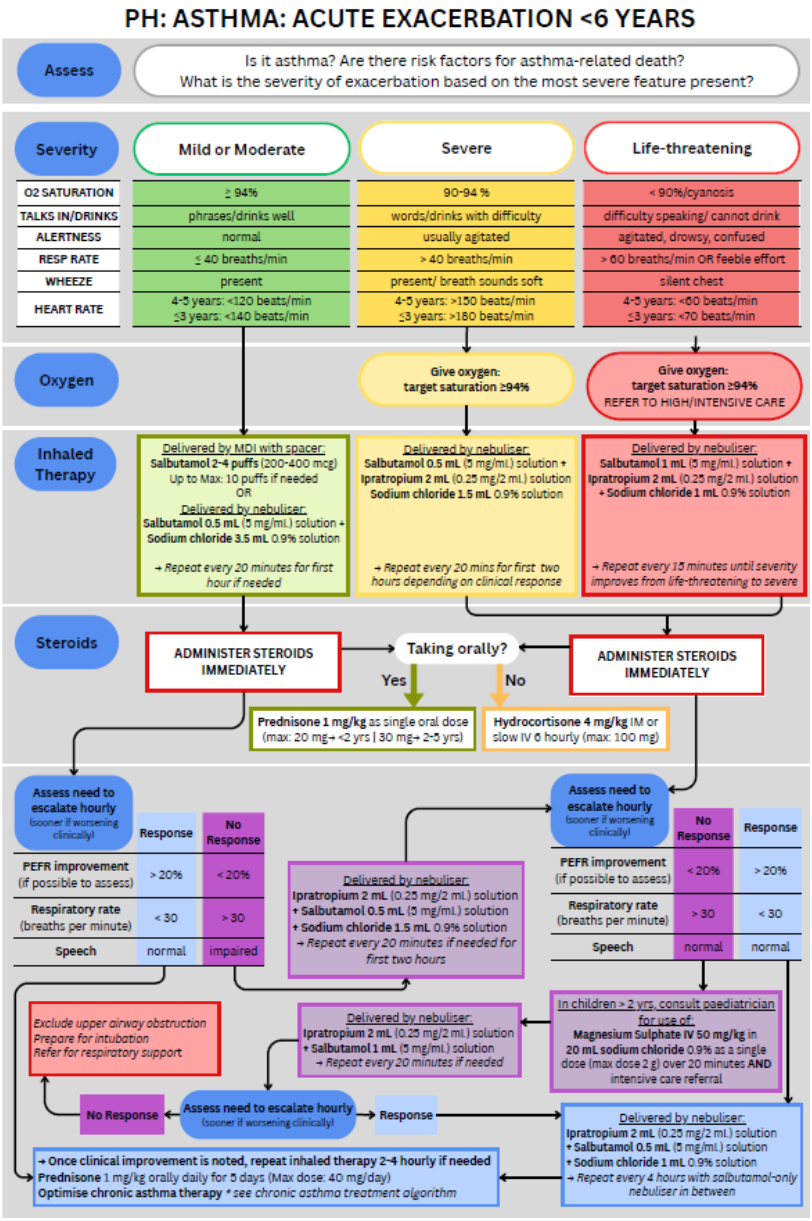

Figure 15.1: Management of acute asthma exacerbation in children < 6yrs

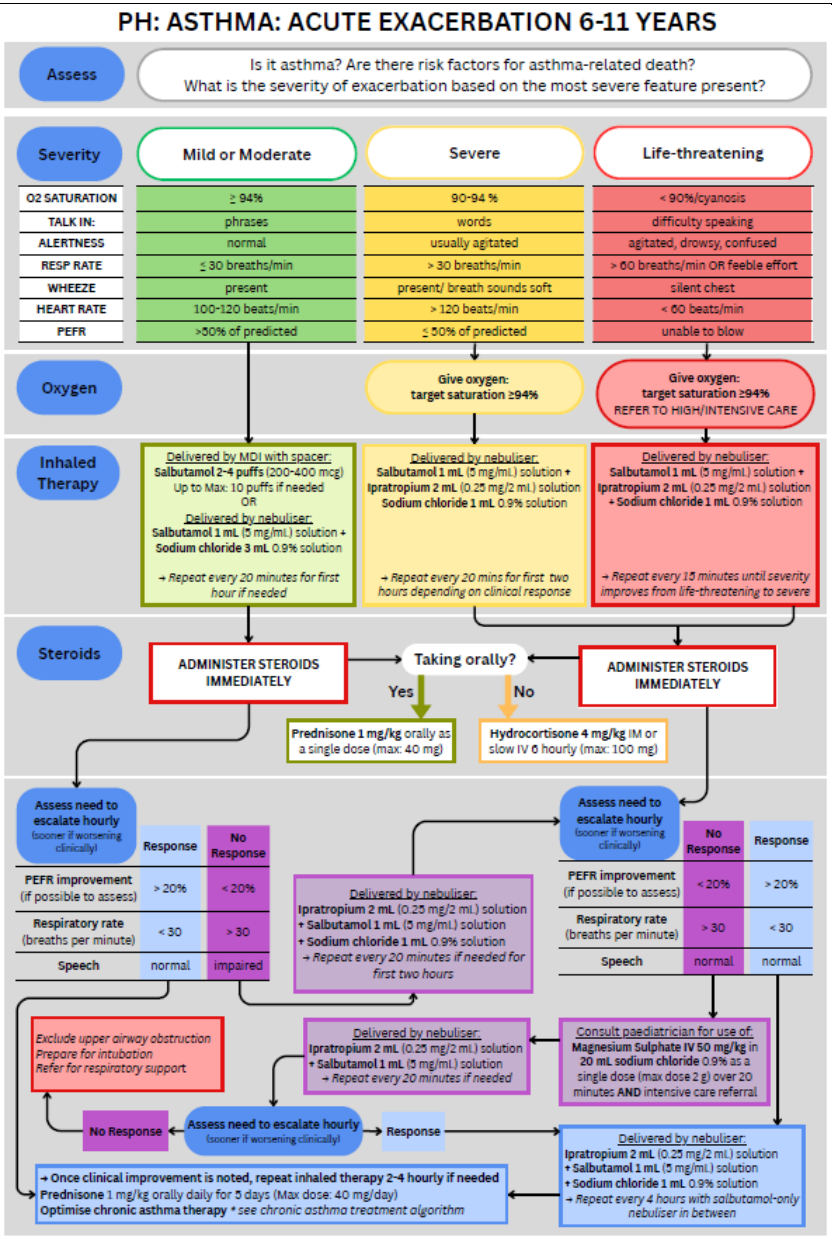

Figure 15.2: Management of acute asthma exacerbation in children 6-11yrs

15.4.2 ASTHMA, CHRONIC

J45.0-1/J45.8-9

DESCRIPTION

Asthma is a chronic inflammatory airways disease defined by a history of recurrent episodes of wheezing, shortness of breath, chest tightness and cough. The pattern of disease and expiratory flow varies over time and in intensity. Chronic, poorly controlled asthma may lead to persistent airflow limitation.

Several clinical asthma phenotypes are recognised by their differences in demographics and clinical characteristics, but in general do not correlate with treatment responses.

DIAGNOSIS

Clinical Features:

» **Wheezing:** High-pitched whistling sounds on exhalation (especially in children).
» **Cough:** Often worse after exercise, laughter/crying, or at night.
» **Difficulty breathing** or chest tightness.
» **Pattern:** Symptoms often worsen at night or early morning; triggered by viral infections, allergens, exercise, or irritants (e.g., tobacco smoke).

Diagnostic criteria include:

Age group	Criteria
< 6 years	» Recurrent acute wheezing episodes <u>OR</u> at least one acute wheezing episode with asthma-like symptoms between episodes. » Timely response to acute or longer-term asthma treatment, defined as either: – Response to SABA within minutes during acute wheezing episode (or within 3-4 hours of SABA and oral corticosteroid use for severe exacerbations treated in healthcare settings). – Reduced frequency or severity of acute wheezing episodes and/or symptoms between episodes during trial of maintenance ICS and SABA therapy. » No likely alternative cause (except for concurrent viral infection). <u>Note:</u> » All 3 criteria are required for diagnosis of asthma. If only 1 or 2 are present, document as suspected asthma and initiate treatment as indicated.
Age 6–11 years	» Documented variable airflow limitation: – Spirometry showing reversible forced expiratory volume in 1 second (FEV1) > 12% post-bronchodilator (See Appendix I in Primary Health Care STGs and EML). – Peak Expiratory Flow (PEF) improvement > 15% post-bronchodilator. » Diurnal PEF variability > 10% over 2 weeks.

GENERAL MEASURES

» Identify triggers and address modifiable risk factors.
» Educate children, parents, caregivers and teachers on avoidance of triggers, inhaler and spacer technique, and early recognition of exacerbation symptoms.
» Manage environmental triggers, e.g.:
  - Minimise exposure to cigarette smoke;
  - avoid preservatives such as sulphites and benzoates;
  - for house-dust mite sensitisation, use plastic mattress covers;
  - minimise exposure to cockroaches: use baits placed in homes;
  - avoid damp or mould in homes.

Table 15.3: Assessment of risk factors

Risk factors for exacerbations		
Poor control	» Uncontrolled asthma (as assessed below).	
Inappropriate medication use	» High SABA use » Inadequate ICS use (not prescribed, poor adherence, poor inhaler technique)	
Co-morbidities	» Obesity » Chronic rhinosinusitis	» GORD » Confirmed food allergy
Exposures	» Second-hand smoke » Air pollution » Preservatives (e.g., sulphites, benzoates)	» Known allergen exposure » Pets (e.g. cats and dogs)
Social factors	» Major psychosocial and socioeconomic issues e.g. poverty, overcrowding, access to healthcare etc.	
Poor lung function	» FEV1 < 60% predicted (measured with spirometry) » High bronchodilator responsiveness	
Inflammatory markers	» Eosinophilia (blood)	
Exacerbations	» Any prior intubation or ICU admission for asthma » Severe exacerbation in the past year	
Risk factors for developing persistent airflow limitation		
History	» Preterm birth, low birth weight, greater infant weight gain » Chronic mucus hypersecretion	
Medications	» History of severe exacerbation (see above for definitions) without ICS treatment thereafter	
Exposures	» Tobacco smoke » Noxious chemicals	» Domestic exposures
Investigations	» Low initial FEV_1	» Blood eosinophilia
Abbreviations: FEV_1: forced expiratory capacity in 1 second, GORD: Gastro-oesophageal reflux disease, ICS: inhaled corticosteroid, SABA: short-acting β2 agonist		

» Regularly assess inhaler and spacer use technique and correct where necessary. See Annexure 3: Devices for Respiratory Conditions for guidance on inhaler, spacer and nebuliser device techniques.

» Breathing exercises may be offered as an adjunct to pharmacological therapy: they may improve symptoms and quality of life, but do not improve lung function or reduce exacerbation risk.

ASSESSMENT OF CONTROL

» Asthma control on therapy can be classified as well-controlled, partially controlled, or uncontrolled.
» Review asthma control frequently and adjust treatment as needed, as symptoms may fluctuate and remit throughout childhood (see stepwise management below).

Table 15.4: Assessment of asthma control over the past 4 weeks (or since last review):

	Yes / No (Assign one point for each "yes" answer)	
	Yes	**No**
Daytime asthma symptoms more than twice weekly		
Night waking due to asthma (any)		
Activity limitation due to asthma (any)		
IF using SABA-only inhaler: SABA-only reliever use more than twice/week for symptoms*		
Total points	**Control**	
0 points	Well controlled	
1–2 points	Partially controlled	
3–4 points	Uncontrolled	

*Only applicable if patient is using an inhaler that **only contains short-acting β_2-agonist**, i.e., not a corticosteroid-containing inhaler.
Abbreviations: SABA: Short acting β_2-agonist

MEDICINE TREATMENT

Medicine delivery systems

» Spacer devices increase the efficacy of inhaled therapy and should be used in combination with metered dose inhalers.
» Prime all spacers with two 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	500 mL	Face mask	Recommended
Children > 5 years	500 mL	Mouthpiece	Recommended
Adolescents	500 mL	Mouthpiece	Not necessary

» The technique of using the spacer varies with age:
  – Infants and young children (deep tidal breathing technique): Actuate the inhaler into the spacer and allow at least 6 tidal breaths.
  – Older children and adolescents (single breath inhalation technique): Breathe out fully into the spacer, actuate the inhaler into the spacer, inhale the entire contents in one long, slow breath and hold breath for 10 seconds.
» Rinse the mouth after inhalation of inhaled corticosteroids to reduce systemic absorption and adverse effects.
» Wash face after use if a face mask is used.
» See Annexure 3: Devices for Respiratory Conditions for guidance on inhaler, spacer and nebuliser device techniques.

Principles of asthma therapy

Asthma symptom control is achieved by optimising the use of inhaled bronchodilators and corticosteroids. Treatment strategies include reliever therapy only, or maintenance therapy with reliever therapy as needed. Early introduction of inhaled corticosteroids, where indicated, improves symptom control and reduces the risk of exacerbations.

Therapeutic goals include:
» Optimal control of symptoms and maintenance of normal activity levels,
» Minimising risk of exacerbations, impaired lung development, and adverse side-effects to medication. The lowest effective dose of inhaled corticosteroids should be used, when indicated.

Review asthma control frequently and consider whether the level of treatment should be adjusted:
» If patient is well-controlled: STEP DOWN treatment.
» If patient is partially controlled or uncontrolled: STEP UP treatment.

Corticosteroid and bronchodilator combination therapy

The use of an anti-inflammatory reliever (AIR) (usually an inhaled corticosteroid/ICS with the rapid onset LABA reliever, formoterol) is more effective than SABA use alone, even in asthma with low symptom frequency. In more severe disease, the same ICS-formoterol combination inhaler can be used for symptom relief as well as maintenance therapy, and is called maintenance-and-reliever therapy (MART).

Note, however, that there is currently insufficient evidence to support MART in children under 6 years of age.

Table 15.5: Principles of asthma therapy by age group:

Age	Principles of therapy
All children	» Inhaled corticosteroids are indicated for maintenance therapy in children with asthma symptoms occurring more than twice a week, or those with ≥ 1 exacerbation in the past year. » The ICS dose may be increased in children whose symptoms are still not well controlled after 2–3 months of initial low-dose ICS therapy, **after** confirming appropriate diagnosis, management of risk factors, inhaler technique, and adherence. » Consider ICS dose reduction after 2–3 months in children with a good response to therapy.
Age 0–5	» Recommended initial asthma therapy is SABA, given as needed <u>without ICS,</u> when symptoms occur. » Consider a 2–3 month trial of SABA therapy, as needed, in children with infrequent acute wheezing episodes that do not require unscheduled medical care. » Consider short-course ICS maintenance therapy, in addition to as-needed SABA therapy, for children with symptoms triggered by viral respiratory tract infections, but who are otherwise well-controlled on reliever therapy only. » Regular ICS maintenance therapy is recommended for children whose asthma is not well-controlled, or who have had one or more asthma exacerbations requiring acute hospital care, oral corticosteroids, or hospital admission in the previous year.
Age 6–11	» Initial therapy depends on recent asthma symptom control, history of exacerbations over the past year, and lung function. » Recommended initial therapy is SABA, given <u>together with an ICS</u>, as needed when symptoms occur. » MART is the preferred treatment strategy for children that require maintenance therapy and have failed to achieve symptom control with regular low-dose ICS. MART should be prescribed where available.

CAUTION

» Inhaled corticosteroids are the mainstay of therapy in asthma.
» There is currently insufficient evidence to support MART in children under 6 years of age.
» β_2-agonist monotherapy is associated with increased mortality in asthma and is **no longer recommended** for children aged 6 years and older.

Chronic asthma management for children under 6 years of age:

» Initiate children with newly diagnosed asthma at the step that correlates with their symptoms.
» Step up treatment to the next level if the child is uncontrolled, partially controlled, or at high risk of exacerbations.
» Consider treatment step down if the child has been well-controlled for 2–3 months.

Table 15.6: Assessment of asthma severity at baseline & recommended entry point for stepwise treatment for children under 6 years of age

Presenting Symptoms	Initial Treatment
Asthma symptoms: two days/week or less	**Step 1** As-needed SABA
Asthma symptoms: 3–4 days/week	**Step 2** Regular low dose ICS + as-needed SABA
Asthma symptoms: Most days (4-5 days/week) OR Night waking once a week or more	**Step 3** Regular double low dose ICS + as needed SABA
Asthma symptoms: Daily AND Night waking once a week or more AND Reduced lung function OR recent exacerbation	**Step 4** Regular double low dose ICS + as needed SABA **AND** Urgent paediatric pulmonology/allergology referral
Abbreviations: ICS = Inhaled corticosteroids; SABA = Short-acting β_2 agonist. *LoE:IIIb*[11]	

STEP 1:

(Asthma symptoms ≤ 2 days per week; and no nocturnal symptoms; and normal lung function).

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Maintenance therapy:

- Maintenance therapy is generally not required. Continue with reliever/rescue therapy and monitor asthma control.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 2:

(Asthma symptoms on 3-4 days per week; and no nocturnal symptoms; and normal lung function).

Maintenance therapy:

- Low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, once daily.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
    - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 3:

(Asthma symptoms 4–5 days per week; or weekly nocturnal symptoms; or reduced lung function).

Maintenance therapy:

- Double low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
    - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a referral for further management.

STEP 4:

(Daily asthma symptoms; and nocturnal symptoms once a week or more; and reduced lung function or has history of recent acute exacerbation).

» Continue STEP 3 therapy.

» Refer to paediatric allergology/pulmonology for further management.

» If patient remains uncontrolled while awaiting referral appointment, increase dose of beclometasone:

- Beclometasone, 100 mcg MDI, to take 200 mcg (two inhalations) with a spacer device, 12 hourly.

Chronic asthma management for children aged 6 to 11:

» Initiate children with newly diagnosed asthma at the step that correlates with their symptoms.
» Step up treatment to the next level if the child is uncontrolled, partially controlled, or at high risk of exacerbations.
» Consider treatment step down if the child has been well-controlled for 2–3 months.

Table 15.7: Assessment of asthma severity at baseline & recommended entry point for stepwise treatment for children aged 6–11 years

Presenting Symptoms	Initial Treatment
Asthma symptoms: two days/week or less	**Step 1** As-needed low-dose ICS + SABA **OR** Low dose ICS-formoterol as AIR ONLY
Asthma symptoms: 3–4 days/week	**Step 2** Regular low dose ICS + as-needed SABA **OR** Low dose ICS-formoterol as AIR only
Asthma symptoms: Most days (4-5 days/week) *OR* Night waking once a week or more *OR* Reduced lung function	**Step 3** Regular medium-dose ICS + as needed SABA **OR** Low-dose ICS-formoterol as MART (once daily maintenance dose)
Asthma symptoms: Daily *AND* Night waking once a week or more AND Reduced lung function OR recent exacerbation	**Step 4** Low-dose ICS-formoterol as MART (twice daily maintenance dose) **OR** Refer
Abbreviations: ICS = Inhaled corticosteroids; AIR only = Anti-inflammatory reliever only; MART = Maintenance-and-reliever therapy; SABA = Short-acting β_2 agonist. *LoE:IIIb*[12]	

OPTION 1: ICS+SABA REGIMEN

STEP 1:

(Asthma symptoms ≤ 2 days per week; and no nocturnal symptoms; and normal lung function)

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review

AND

- Low dose inhaled corticosteroid, e.g.:

- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, as needed whenever salbutamol is used for symptom relief.

Maintenance therapy:

» Maintenance therapy is generally not required. Continue with reliever/rescue therapy and monitor asthma control.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 2:

(Asthma symptoms on 3-4 days per week; and no nocturnal symptoms; and normal lung function)

Maintenance therapy:

- Low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 3:

(Asthma symptoms 4–5 days per week; or weekly nocturnal symptoms; or reduced lung function)

Maintenance therapy:

- Medium dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 200 mcg (two inhalations) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 4:
(*Daily asthma symptoms; and nocturnal symptoms; and reduced lung function or has history of recent acute exacerbation)*
Switch to OPTION 2 STEP 3 therapy (see below).
» If both options in STEP 3 fail to achieve asthma control, refer to paediatric allergology/pulmonology for further management.

CAUTION

» Formoterol has a rapid onset of action and can be used as reliever therapy in children 6 years and older, **BUT ONLY in combination with an ICS**.
» Salmeterol is not rapid acting and **should not be used as reliever therapy.**
» Budesonide and fluticasone have significant drug-drug interactions with HIV protease inhibitors. Substitute with beclometasone-based regimens where indicated.

OPTION 2: Anti-inflammatory reliever (AIR) ONLY or Maintenance and reliever therapy (MART)
STEP 1 AND STEP 2:
(Asthma symptoms less than 4 days per week; and no nocturnal symptoms; and normal lung function)
AIR only
Anti-inflammatory reliever/rescue therapy:
- Low dose corticosteroid/formoterol inhaler, e.g.:
- Budesonide/formoterol, MDI, 80 mcg/4.5 mcg, one inhalation with a spacer device, as needed.
  - Maximum daily dose: 640 mcg/36 mcg (8 inhalations) doses per day.
  - Patients/carers should be counselled to present to their healthcare facility for review if they require maximum doses of inhaler therapy for more than one week in a month.

Note: Insufficient asthma control on maximum therapeutic doses should trigger a review to step up treatment.

Maintenance therapy:
No maintenance therapy required. Continue with reliever/rescue therapy using ICS/formoterol combination inhaler and monitor asthma control.

STEP 3:
(Asthma symptoms 4–5 days per week; or weekly nocturnal symptoms; or reduced lung function)
MART
Maintenance therapy:
- Low dose corticosteroid/formoterol inhaler, e.g.:

- Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, once daily.

Reliever/rescue therapy:

- Low dose corticosteroid/formoterol inhaler, e.g.:
- Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, as needed for symptom relief.
  - Daily dose of budesonide/formoterol should not exceed 640 mcg/36 mcg (8 inhalations) considering maintenance and reliever doses per day. This equates to 7 additional reliever inhalations on top of 1 maintenance inhalation per day.

  Note: Insufficient asthma control on maximum therapeutic doses should trigger a review to step up treatment.

STEP 4:
(*Daily asthma symptoms; and nocturnal symptoms; and reduced lung function or has history of recent acute exacerbation)*
MART
Maintenance therapy:

- Low dose corticosteroid/formoterol inhaler, e.g.:
- Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Low dose corticosteroid/formoterol inhaler, e.g.:
- Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, as needed for symptom relief.
- Daily dose of budesonide/formoterol should not exceed 640 mcg/36 mcg (8 inhalations) considering maintenance and reliever doses per day. This equates to 6 additional reliever inhalations on top of 2 maintenance inhalations per day.

Note:

» Budesonide has a significant drug-drug interaction with HIV protease inhibitors. Replace with beclometasone-based regimen (OPTION 1 above).

REFERRAL

» Diagnostic uncertainty.
» After a life-threatening asthma exacerbation.
» Unstable or difficult to control asthma.
» Asthma not responding to medium/high dose ICS therapy

PH: ASTHMA, CHRONIC MANAGEMENT

Diagnose

Typical features

Wheeze
Cough
Difficulty breathing or chest tightness
Pattern:
- **generally worse** at night / early morning
- triggers include:
  - viral infections
  - allergens
  - exercise
  - irritants

Age < 6 years old

ALL 3 of the below criteria are required for diagnosis:
1. Recurrent acute wheezing episodes
2. No alternative cause except for concurrent viral infection
3. Timely response to acute or longer term asthma treatment
   → *if only 2 of 3 met, noted as "possible asthma"*
   → *PEF cannot be used to diagnose*

Age 6-11 years old

Diagnosis is based on:
1. **Documented variable airflow limitation**
   - Spirometry showing reversible FEV1 >12% after bronchodilator
   - Improvement >15% PEF after bronchodilator
2. PEF variability >10 %

Inhaler technique education → Modifiable risk factor management → Identify triggers

Treat

Start treatment

Age < 6 years

SYMPTOM FREQUENCY	START AT :
1-2 days per week	STEP 1
> 3-4 days/week - trial ICS	STEP 2
If **intermittent viral-induced** asthma (no interval symptoms): consider **intermittent** high-dose **ICS (STEP 3)**	

Age 6 - 11 years

SYMPTOM FREQUENCY	START AT :
1-2 days per week	STEP 1
3-4 days/week	STEP 2
most days; or waking from asthma ≥ once weekly OR low lung function	STEP 3
daily; waking from asthma ≥ once weekly AND low lung function	STEP 4

	Age < 6 years: MAINTENANCE	Age < 6 years: RELIEVER	Age 6 - 11 years: MAINTENANCE	Age 6 - 11 years: RELIEVER
STEP 1	No maintenance therapy	Salbutamol 1-2 inh, 100-200 mcg *ONLY as needed*	*ICS with SABA is an alternative treatment regimen option included in paediatric PHC algorithm* Budesonide/formoterol 1 inh, (80 mcg/4.5 mcg) *ONLY as needed*	
STEP 2	Beclomethasone 1 inh, (100 mcg) *daily*	Salbutamol 1-2 inh, (100-200 mcg) *as needed*		
STEP 3	Beclomethasone 1 inh, (100 mcg) *12-hourly*	Salbutamol 1-2 inh, (100-200 mcg) *as needed*	Budesonide/formoterol 1 inh, (80 mcg/4.5 mcg) *daily*	Budesonide/formoterol 1 inh, (80 mcg/4.5 mcg) *as needed*
STEP 4	Refer for paediatric allergology/pulmonology assessment		Budesonide/formoterol 1 inh, (80 mcg/4.5 mcg) *12 hourly*	Budesonide/formoterol 1 inh, (80 mcg/4.5 mcg) *as needed*

Note: There is an interaction between budesonide and protease inhibitor-based antiretroviral therapy. Refer to the STG for treatment guidance.

STEP UP →
← STEP DOWN

Follow up

Check control over past 4 weeks

A: Give 1 point for the presence of each of the below symptoms
- Daytime asthma symptoms >2x/week
- Night waking due to asthma (any)
- Used SABA-only-reliever for symptoms >2x/week*
- Activity limitation due to asthma (any)

*No point assigned if SABA or formoterol used with ICS

B: Assess level of control

Total points	Control
0	Well controlled
1-2	Partly controlled
3-4	Uncontrolled

Assess → Adjust → Review

Consider STEP DOWN

Consider STEP UP

STEP DOWN Review Checklist
1. Well-controlled > 3 months?
2. No exacerbations in past year?
3. < 2 risk factors for exacerbations?

STEP UP Review Checklist
1. Medication adherence is good?
2. Inhaler technique is correct?
3. Exposures have been minimised?
4. Co-morbidities are controlled?
5. No inappropriate medication use?

PEF: Peak expiratory flow | ICS: Inhaled corticosteroid | SABA: short-acting β2 agonist | inh: inhalation/s

Figure 15.3: Management of chronic asthma in children < 12 years

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. W

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, retropharyngeal 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 A 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 mcg/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.

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[3] (Classification of Severity of Acute Asthma Exacerbations - O2 saturation): National Asthma Council. Australian Asthma Handbook. Managing Acute Asthma in children 1-5 years in the ED. Accessed online https://www.asthmahandbook.org.au/acute-asthma/children-1-5-years/managing-acute-asthma-in-children-1-5-years-in-the-ed

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[5] (Salbutamol neb dose): SIGN 158: British Guideline on the management of asthma. Revised edition published Nov 2024. Corrections May 2025. Pg 39 accessed online https://www.sign.ac.uk/media/2342/sign-158-2024-british-guideline-on-the-management-of-asthma-may-2025.pdf

[6] (Salbutamol & ipratrop neb dose - < 6 yrs): SIGN 158: British Guideline on the management of asthma. Revised edition published Nov 2024. Corrections May 2025. Pg 39 accessed online https://www.sign.ac.uk/media/2342/sign-158-2024-british-guideline-on-the-management-of-asthma-may-2025.pdf

[7] (Salbutamol & ipratrop neb dose - 6-11 yrs):): SIGN 158: British Guideline on the management of asthma. Revised edition published Nov 2024. Corrections May 2025. Pg 39 accessed online https://www.sign.ac.uk/media/2342/sign-158-2024-british-guideline-on-the-management-of-asthma-may-2025.pdf

[8] (Salbutamol & ipratrop neb dose - < 6 yrs): SIGN 158: British Guideline on the management of asthma. Revised edition published Nov 2024. Corrections May 2025. Pg 39 accessed online https://www.sign.ac.uk/media/2342/sign-158-2024-british-guideline-on-the-management-of-asthma-may-2025.pdf

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[10] (Life-threatening exacerbation Salbutamol & ipratrop neb dose < 11 yrs): National Asthma Council. Australian Asthma Handbook. Managing Acute Asthma in children 1-5 years in the ED. Accessed online https://www.asthmahandbook.org.au/acute-asthma/children-1-5-years/managing-acute-asthma-in-children-1-5-years-in-the-ed

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2030 NDP

SOUTH AFRICAN NATIONAL DEPARTMENT OF HEALTH
NEMLC SUMMARY REPORT ON UPDATES MADE TO THE
THE STANDARD TREATMENT GUIDELINES AND ESSENTIAL MEDICINE LIST GUIDANCE PRODUCTS
Paediatric Hospital Chp 15 RESPIRATORY SYSTEM

Document Version Control

Report Version	Date	Detail
V1.0	*30/07/2026*	*Draft for external comment*
V1.1	*29/09/2026*	*Ratified for publication*

Summary Tables

Medicine Amendments

Medicine amendment recommendations, with supporting evidence and rationale are listed below. If appropriate can include non-medicine amendments if appropriate (for example if item has a large impact on how medicine is accessed). Kindly review the medicine amendments in the context of the respective standard treatment guideline (STG). Include updates post initial publication first or mark/highlight appropriately.

STG/SECTION	GUIDANCE PRODUCTS (Tick relevant)				MEDICINE / MANAGEMENT	ADDED / DELETED / AMENDED	TI* CONSIDERATIONS (if applicable)
	PHC STGs & EML	AH STG & EML	PaedH STG & EML	TQ EML			
Report Version 1.0:							
Section 15.4.1 Asthma exacerbation, acute			√		0.45% sodium chloride/5% dextrose IV infusion	Deleted	
			√		0.9% sodium chloride/5% dextrose IV infusion:	Added	
	√		√		Prednisolone/prednisone, oral – dose guidance	Amended	
	√		√		Hydrocortisone, IM/IV – dose guidance	Amended	
	√		√		Salbutamol 0.5% nebulised therapy – dose guidance	Amended	
	√		√		Ipratropium bromide 0.25mg/2mL nebulised therapy – dose guidance	Amended	
			√		Magnesium sulphate IV – dose guidance	Amended	
		√	√		Salbutamol IV Infusion:	Retained	
			√		Aminophylline IV Infusion	Retained	
Section 15.4.2 Asthma, chronic – children < 6 years	√		√		SABA MDI	Retained	
	√		√		ICS MDI	Retained	Y
Section 15.4.2 Asthma, chronic –	√		√		SABA MDI	Retained	
	√		√		ICS MDI	Retained	Y

children 6-11 years	√		√		Budesonide/formoterol 80/4.5mcg MDI for AIR/MART	Added	Y
Section 15.4.2 Asthma, chronic – children 6-11 years on PI-based ART	√		√		Beclometasone 100 HFA MDI	Retained	

*Therapeutic Interchange

Paediatric Hospital Respiratory System Chapter 15

Section 15.4 Conditions with predominant wheeze

Section 15.4.1 Asthma exacerbation, acute

Classification of severity of acute asthma exacerbations

The GINA guideline[1] does not include a category for life-threatening exacerbations of asthma in children ≤ 11 years of age. Local expert opinion, however strongly advises that the STGs should include a category for life-threatening acute exacerbations of asthma in children, to ensure that children presenting with life-threatening exacerbations are urgently referred upward for emergency care management. Guidance on the interim management of these patients, until transferred to the next level of care, is included in the STGs. In the absence of GINA guideline recommendations, the assessment and management of children with life-threatening exacerbation of asthma have been adopted from the most recent BTS/SIGN guidelines[2] and Australian National Council Asthma Handbooks for children 1-5 years[3] and 6-11 years[4].

Recognition and assessment of severity of asthma exacerbations in children < 11 years - oxygen saturation

Guidance on the measurement of oxygen saturation on room air for the classification of mild-moderate, severe and life-threatening acute asthma exacerbations as tabulated below, has been adopted from the Australian National Council Asthma Handbooks for children (references as cited above).

	Mild/Moderate	Severe	Life-Threatening
Oxygen saturation (room air)	Age ≤ 5 yrs: ≥ 94% Age 6-11 yrs: ≥ 94%	Age ≤ 5 yrs: < 94% Age 6–11 yrs: < 90-94	Age ≤ 5 yrs: < 90% Age 6–11 yrs: < 90%

IV fluid replacement

[1] Global Initiative for Asthma (GINA). (2025). *Global Strategy for Asthma Management and Prevention, Updated Nov 2025* pg 168 access online: https://ginasthma.org/wp-content/uploads/2025/11/GINA-2025-Update-25_11_08-WMS.pdf

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0.45% sodium chloride/5% dextrose IV infusion: Deleted
0.9% sodium chloride/5% dextrose IV infusion: Added
For children presenting with an acute exacerbation of asthma who are unable to drink, fluid replacement with IV 0.9% sodium chloride/5% dextrose is recommended[5], and has been aligned to the standard IV replacement fluid recommendation for children.

Corticosteroids

Prednisone/Prednisolone, oral – acute exacerbations of asthma children < 12 years: Amended
The NEMLC recommendation for the use of oral prednisone/prednisolone has been standardised to 1mg /kg once daily (i.e. dose range of 1-2mg/kg has been removed), with maximum doses for the respective age bands as tabulated below:

- Prednisone, oral, 1 mg/kg, immediately up to a maximum of:
  - Children < 2 years: 20 mg (consider omitting steroids for children in this age group with episodic viral wheeze).
  - Children 2–5 years: 30 mg.
  - Children 6–11 years: 40 mg.

Hydrocortisone, IM/slow IV – acute exacerbations of asthma children < 12 years: Amended
The NEMLC recommendation for the use of hydrocortisone IM/IV has been standardised to 4mg /kg (max 100mg) 6 hourly (i.e. dose range of 2-4mg/kg has been removed), as tabulated below:

In patients who cannot tolerate oral therapy, are vomiting, or are suspected to have gastric atony:

- Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated.

Oxygen flow rate: Amended
For severe exacerbations of asthma in children < 12 years of age requiring oxygen therapy, the oxygen flow rate has been amended from 5L/min to 8L/min to ensure adequate aerosol output and deposition efficiency[6].

Salbutamol and ipratropium nebulised therapy

Dosing guidance on the use of nebulised salbutamol and ipratropium bromide for the management of mild to moderate and severe acute exacerbations of asthma in children < 11 years, has been adapted from the BTS/SIGN guideline,[7] and the Australian National Council Asthma Handbooks for children (references as cited above), in consultation with local Paediatric experts. Local factors, including medicine availability (e.g. discontinuation of ipratropium bromide MDI), and the potential for delays with transferring patients to a higher level of care, informed the need to adapt dosing guidance.

Magnesium sulphate injection: Amended

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[5] Meyers R. Management of Pediatric Parenteral Fluids. J Pediatr Pharmacol Ther. 2024 Aug;29(4):346-353. doi: 10.5863/1551-6776-29.4.346. Epub 2024 Aug 13. PMID: 39144385; PMCID: PMC11321816.
Initial intravenous fluid prescription in general paediatric in-patients aged >28 days and. HKMJ [Internet]. 2021 Aug 19 [cited 2026 July 6];. Available from: https://www.hkmj.org/abstracts/v27n4/276.htm
Rey C., Los-Arcos M., Hernández A., Sánchez A., Díaz J.J., López-Herce J. Hypotonic versus isotonic maintenance fluids in critically ill children: A multicenter prospective randomized study
Shukla S, Basu S, Moritz ML. Use of Hypotonic Maintenance Intravenous Fluids and Hospital-Acquired Hyponatremia Remain Common in Children Admitted to a General Pediatric Ward. Front Pediatr. 2016 Aug 25;4:90. doi: 10.3389/fped.2016.00090. PMID: 27610358; PMCID: PMC4996996.
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For patients suffering from an acute exacerbation of asthma who remain unresponsive to optimal doses of nebulised bronchodilators, the dose of magnesium sulfate injection has been amended from a range of 25-75 mg/kg, to 50 mg/kg, for administration in 20 mL sodium chloride 0.9%, administered as a single dose over 20 minutes for ease of implementation.

Salbutamol IV Infusion: Amended
Dosing guidance (loading dose and continuous infusion[8]) has been amended to accommodate for the 1mg/mL injection for IV infusion.

Aminophylline IV Infusion: Retained
The use of aminophylline IV infusion has been retained for the management of acute asthma exacerbation in children as an alternative to salbutamol IV[9], to accommodate for intermittent supply constraints with salbutamol injection.

STG Update
STG guidance on the management of acute asthma has been subject to editorial updates as detailed below:

AMENDED FROM:	**AMENDED TO:**
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, » decreased air entry, » hyperinflation, » dyspnoea, » tachypnoea, » tachycardia, » hypoxaemia, » anxiety, » restlessness, » palpable pulsus paradoxus, » difficulty or inability to talk or feed, » reduced peak flow rate. The following are danger signs in acute, severe asthma and require referral: » restlessness, » PEFR < 60% of predicted value, » disturbance in level of consciousness, » decreasing oxygen saturation < 85%, » rising P_aCO_2, » palpable pulsus paradoxus, » silent chest with auscultation, » chest pain (air leaks).	**15.4.1 ASTHMA EXACEBRBATION, ACUTE** J45.0-1/J45.8-9//J46 **DESCRIPTION** Acute asthma is an emergency and presents with one or more of the following: » wheeze » cough » chest tightness » respiratory distress » shortness of breath There are many other causes of wheezing in children, but they will be initially treated the same way in the acute setting if severe. **DIAGNOSTIC CRITERIA** The following are danger signs in acute, severe asthma and require referral to high or intensive level of care: » restlessness, » PEFR < 50% of predicted value, » disturbance in level of consciousness » decreasing oxygen saturation < 85% » rising P_aCO_2, » palpable pulsus paradoxus, » silent chest with auscultation » chest pain (air leaks) **Table 15.1 Classification of Severity of Acute Asthma Exacerbations in Children ≤ 11 years**

[8] Kling S, Zar HJ, Levin ME, Green RJ, Jeena PM, Risenga SM, Thula SA, Goussard P, Gie RP; South African Childhood Asthma Working Group (SACAWG). Guideline for the management of acute asthma in children: 2013 update. S Afr Med J. 2013 Feb 5;103(3 Pt 3):199-207. doi: 10.7196/samj.6658. PMID: 23656745.
[9] Craig SS, Dalziel SR, Powell CV, Graudins A, Babl FE, Lunny C. Interventions for escalation of therapy for acute exacerbations of asthma in children: an overview of Cochrane Reviews. Cochrane Database Syst Rev. 2020 Aug 5;8(8):CD012977. doi: 10.1002/14651858.CD012977.pub2. PMID: 32767571; PMCID: PMC8078579.

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
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.

	Mild/Moderate	Severe	Life-Threatening
Oxygen saturation (room air)	Age ≤ 5 yrs: ≥ 94% Age 6-11 yrs: ≥ 94%	Age ≤ 5 yrs: < 94% Age 6–11 yrs: < 90-94	Age ≤ 5 yrs: < 90% Age 6–11 yrs: < 90%
PEFR*	Age 6-11 yrs: > 50%	Age 6–11 yrs: < 50%	Cannot blow
Arterial P_aCO_2	< 40 mmHg (5.3 kPa)	≥ 40 mmHg (5.3 kPa)	≥ 40 mmHg (5.3 kPa)
Wheezing	Present	Breath sounds soft	Silent chest
Respiratory rate	Age ≤ 5 yrs: ≤ 40/min Age 6-11 yrs: ≤ 30/min	Age ≤ 5 yrs: > 40/min Age 6-11 yrs: > 30/min	Poor respiratory effort
Heart rate	Normal or mildly elevated	Significant tachycardia	Significant bradycardia
Additional signs	Speaks in phrases Able to drink Chest indrawing	Speaks in words Not drinking well Use of accessory muscles	Difficulty speaking Unable to feed/drink Confusion/drowsiness Cyanosis

*Peak expiratory flow rate (PEFR) – as percentage of predicted value and not performed in children < 6 years.

Peak expiratory flow rate (PEFR) is expressed as percentage of predicted normal (or personal best if known). See PEF charts in Annexure 2: Asthma monitoring.

GENERAL MEASURES

» Assess the severity of the exacerbation and treat according to the management below.

» Admit children with severe asthma exacerbations to a high care unit, if available.

» Monitor:
- > heart rate
- > respiratory rate
- > peak expiratory flow rate
- > 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 0.9% sodium chloride/ 5% dextrose IV.
- – Patients with a prolonged episode of a severe asthma exacerbation may become dehydrated due to poor intake or vomiting.
- – Avoid overhydration of patients with acute asthma: do not exceed the recommended IV fluid volume in children, i.e., 50 mL/kg per 24 hours.

» Monitor potassium levels in a patient on continuous $β_2$-agonist therapy.

» Monitor response to treatment with repeated PEFR and clinical signs. Assess need to escalate therapy hourly, or sooner if worsening clinically.

Table 15.2: Assess response to initial management:

	Response	No response

» 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 mcg (2–4 puffs of 100 mcg/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 mcg/puff) = 1 mg per administration, repeated every 20–30 minutes depending on clinical response.
  - Moderate severity:
    - Salbutamol, 400–600 mcg (4–6 puffs of 100 mcg/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

Respiratory rate (breaths per minute)	< 40	> 40
Speech/Drinking	normal	impaired

Note:
» Physiotherapy, antihistamines, antibiotics and sedation are not beneficial in the acute setting.
» Agitation and restlessness are signs of severe hypoxia and require urgent assessment for respiratory support.
» See Annexure 3: Devices for Respiratory Conditions for guidance on inhaler, spacer and nebuliser device techniques.

MEDICINE TREATMENT
Mild/Moderate exacerbation of asthma

- Oxygen to keep oxygen saturation 93–95%.

AND

- Short-acting β$_2$-agonist, e.g.:
- Salbutamol, 100 mcg metered-dose inhaler (MDI) with a spacer device.
  - Administer 200–400 mcg (2–4 puffs).
  - A maximum of 10 puffs may be administered based on clinical response.
  - Repeat every 20 minutes for the first hour depending on clinical response.
  - Thereafter repeat every 2–4 hours if needed.

OR

- Salbutamol 0.5% (5 mg/mL), solution.
  - **Age < 6 years:** Administer 2.5 mg salbutamol 0.5% (5 mg/mL) solution, made to 4 mL nebuliser solution by mixing 0.5 mL salbutamol and 3.5 mL sodium chloride, 0.9% solution.
  - **Age 6–11 years:** Administer 5 mg salbutamol 0.5% (5 mg/mL) solution, made to 4 mL nebuliser solution by mixing 1 mL salbutamol and 3 mL sodium chloride, 0.9% solution.
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Repeat every 20 minutes for the first hour if needed.
  - Thereafter repeat every 2–4 hours if needed.

PLUS

- Prednisone, oral, 1 mg/kg, immediately up to a maximum of:
  - Children < 2 years: 20 mg (consider omitting steroids for children in this age group with episodic viral wheeze).
  - Children 2–5 years: 30 mg.
  - Children 6–11 years: 40 mg.

In patients who cannot tolerate oral therapy, are vomiting, or are suspected to have gastric atony:

- Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated.

If response is poor or clinical condition is worsening:
Continue oxygen and salbutamol therapy, and add ipratropium bromide:
Age < 6 years

- 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 mcg (2 puffs of 100 mcg/puff) as required using a metered-dose inhaler with a spacer device.
  - Review maintenance asthma therapy at follow-up.

- Salbutamol 0.5% (5 mg/mL) solution, 2.5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing 2.5 mg salbutamol (0.5mL of 5mg/mL solution) with ipratropium bromide 0.25mg (2 mL of 0.25mg/2mL solution). Make up to a total volume of 4 mL by adding 1.5 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours depending on clinical response
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 2.5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

Age 6-11 years:

- Salbutamol 0.5% (5 mg/mL) solution, 5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 5 mg (1mL of 5 mg/mL solution) with ipratropium bromide 0.25 mg (2mL of 0.25 mg/2 mL solution)Make up to a total volume of 4 mL by adding 1 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours, depending on clinical response.
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue

If response is poor after salbutamol/ipratropium bromide nebulisation:

» Prioritise transfer to a high care- or intensive care-unit.
» Exclude upper airway obstruction.
» Treat as a severe asthma exacerbation.

Once the patient has responded to therapy, continue oral corticosteroids:

- Prednisone, oral, 1 mg/kg, daily up to a maximum dose of:
  - Children < 2 years: 20 mg for 5 days.
  - Children 2–5 years: 30 mg for 5 days.
  - Children 6–11 years: 40 mg for 5 days.

Severe exacerbation of asthma

- Oxygen to keep oxygen saturation ≥94%.

AND

- Salbutamol 0.5% (5 mg/mL) solution with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:

Age < 6 years

- Salbutamol 0.5% (5 mg/mL) solution, 2.5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 2.5 mg (0.5mL of 5mg/mL solution) with ipratropium bromide 0.25mg (2 mL of 0.25mg/2mL solution). Make up to a total volume of 4 mL by adding 1.5 mL sodium chloride, 0.9%.

Non-responder:
Intensify treatment as follows:
Continue
- Short-acting ß2-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 ß2-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 mcg/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 mcg/kg (do not give if stat dose already given).
  - Follow with: 1 mcg/kg/minute.
  - If necessary, increase dose by 1 mcg/kg every 15 minutes.
  - Maximum dose: 5 mcg/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.

  - Administer every 20 minutes for the first two hours depending on clinical response
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 2.5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

Age 6-11 years:
- Salbutamol 0.5% (5 mg/mL) solution, 5 mg with ipratropium bromide 0.25 mg/2 mL solution, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 5 mg (1mL of 5 mg/mL solution) with ipratropium bromide 0.25 mg (2mL of 0.25 mg/2 mL solution).Make up to a total volume of 4 mL by adding 1 mL sodium chloride, 0.9%.
  - Administer every 20 minutes for the first two hours, depending on clinical response.
  - Recommended delivery at a flow rate of 8 L/minute with oxygen.
  - Based on clinical response, taper:
    - Salbutamol 5 mg to 1-2 hourly and
    - Ipratropium 0.25 mg to 4-6 hourly or discontinue.

PLUS
- Prednisone, oral, 1 mg/kg, immediately up to a maximum of:
  - Children < 2 years: 20 mg.
  - Children 2–5 years: 30 mg.
  - Children 6–11 years: 40 mg

In patients who cannot tolerate oral therapy, are vomiting, or are suspected to have gastric atony:
- Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated.

If response is poor after salbutamol/ipratropium bromide nebulisation:
» Prioritise transfer to a high care- or intensive care-unit.
» Consult paediatrician for magnesium sulfate use:
- Magnesium sulfate, IV bolus, 50 mg/kg in 20 mL sodium chloride 0.9%, as a single dose, administered over 20 minutes.

Life-threatening exacerbation of asthma
» Prioritise transfer to a high care- or intensive care-unit. Discuss management with specialist.
- Oxygen, to keep saturation ≥94%.

AND
All children aged ≤ 11 years:
- Salbutamol 0.5% (5 mg/mL) solution 5 mg, with ipratropium bromide (0.25 mg/2 mL) solution, 0.5 mg, by nebuliser:
  - Prepare nebuliser solution by mixing salbutamol 5 mg (1mL of 5 mg/mL solution) with ipratropium bromide 0.5 mg (4mL of 0.25 mg/2 mL solution).
  - Administer every 15 minutes until the asthma severity category improves from life-threatening to severe.

REFERRAL » Acute exacerbation not responding to treatment.	○ Recommended delivery at a flow rate of 8 L/min with oxygen. **PLUS** • Hydrocortisone, IM/slow IV, 4 mg/kg (max dose 100 mg), immediately, then 6 hourly until oral therapy is tolerated. <u>If response is poor after salbutamol/ipratropium bromide nebulisation:</u> » While awaiting transfer to high care or intensive care unit, consult paediatrician for magnesium sulfate use: • Magnesium sulfate, IV bolus, 50 mg/kg in 20 mL sodium chloride 0.9%, as a single dose, administered over 20 minutes. <u>If response is poor after magnesium sulfate:</u> » Exclude upper airway obstruction. » Prepare for intubation. » Refer for respiratory support. <u>In patients where nebulised treatment cannot be given effectively, e.g., silent chest, agitation with mask intolerance, repeated mask removal, or cyanosis:</u> **In a high care or intensive care setting where adequate monitoring is accessible, consult a specialist for use of:** • Salbutamol, IV, 1mg/mL injection for IV infusion. ○ Loading dose: Administer 5–10 mcg/kg per minute of 1 mg/ml solution over 1 hour. ○ Follow with continuous infusion at 1 mcg/kg per minute. If necessary, increase dose by 1 mcg/kg every 15 minutes, titrating according to clinical response and adverse effects. ○ Maximum dose: 5 mcg/kg per minute. ○ Continue nebulised bronchodilator therapy concurrently. ○ Monitor for tachycardia, arrhythmias, hypokalaemia, hyperglycaemia, and lactic acidosis (uncommon). <u>In cases of life-threatening asthma that are unresponsive to other measures:</u> **Requires admission to intensive care unit for appropriate monitoring, e.g., ECG monitoring.** • Aminophylline, IV. ○ Loading dose: 5 mg/kg, administered over 20–30 minutes. Omit loading dose in children receiving maintenance oral theophylline. ○ Follow with continuous infusion at 1 mg/kg/hour. <u>Once the patient has responded to therapy, continue short-acting β2-agonists and oral corticosteroids:</u> ▪ Short-acting β_2-agonists, e.g.: • Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief. **AND** • Prednisone, oral, 1 mg/kg, daily up to a maximum dose of: ○ Children < 2 years: 20 mg for 5–7 days. ○ Children 2–5 years: 30 mg for 5–7 days.

	○ Children 6–11 years: 40 mg for 5–7 days. » On discharge, determine/review chronic asthma management and follow-up symptom control at next visit. *See algorithms below* Figure 15.1: Management of acute asthma exacerbation in children < 6yrs Figure 15.2: Management of acute asthma exacerbation in children 6-11yrs

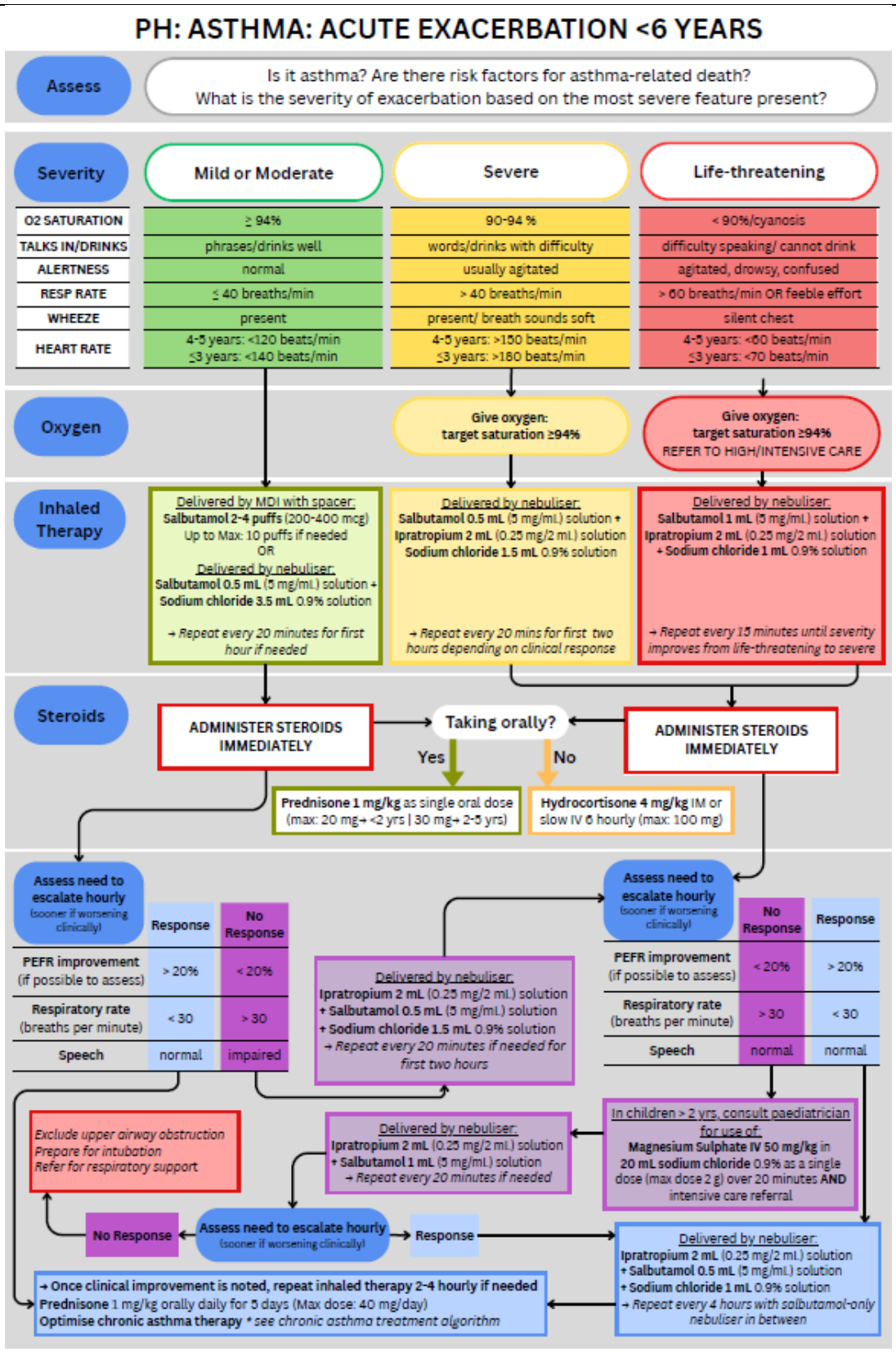

Figure 15.1: Management of acute asthma exacerbation in children < 6yrs

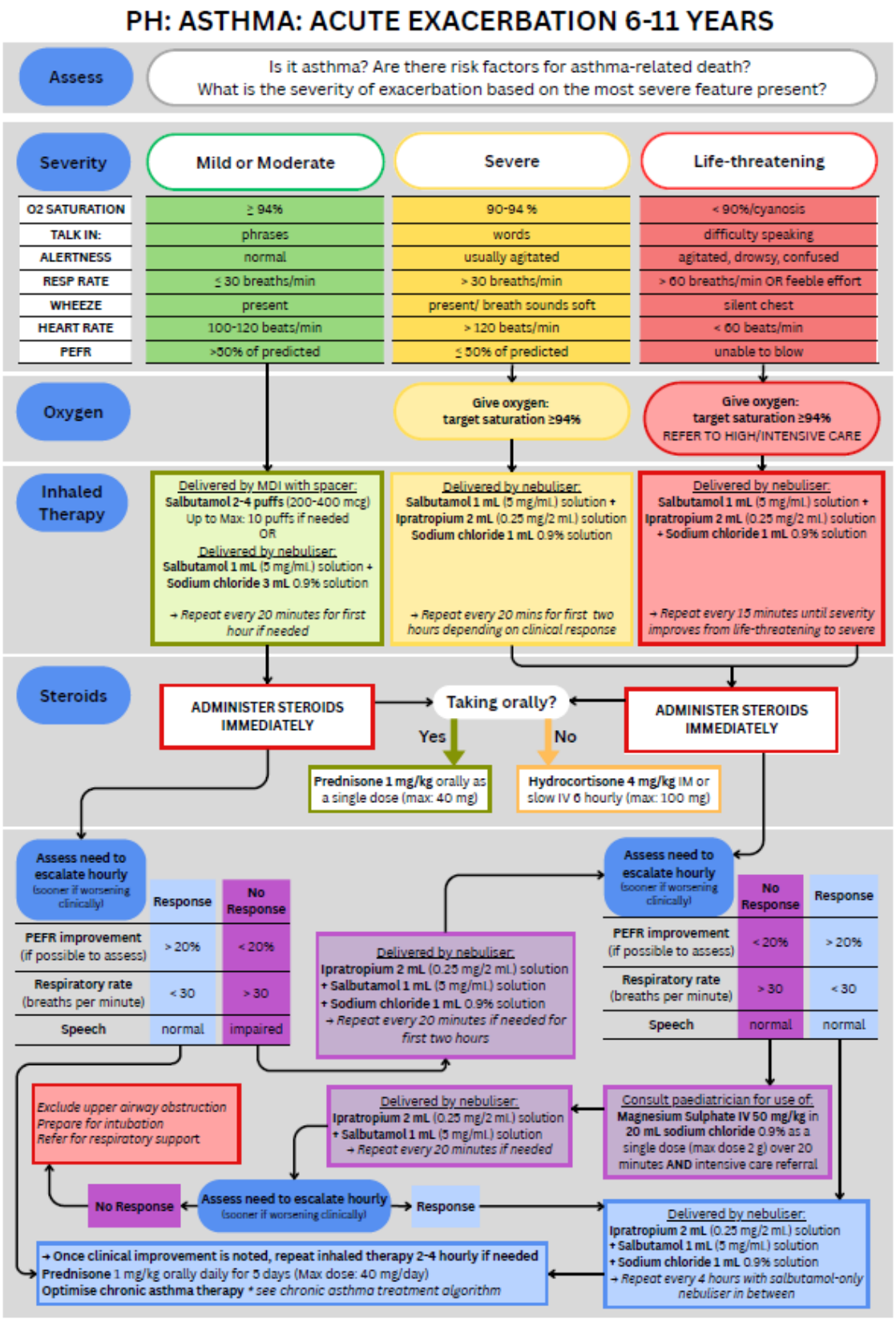

Figure 15.2: Management of acute asthma exacerbation in children 6-11yrs

Section 15.4.2 Asthma, chronic

Medicine delivery systems

In response to an external comment received, guidance on the spacer volumes for adolescents, has been aligned to the recommendation included in the AH Appendix VI: Devices for Respiratory Conditions.

Technique for the use of spacer devices

Guidance on the use of spacer devices across the spectrum of age cohorts, has been amended to align the newly introduced Annexure 3: Devices for Respiratory Conditions, which has been adapted from the AH and PHC publications.

Children < 6 years

Short-acting beta agonist (SABA) – asthma reliever/rescue therapy: Retained

The use of inhaled short-acting beta agonist (SABA) for reliever therapy in children under 6 years of age has been retained for chronic asthma management Step 1.

Inhaled Corticosteroid (ICS) therapy- asthma controller therapy + SABA: Retained

The use of inhaled corticosteroid maintenance/controller therapy with a short-acting beta agonist (SABA) for reliever therapy in children < 6 years has been retained for chronic asthma management Steps 2 to 4.

Comparative ICS doses

Comparative ICS doses for children < 6 years are tabulated below. The recommended doses do not necessarily imply dose equivalence or equipotency (i.e. switching patients from low dose of one medicine to low dose of another medicine may represent an increase or decrease in potency)[10].

Children < 6years	
Drug	Daily dose (mcg)
	Low
Beclometasone dipropionate (MDI standard particle, HFA)	100
Beclometasone dipropionate (MDI extra-fine particle, HFA)	50
Fluticasone propionate (MDI, standard particle, HFA)	50
Mometasone furoate (MDI, standard particle, HFA)	100
CFC: chlorofluorocarbon propellant HFA: hydrofluoroalkane propellant MDI: metered dose inhaler	

Children 6-11 years

Inhaled Corticosteroid (ICS) therapy- asthma controller therapy + SABA: Retained

The use of inhaled corticosteroid therapy with a short-acting beta agonist (SABA) for maintenance and reliever therapy in children 6-11 years of age has been retained for chronic asthma management Steps 1 to 4.

Anti-inflammatory reliever (AIR) and Maintenance and reliever therapy (MART)

ICS/formoterol combination inhaler for AIR & MART: Added

Low dose budesonide/formoterol MDI: Added

[10] Global Initiative for Asthma (GINA). (2024). Global Strategy for Asthma Management and Prevention, 2024. https://ginasthma.org/2024-report/

The budesonide/formoterol 80/4.5mcg MDI, as part of AIR/MART therapy, has been added to the Paediatric Hospital STG as an alternative treatment option to ICS/SABA therapy for children aged 6-11 years with chronic asthma, in line with the GINA guideline. NEMLC acknowledges gaps in the evidence to support the use of AIR/MART in the 6-11 year age cohort. Introduction of the AIR/MART chronic asthma treatment pathway is currently limited to initiation at Paediatric Hospital level of care, with maintenance and step down therapy permitted at PHC level of care. Access to AIR/MART therapy in the 6-11 year old age cohort will provide clinicians with an alternative treatment pathway for children with asthma that remains uncontrolled on optimised therapy with the ICS/SABA regimen, and requiring referral to paediatric level of care. Access to the AIR/MART regimen for this age cohort will also facilitate the transition from paediatric to adult asthma management care.

Comparative ICS doses

Comparative ICS doses for children 6-11 years of age are tabulated below. The recommended doses do not necessarily imply dose equivalence or equipotency (i.e. switching patients from low dose of one medicine to low dose of another medicine may represent an increase or decrease in potency)[11].

Children < 6years			
Drug	Daily dose (mcg)		
	Low	Medium	High
Beclometasone dipropionate (MDI standard particle, HFA)	100-200	> 200-400	>400
Beclometasone dipropionate HFA	100–200	>200–400	>400
Beclometasone dipropionate (MDI extra-fine particle, HFA)	50-100	>100-200	>200
Budesonide (DPI, or MDI, standard particle, HFA)	100-200	> 200-400	>400
Ciclesonide (MDI, extrafine particle, HFA)	80	>80-160	>160
Fluticasone furoate (DPI)	50	50	n/a
Fluticasone propionate (DPI)	50-100	>100-200	>200
Fluticasone propionate (MDI, standard particle, HFA)	50-100	>100-200	>200
Mometasone furoate (MDI, standard particle, HFA)	100	100	200
HFA: hydrofluoroalkane propellant MDI: metered dose inhaler DPI: dry powder inhaler			

Budesonide 80mcg/fomoterol 4.5mcg MDI: Added

Budesonide 80mcg/fomoterol 4.5mcg MDI has been added to the STG for AIR/MART in children aged 6-11 years.

Caution against the use of salmeterol for AIR/MART

The external comment to remove reference to salmeterol in the 'caution box', as tabulated below, was not supported, as salmeterol is still included on the most recent HP07 tender[12] for non-asthma related indications. The caution is a reminder to clinical staff that salmeterol is not a rapid-acting bronchodilator, and is therefore not suitable for use AIR/MART asthma care.

	CAUTION
	» Formoterol has a rapid onset of action and can be used as reliever therapy in children 6 years and older, **BUT ONLY in combination with an ICS**.

[11] Global Initiative for Asthma (GINA). (2024). Global Strategy for Asthma Management and Prevention, 2024. https://ginasthma.org/2024-report/

[12] HP07-2026DAI: Supply and delivery of pharmaceutical products: drops, aerosols and inhaled medicines to the department of health for the period 01 September 2026 to 31 August 2029. Ref: HP07-2026DAI

» Salmeterol is not rapid acting and **should not be used as reliever therapy.**
» Budesonide and fluticasone have significant drug-drug interactions with HIV protease inhibitors. Substitute with beclometasone-based regimens where indicated.

PATIENTS ON PROTEASE-INHIBITOR-BASED ANTIRETROVIRAL THERAPY

Short-acting beta agonist (SABA) – asthma reliever/rescue therapy for children on protease inhibitors: Retained

Beclomethasone 100mcg MDI HFA- asthma controller therapy for children aged 6-11 years on protease inhibitors: Retained

Beclomethasone is the preferred ICS for people living with HIV and on protease inhibitor based antiretroviral therapy, as there are drug interactions between protease inhibitors and budesonide. For children aged 6-11 years, use the chronic asthma management OPTION 1 treatment regimen.

STG Update

Guidance on the management of chronic asthma for children aged 6-11 years, has been updated to include two regimens, namely:

- OPTION 1: SABA as reliever/rescue therapy with ICS as maintenance therapy for Steps 2-4
- OPTION 2: ICS/formoterol as AIR/MART (initiation at Paeds Hospital level of care)

The updated STG guidance is detailed below.

AMENDED FROM:	AMENDED TO
15.4.2 ASTHMA, CHRONIC	**16.2 ASTHMA, CHRONIC**
J45	**J45.0-1/J45.8-9**
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.	**DESCRIPTION** Asthma is a chronic inflammatory airways disease defined by a history of recurrent episodes of wheezing, shortness of breath, chest tightness and cough. The pattern of disease and expiratory flow varies over time and in intensity. Chronic, poorly controlled asthma may lead to persistent airflow limitation. Several clinical asthma phenotypes are recognised by their differences in demographics and clinical characteristics, but in general do not correlate with treatment responses.
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.	**DIAGNOSIS** **Clinical Features:** » **Wheezing:** High-pitched whistling sounds on exhalation (especially in children). » **Cough:** Often worse after exercise, laughter/crying, or at night. » **Difficulty breathing** or chest tightness. » **Pattern:** Symptoms often worsen at night or early morning; triggered by viral infections, allergens, exercise, or irritants (e.g., tobacco smoke).
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:	**Diagnostic criteria include:** **Age group** | **Criteria**

» 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	None	one previous admission	> one previous admission or

< 6 years	» Recurrent acute wheezing episodes OR at least one acute wheezing episode with asthma-like symptoms between episodes. » Timely response to acute or longer-term asthma treatment, defined as either: – Response to SABA within minutes during acute wheezing episode (or within 3-4 hours of SABA and oral corticosteroid use for severe exacerbations treated in healthcare settings). – Reduced frequency or severity of acute wheezing episodes and/or symptoms between episodes during trial of maintenance ICS and SABA therapy. » No likely alternative cause (except for concurrent viral infection). Note: » All 3 criteria are required for diagnosis of asthma. If only 1 or 2 are present, document as suspected asthma and initiate treatment as indicated.
Age 6–11 years	» Documented variable airflow limitation: – Spirometry showing reversible forced expiratory volume in 1 second (FEV1) > 12% post-bronchodilator (See Appendix I in Primary Health Care STGs and EML). – Peak Expiratory Flow (PEF) improvement > 15% post-bronchodilator. » Diurnal PEF variability > 10% over 2 weeks.

GENERAL MEASURES

» Identify triggers and address modifiable risk factors.
» Educate children, parents, caregivers and teachers on avoidance of triggers, inhaler and spacer technique, and early recognition of exacerbation symptoms.
» Manage environmental triggers, e.g.:
- Minimise exposure to cigarette smoke;
- avoid preservatives such as sulphites and benzoates;
- for house-dust mite sensitisation, use plastic mattress covers;
- minimise exposure to cockroaches: use baits placed in homes;
- avoid damp or mould in homes.

Table 15.3: Assessment of risk factors

Risk factors for exacerbations	
Poor control	» Uncontrolled asthma (as assessed below).

hospital for asthma			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:

Inappropriate medication use	» High SABA use » Inadequate ICS use (not prescribed, poor adherence, poor inhaler technique)	
Co-morbidities	» Obesity » Chronic rhinosinusitis	» GORD » Confirmed food allergy
Exposures	» Second-hand smoke » Air pollution » Preservatives (e.g., sulphites, benzoates)	» Known allergen exposure » Pets (e.g. cats and dogs)
Social factors	» Major psychosocial and socioeconomic issues e.g. poverty, overcrowding, access to healthcare etc.	
Poor lung function	» FEV1 < 60% predicted (measured with spirometry) » High bronchodilator responsiveness	
Inflammatory markers	» Eosinophilia (blood)	
Exacerbations	» Any prior intubation or ICU admission for asthma » Severe exacerbation in the past year	
Risk factors for developing persistent airflow limitation		
History	» Preterm birth, low birth weight, greater infant weight gain » Chronic mucus hypersecretion	
Medications	» History of severe exacerbation (see above for definitions) without ICS treatment thereafter	
Exposures	» Tobacco smoke » Noxious chemicals	» Domestic exposures
Investigations	» Low initial FEV_1	» Blood eosinophilia

Abbreviations: FEV_1: forced expiratory capacity in 1 second, GORD: Gastro-oesophageal reflux disease, ICS: inhaled corticosteroid, SABA: short-acting β2 agonist

» Regularly assess inhaler and spacer use technique and correct where necessary. See Annexure 3: Devices for Respiratory Conditions for guidance on inhaler, spacer and nebuliser device techniques.
» Breathing exercises may be offered as an adjunct to pharmacological therapy: they may improve symptoms and quality of life, but do not improve lung function or reduce exacerbation risk.

ASSESSMENT OF CONTROL
» Asthma control on therapy can be classified as well-controlled, partially controlled, or uncontrolled.
» Review asthma control frequently and adjust treatment as needed, as symptoms may fluctuate and remit throughout childhood (see stepwise management below).

- ß$_2$-agonist (short-acting), e.g.:
  - Salbutamol, inhalation, 100–200 mcg, 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 mcg, 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 mcg, 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 mcg, 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 mcg, 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:
    - Salmeterol/fluticasone, 25/50 MDI, 2 puffs 12 hourly.

    OR
    - Salmeterol/fluticasone 25/125 MDI, 2 puffs, 12 hourly.

    OR

    Accuhaler:
    - Salmeterol/fluticasone 50/100, 1 inhalation, 12 hourly.

    OR
    - Salmeterol/fluticasone 50/250, 1 inhalation, 12 hourly.

Severe persistent asthma

- To relieve symptoms:
- ß$_2$-agonist (short-acting), e.g.:

Table 15.4: Assessment of asthma control over the past 4 weeks (or since last review):

	Yes / No (Assign one point for each "yes" answer)	
	Yes	**No**
Daytime asthma symptoms more than twice weekly		
Night waking due to asthma (any)		
Activity limitation due to asthma (any)		
IF using SABA-only inhaler: SABA-only reliever use more than twice/week for symptoms*		
Total points	**Control**	
0 points	Well controlled	
1–2 points	Partially controlled	
3–4 points	Uncontrolled	

*Only applicable if patient is using an inhaler that **only contains short-acting β$_2$-agonist**, i.e., not a corticosteroid-containing inhaler.
Abbreviations: SABA: Short acting β$_2$-agonist

MEDICINE TREATMENT

Medicine delivery systems

» Spacer devices increase the efficacy of inhaled therapy and should be used in combination with metered dose inhalers.

» Prime all spacers with two 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	500 mL	Face mask	Recommended
Children > 5 years	500 mL	Mouthpiece	Recommended
Adolescents	500 mL	Mouthpiece	Not necessary

» The technique of using the spacer varies with age:
  - Infants and young children (deep tidal breathing technique): Actuate the inhaler into the spacer and allow at least 6 tidal breaths.
  - Older children and adolescents (single breath inhalation technique): Breathe out fully into the spacer, actuate the inhaler into the spacer, inhale the entire contents in one long, slow breath and hold breath for 10 seconds.

- Salbutamol, inhalation, 100–200 mcg, 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:
    - Salmeterol/fluticasone, 25/50 MDI, 2 puffs, 12 hourly.

    OR
    - Salmeterol/fluticasone 25/125 MDI, 2 puffs, 12 hourly.

    OR

    Accuhaler:
    - Salmeterol/fluticasone 50/100, 1 inhalation, 12 hourly.

    OR
    - Salmeterol/fluticasone 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

Cont.

**Based on African American data.*

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

» Rinse the mouth after inhalation of inhaled corticosteroids to reduce systemic absorption and adverse effects.
» Wash face after use if a face mask is used.
» See Annexure 3: Devices for Respiratory Conditions for guidance on inhaler, spacer and nebuliser device techniques.

Principles of asthma therapy

Asthma symptom control is achieved by optimising the use of inhaled bronchodilators and corticosteroids. Treatment strategies include reliever therapy only, or maintenance therapy with reliever therapy as needed. Early introduction of inhaled corticosteroids, where indicated, improves symptom control and reduces the risk of exacerbations.

Therapeutic goals include:
» Optimal control of symptoms and maintenance of normal activity levels,
» Minimising risk of exacerbations, impaired lung development, and adverse side-effects to medication. The lowest effective dose of inhaled corticosteroids should be used, when indicated.

Review asthma control frequently and consider whether the level of treatment should be adjusted:
» If patient is well-controlled: STEP DOWN treatment.
» If patient is partially controlled or uncontrolled: STEP UP treatment.

Corticosteroid and bronchodilator combination therapy

The use of an anti-inflammatory reliever (AIR) (usually an inhaled corticosteroid/ICS with the rapid onset LABA reliever, formoterol) is more effective than SABA use alone, even in asthma with low symptom frequency. In more severe disease, the same ICS-formoterol combination inhaler can be used for symptom relief as well as maintenance therapy, and is called maintenance-and-reliever therapy (MART).

Note, however, that there is currently insufficient evidence to support MART in children under 6 years of age.

Table 15.5: Principles of asthma therapy by age group:

Age	Principles of therapy
All children	» Inhaled corticosteroids are indicated for maintenance therapy in children with asthma symptoms occurring more than twice a week, or those with ≥ 1 exacerbation in the past year. » The ICS dose may be increased in children whose symptoms are still not well controlled after 2–3 months of initial low-dose ICS therapy, **after** confirming appropriate diagnosis, management of risk factors, inhaler technique, and adherence. » Consider ICS dose reduction after 2–3 months in children with a good response to therapy.

Age 0–5	» Recommended initial asthma therapy is SABA, given as needed without ICS, when symptoms occur. » Consider a 2–3 month trial of SABA therapy, as needed, in children with infrequent acute wheezing episodes that do not require unscheduled medical care. » Consider short-course ICS maintenance therapy, in addition to as-needed SABA therapy, for children with symptoms triggered by viral respiratory tract infections, but who are otherwise well-controlled on reliever therapy only. » Regular ICS maintenance therapy is recommended for children whose asthma is not well-controlled, or who have had one or more asthma exacerbations requiring acute hospital care, oral corticosteroids, or hospital admission in the previous year.
Age 6–11	» Initial therapy depends on recent asthma symptom control, history of exacerbations over the past year, and lung function. » Recommended initial therapy is SABA, given together with an ICS, as needed when symptoms occur. » MART is the preferred treatment strategy for children that require maintenance therapy and have failed to achieve symptom control with regular low-dose ICS. MART should be prescribed where available.

CAUTION

» Inhaled corticosteroids are the mainstay of therapy in asthma.
» There is currently insufficient evidence to support MART in children under 6 years of age.
» β_2-agonist monotherapy is associated with increased mortality in asthma and is **no longer recommended** for children aged 6 years and older.

Chronic asthma management for children under 6 years of age:

» Initiate children with newly diagnosed asthma at the step that correlates with their symptoms.
» Step up treatment to the next level if the child is uncontrolled, partially controlled, or at high risk of exacerbations.
» Consider treatment step down if the child has been well-controlled for 2–3 months.

Table 15.6: Assessment of asthma severity at baseline & recommended entry point for stepwise treatment for children under 6 years of age

Presenting Symptoms	Initial Treatment

Asthma symptoms: two days/week or less	**Step 1** As-needed SABA
Asthma symptoms: 3–4 days/week	**Step 2** Regular low dose ICS + as-needed SABA
Asthma symptoms: Most days (4-5 days/week) OR Night waking once a week or more	**Step 3** Regular double low dose ICS + as needed SABA
Asthma symptoms: Daily AND Night waking once a week or more AND Reduced lung function OR recent exacerbation	**Step 4** Regular double low dose ICS + as needed SABA **AND** Urgent paediatric pulmonology/allergology referral
Abbreviations: ICS = Inhaled corticosteroids; SABA = Short-acting β_2 agonist.	

STEP 1:
(Asthma symptoms on ≤ 2 days per week; and no nocturnal symptoms; and normal lung function)

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Maintenance therapy:

- Maintenance therapy is generally not required. Continue with reliever/rescue therapy and monitor asthma control.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 2:
(Asthma symptoms on 4–6 days per week; and no nocturnal symptoms; and normal lung function).

Maintenance therapy:

- Low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, once daily.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 3:
(Asthma symptoms 4–6 days per week; or weekly nocturnal symptoms; or reduced lung function).

Maintenance therapy:

- Double low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a referral for further management.

STEP 4:

((Daily asthma symptoms; and nocturnal symptoms once a week or more; and reduced lung function or has history of recent acute exacerbation).

» Continue STEP 3 therapy.

» Refer to paediatric allergology/pulmonology for further management.

» If patient remains uncontrolled while awaiting referral appointment, increase dose of beclometasone:

- Beclometasone, 100 mcg MDI, to take 200 mcg (two inhalations) with a spacer device, 12 hourly.

Chronic asthma management for children aged 6 to 11:

» Initiate children with newly diagnosed asthma at the step that correlates with their symptoms.

» Step up treatment to the next level if the child is uncontrolled, partially controlled, or at high risk of exacerbations.

» Consider treatment step down if the child has been well-controlled for 2–3 months.

Table 15.7: Assessment of asthma severity at baseline & recommended entry point for stepwise treatment for children aged 6–11 years

Presenting Symptoms	Initial Treatment
Asthma symptoms: two days/week or less	**Step 1** As-needed low-dose ICS + SABA **OR** Low dose ICS-formoterol as AIR ONLY
Asthma symptoms: 3–4 days/week	**Step 2** Regular low dose ICS + as-needed SABA **OR** Low dose ICS-formoterol as AIR only
Asthma symptoms: Most days (4-5 days/week) *OR* Night waking once a week or more *OR* Reduced lung function	**Step 3** Regular medium-dose ICS + as needed SABA **OR**

	Low-dose ICS-formoterol as MART (once daily maintenance dose)
Asthma symptoms: Daily *AND* Night waking once a week or more AND Reduced lung function OR recent exacerbation	**Step 4** Low-dose ICS-formoterol as MART (twice daily maintenance dose) **OR** Refer
Abbreviations: ICS = Inhaled corticosteroids; AIR only = Anti-inflammatory reliever only; MART = Maintenance-and-reliever therapy; SABA = Short-acting β_2 agonist.	

OPTION 1: ICS+SABA REGIMEN
STEP 1:

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review

AND

- Low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, as needed whenever salbutamol is used for symptom relief.

Maintenance therapy:

» Maintenance therapy is generally not required. Continue with reliever/rescue therapy and monitor asthma control.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 2:

Maintenance therapy:

- Low dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 100 mcg (one inhalation) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:
- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 3:

Maintenance therapy:

- Medium dose inhaled corticosteroid, e.g.:
- Beclometasone, 100 mcg MDI, to take 200 mcg (two inhalations) with a spacer device, 12 hourly.

Reliever/rescue therapy:

- Short-acting β_2-agonists, e.g.:

- Salbutamol, 100 mcg MDI, to take 100–200 mcg (one to two inhalations) with a spacer device, as needed for symptom relief.
  - Routine use exceeding four times daily suggests poor control and requires review.

Note: Asthma that is not well-controlled on maximum therapeutic doses should trigger a review to step up treatment.

STEP 4:

» Switch to OPTION 2 STEP 3 therapy (see below).

» If both options in STEP 3 fail to achieve asthma control, refer to paediatric allergology/pulmonology for further management.

CAUTION

» Formoterol has a rapid onset of action and can be used as reliever therapy in children 6 years and older, **BUT ONLY in combination with an ICS**.

» Salmeterol is not rapid acting and **should not be used as reliever therapy.**

» Budesonide and fluticasone have significant drug-drug interactions with HIV protease inhibitors. Substitute with beclometasone-based regimens where indicated.

OPTION 2: Anti-inflammatory reliever (AIR) ONLY or Maintenance and reliever therapy (MART)
STEP 1 AND STEP 2: AIR only

Anti-inflammatory reliever/rescue therapy:

- Low dose corticosteroid/formoterol inhaler, e.g.:
- Budesonide/formoterol, MDI, 80 mcg/4.5 mcg, one inhalation with a spacer device, as needed.
  - Maximum daily dose: 640 mcg/36 mcg (8 inhalations) doses per day.
  - Patients/carers should be counselled to present to their healthcare facility for review if they require maximum doses of inhaler therapy for more than one week in a month.

Note: Insufficient asthma control on maximum therapeutic doses should trigger a review to step up treatment.

Maintenance therapy:

No maintenance therapy required. Continue with reliever/rescue therapy using ICS/formoterol combination inhaler and monitor asthma control.

STEP 3: MART

Maintenance therapy:

- Low dose corticosteroid/formoterol inhaler, e.g.:
- Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, once daily.

Reliever/rescue therapy:

- Low dose corticosteroid/formoterol inhaler, e.g.:

	• Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, as needed for symptom relief. ○ Daily dose of budesonide/formoterol should not exceed 640 mcg/36 mcg (8 inhalations) considering maintenance and reliever doses per day. This equates to 7 additional reliever inhalations on top of 1 maintenance inhalation per day. **Note:** Insufficient asthma control on maximum therapeutic doses should trigger a review to step up treatment. **STEP 4: MART** <u>Maintenance therapy:</u> ▪ Low dose corticosteroid/formoterol inhaler, e.g.: • Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, 12 hourly. <u>Reliever/rescue therapy:</u> ▪ Low dose corticosteroid/formoterol inhaler, e.g.: • Budesonide/formoterol, 80 mcg/4.5 mcg MDI, to take 80 mcg/4.5 mcg (one inhalation) with a spacer device, as needed for symptom relief. ○ Daily dose of budesonide/formoterol should not exceed 640 mcg/36 mcg (8 inhalations) considering maintenance and reliever doses per day. This equates to 6 additional reliever inhalations on top of 2 maintenance inhalations per day. **Note:** » Budesonide has a significant drug-drug interaction with HIV protease inhibitors. Replace with beclometasone-based regimen (OPTION 1 above). **REFERRAL** » Diagnostic uncertainty. » After a life-threatening asthma exacerbation. » Unstable or difficult to control asthma. » Asthma not responding to medium/high dose ICS therapy *See algorithm below* **Figure 15.3: Management of chronic asthma in children < 12 years**

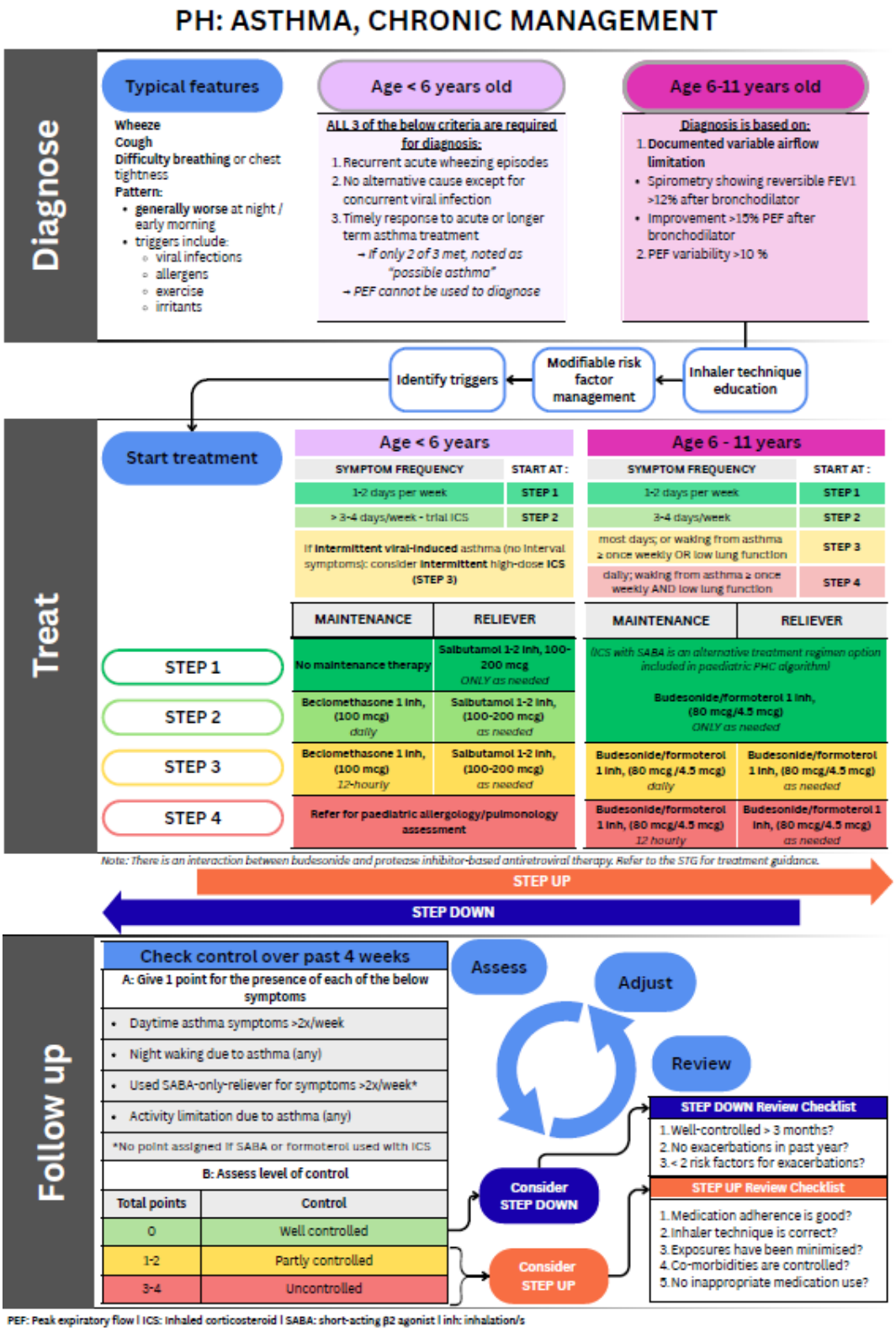

Figure 15.3: Management of chronic asthma in children < 12 years

Paed Hospital Annexure 2: ASTHMA MONITORING

A new annexure has been added which includes the reference table for monitoring peak expiratory flow values in children.
Annexure 2: Asthma monitoring, may be found at the end of this report or on the NHI webpage.

Paed Hospital Annexure 3: DEVICES FOR RESPIRATORY CONDITIONS

A new annexure has been added which includes guidance on the use of inhaler devices in children commonly used in respiratory conditions.
Annexure 3: Devices for Respiratory Conditions, may be found at the end of this report or on the NHI webpage.

Comparative Interchange

NEMLC approved categories and products for inclusion on the therapeutic interchange database are detailed below (note that recommended doses do not necessarily imply dose equivalence or equipotency).

The delivered dose of inhaled medication may be influenced by several factors, including the drug chemical composition (e.g. fluticasone propionate versus fluticasone furoate), device type (e.g. MDI vs DPI), particle size (e.g. standard vs extra fine) and propellant type for MDIs (e.g. chlorofluorocarbon (CFC) vs hydrofluoroalkane (HFA)). The list below is not an exhaustive list of all SAHPRA approved products and it is therefore recommended that the individual product information be consulted for guidance on the delivered dose and comparative potency.

Product information last sourced from SAHPRA Registered Heath Products database: 19 July 2026

Therapeutic class	No. of doses/ inhaler	Trade name	strength	unit	Device type	Dosing interval (times per day)	Adult/ child	SAHPRA Approved indication /Off-label	DDD	No. of inhalers modelled per annum. Estimated equivalent	Comments
ICS MDI - maintenance therapy in children < 11 years (low –medium dose ICS)											
Beclometasone dipropionate (MDI standard particle, HFA)	200	Beclorest	100	mcg	MDI	Once or twice daily	Child	Approved	100-200mcg	n/a	
Beclometasone dipropionate (MDI standard particle, HFA)	200	Beclomiz (Unimed)	100	mcg	MDI	Once or twice daily	Child	Approved	100-200mcg	n/a	
n/a	n/a	Biosone	100	mcg	MDI	n/a	n/a	n/a	n/a	n/a	

Therapeutic class	Number of doses/inhaler	Trade name	strength	unit	Inhaler device type	Dosing interval (times per day)	Adult/ child	SAHPRA Approved indication /Off-label	DDD	No. of inhalers modelled per annum. Estimated equivalent	Comments
ICS/formoterol Combination - Anti-inflammatory and/or Reliever Plus Maintenance Therapy: MDI for children 6-11 years											
Budesonide, Formoterol fumarate dihydrate	120	Vannair 80/4.5	80/4.5	mcg	MDI	1p OD or BD *plus* 1p prn	Children 6-11 years	Off-label	Max 8 puffs per day	n/a	Shelf life reduced to 3 months once the foil wrapper is opened
Budesonide, Formoterol fumarate dihydrate	120	Budofor 80/4.5	80/4.5	mcg	MDI	1p OD or BD *plus* 1p prn	Children 6-11 years	Off-label	Max 8 puffs per day	n/a	Shelf life reduced to 3 months once the laminated wrapper is opened

PEAK EXPIRATORY FLOW RATES

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
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

Height (cm)	PEF		PEF	
	Caucasian		African*	
	Male	Female	Male	Female
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
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.

CALCULATING PEAK FLOW VARIABILITY IN CHILDREN

- Perform peak flow measurements 4 times per day spread over the course of the day.
- Subtract the lowest reading of each day from the highest reading.
- Calculate the mean/average reading by adding all 4 readings from that day and dividing total by 4.
- Calculate PEF variability:

$$\text{PEF variability} = \frac{(\text{Highest PEF} - \text{Lowest PEF})}{\text{Mean PEF}} \times 100.$$

Determine this value on each day over two weeks, and average the results. Excessive diurnal PEF variability defined as >10% in adults and >12% in children strongly supports a diagnosis of asthma.

ASTHMA CONTROL TEST™

This is a validated measure of clinical asthma control that can be completed by the patient (after initial instruction) at each visit to the clinic prior to consultation. A value of ≥19 suggests adequate asthma control.

Online version of the test is accessible at: https://www.asthmacontroltest.com/

Reference: Nathan RA, Sorkness CA, Kosinski M, Schatz M, Li JT, Marcus P, Murray JJ, Pendergraft TB. Development of the asthma control test: a survey for assessing asthma control. J Allergy Clin Immunol. 2004 Jan;113(1):59-65. http://www.ncbi.nlm.nih.gov/pubmed/14713908

INHALER DEVICES

SPACER DEVICES

» Spacers are vital for an adequate therapeutic effect of inhaled therapy.
» Spacer devices should be used for all inhaled medications in all age groups to improve efficacy of medicine delivery and limit adverse effects.
» Use a spacer that is appropriate for the patient's age.

	Spacer volume	Valve	Delivery	Technique
Infants <3 years	150–250 mL	Required	Face mask	Deep tidal breathing
Children 3 to 6 years	500 mL	Required	Mouthpiece	Deep tidal breathing
Children >7 years	500 mL	Optional	Mouthpiece	Single inhalation and breath-hold

» Inhalation spacer devices enable optimal aerosol delivery.
» Children < 3 years of age should have a spacer with a face mask, while older children and adults should use the spacer with a mouth piece directly.
» Demonstrate the relevant inhaler technique more than once to ensure the correct procedure (see below). *LoE:IVb*[1]

Patient and caregiver education on inhaler and spacer techniques:
» If patients are switched between different types of devices (e.g. from MDI to DPI), patients need to be re-educated on inhaler technique.
» If changing from a DPI to MDI, consider if a spacer is required, and the optimal technique for inhalation.
» Doses may not be equivalent between different inhaler devices – ensure that patients are prescribed the correct dose when switching between devices.

METERED DOSE INHALERS (MDIs)

» A mask attachment must be used with the spacer for children < 3 years of age and be removed as soon as the child is able to use the mouthpiece.

A. Inhalation therapy without a spacer in adolescents: Single breath inhalation technique

1. Remove the cap from the mouthpiece.
2. Shake the inhaler well.
3. While standing or sitting upright, breathe out as much air as possible.
4. Immediately place the mouth piece of the inhaler between the lips and gently close the lips around it.
5. Start breathing in slowly.
6. Immediately press down the canister of the metered dose inhaler once to release one puff while simultaneously breathing in as deeply as possible.

7. Hold breath for 5 to 10 seconds, if possible.
8. Breathe out slowly through the nose and rest for a few breaths (30–60 seconds).
9. Repeat steps 2–8 for each puff prescribed.
10. Rinse mouth after inhalation of corticosteroids. *LoE:IVb*[2]

B. Inhalation therapy with a spacer in older children and adolescents: Single breath inhalation technique

1. Remove the caps from the inhaler and the spacer.
2. Shake the inhaler well.
3. Insert the mouthpiece of the metered dose inhaler into the back of the spacer.
4. Insert the mouthpiece of the spacer into the mouth and close the lips around the mouthpiece.
5. Exhale fully into the spacer.
6. Start inhalation and immediately press down the canister of the metered dose inhaler once to release one puff into the spacer.
7. Breathe in slowly to full inhalation and hold the breath for 5 to 10 seconds.
8. Breathe out through the nose.
9. Repeat steps 2–8 for each puff prescribed, waiting at least 30 seconds between puffs.
10. Rinse mouth after inhalation of corticosteroids.

C. Inhalation therapy with the spacer alone in younger children or in adolescents unable to do single inhalation: Deep tidal breathing technique

1. Remove the caps from the inhaler and the spacer.
2. Shake the inhaler well.
3. Insert the mouthpiece of the spacer into the mouth and close the lips around the mouthpiece.
4. Press down the canister of the metered dose inhaler once to release one puff into the spacer.
5. Breathe slowly and deeply in and out of the spacer continuously for at least 6 breaths
6. If breathing through the nose as well as the mouth, pinch the nose gently while breathing from the spacer.

D. Inhalation therapy with a spacer and mask for infants and children < 3 years:

1. Remove the caps from the inhaler and the spacer.
2. Infants may be preferably placed on the caregiver's lap or alternatively laid on a bed while administering the medication.
3. Shake the inhaler well.
4. Apply the mask to the face, ensuring that the mouth and nose are well covered.
5. With the mask held firmly onto the face, press down the canister of the metered dose inhaler once to release one puff into the spacer.
6. Keep the mask in place for at least six breaths, then remove.

7. Repeat steps 3–6 for each puff prescribed, waiting at least 30 seconds between puffs.

DRY POWDER INHALERS (DPIs)

E. Inhalation therapy with a dry powder inhaler (DPI) for children over 6 years of age:

1. There is no need to shake a DPI.
2. Open, twist or click the device to load the medication dose.
3. Stand or sit up straight and breathe out completely (away from the device, not into the mouthpiece).
4. Immediately place the mouthpiece into the mouth, close lips tightly around it and breathe in quickly and forcefully to full inhalation.
5. Remove the DPI from the mouth, hold breath for 5-10 seconds, then exhale slowly.
6. Optimise positioning and repeat steps 2–5 for each puff prescribed, waiting at least 30 seconds between puffs.
7. Rinse mouth with water after inhalation of corticosteroids.

NEBULISERS

The guidance below is tailored to the use of jet nebulisers which are primarily used in the public sector.

1. Ensure the nebuliser cup is filled sufficiently to allow effective nebulisation (approx. 4 mL minimum volume). Volume must be more than the equipment dead space to be sufficient. The dead space in a nebuliser refers to the volume of the nebulizer chamber and tubing that remains filled with medication after treatment. This volume is not delivered to the patient and can vary depending on the nebulizer design. Typical dead space volumes in jet nebulizers is 2-3 mL.
2. Hold the nebuliser upright.
3. Select a flow rate of oxygen of 6 to 8 L/min for jet nebulisers.
4. Use a mouthpiece rather than a facemask in adults and in any child able to hold a mouthpiece between their lips and breathe via their mouths.
   Better medication delivery: The T-piece allows for more direct delivery of medication to the lungs, reduced medication loss, improved patient comfort, enhanced cooperation, reduced risk of skin irritation and easier observation of the patient's mouth and nose.
5. Place the mouthpiece in the patient’s mouth. Advise the patient to keep their lips firmly around the mouthpiece. If using a facemask, place it over the mouth and nose.
6. Ensure patient is calm and relaxed.
7. Advise patient to breathe slowly and deeply through the mouth as far in and as far out as possible until all the medication is used.

The following should be avoided when using nebulisers:

» Rapid or forceful inhalation (including crying)
» Nebulising whilst sleeping
» Using a facemask when a mouthpiece is possible
» A loose-fitting facemask or placing the nebuliser near a child's nose and mouth rather than securing a facemask

LoE:IVb[3]

[1] Spacers: Vincken W, Levy ML, Scullion J, Usmani OS, Dekhuijzen PNR, Corrigan CJ. Spacer devices for inhaled therapy: why use them, and how? ERJ Open Res. 2018 Jun 18;4(2):00065-2018. doi: 10.1183/23120541.00065-2018. PMID: 29928649; PMCID: PMC6004521.
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[2] Optimal aerosol delivery: Levin ME. Optimal aerosol delivery. Current Allergy & Clinical Immunology. 2011; 24(1):27-30
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[3] Optimal aerosol delivery: Levin ME. Optimal aerosol delivery. Current Allergy & Clinical Immunology. 2011; 24(1):27-30