

MANAGEMENT OF ASTHMA

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FOREWORD

Asthma is a heterogeneous disease and the phrase “asthma syndrome” is probably better than the word “disease” to describe the condition. Wheezing is perhaps the commonest cause of hospital admission in Sri Lankan children[1]. The Sri Lankan phase of the International Study of Asthma and Allergies in Childhood (ISAAC) found that the prevalence rate of childhood asthma in this country is between 15-20% with some areas reaching figures as high as 35-40%. It is also a common cause of school absenteeism[2].

Childhood asthma has many and varied facets like different modes of presentation, precipitation by many trigger factors and variable responses to medication. Therefore, asthma cannot be managed properly without treating the entire patient, educating the parents and possibly modifying the environment.

This booklet containing management guidelines for childhood asthma was prepared by a subcommittee appointed by the Sri Lanka College of Paediatricians under the Health Sector Development Project by the Ministry of Health, Sri Lanka. This was funded by the World Bank.

The guidelines are meant for clinicians who manage childhood asthma in different parts of the country. The text contains more information than the wall charts about childhood asthma.

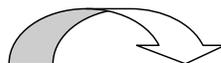
Due consideration has been given to levels of evidence based on published references and the availability of facilities in different areas of the country.

Asthma Guideline Sub Committee
Sri Lanka College of Paediatricians

GUIDELINES FOR MANAGEMENT OF ASTHMA

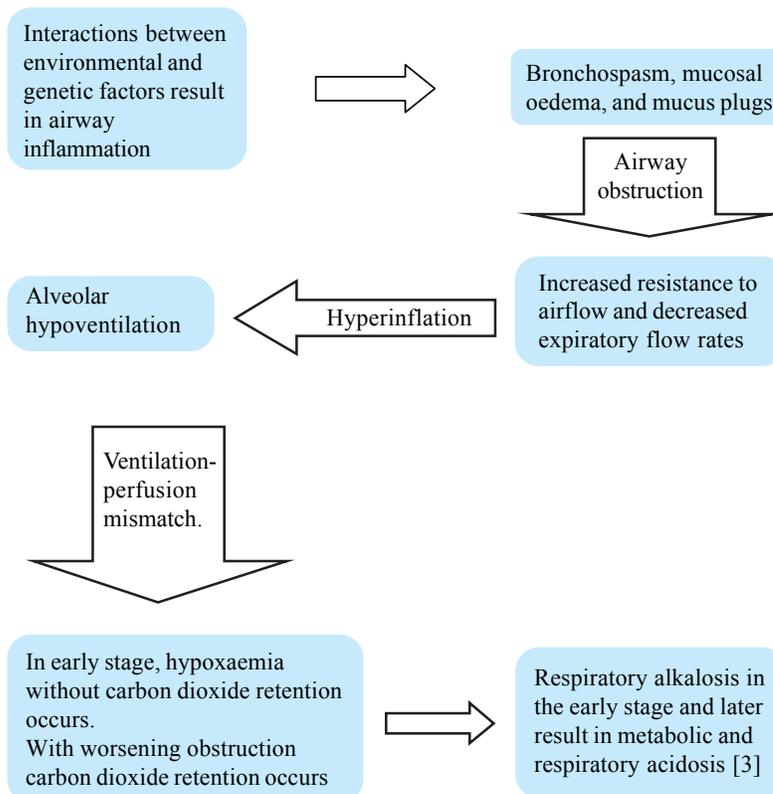
DEFINITION OF ASTHMA

Asthma is a chronic inflammatory disorder of the airways characterized by an obstruction to airflow, which may be completely or partially reversible with or without specific therapy.



Airway inflammation is associated with airway hyper-reactivity or bronchial hyper-responsiveness (BHR), which is defined as the inherent tendency of the airways to narrow in response to a variety of stimuli (e.g. environmental allergens and irritants) [3].

PATHOPHYSIOLOGY



CLINICAL FEATURES

- Wheeze.
- Cough which is chesty, repetitive in nature and which occurs primarily or becomes worse in the night or early hours of the morning.
- Cough may be precipitated by exercise or crying and may be paroxysmal.
- Breathlessness, chest tightness.

Cough is often an early symptom of asthma in children, which can be overlooked for years, especially if the airway obstruction has not been severe enough to produce overt wheezing.

Presence of a wheeze as noted by parent/s or documented by a clinician is perhaps the best evidence for asthma in children.

Symptoms may be of

- varying severity.
- short or long duration.

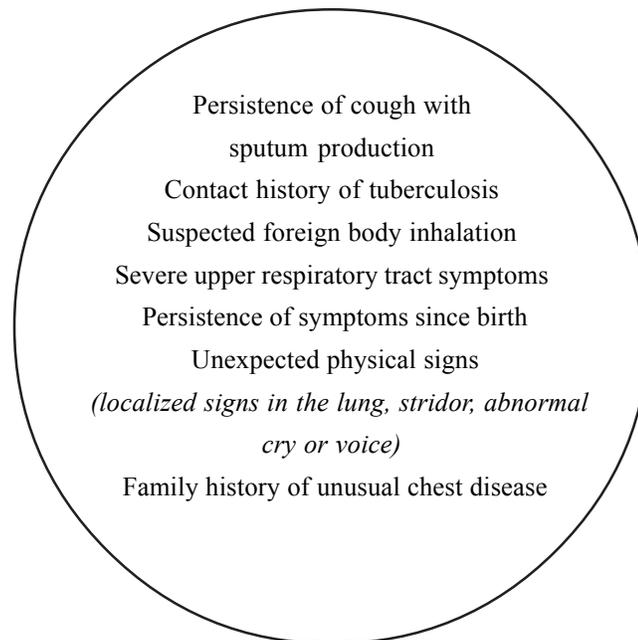
Symptoms may be precipitated by a wide variety of triggers and may get worse in the late evening or at night.

Common precipitating factors

- Viral respiratory tract infections
- Exercise
- Cold dry air
- Air pollutants
- Tobacco smoke and other types of smoke
- Stress
- Psychological factors
- Drugs e.g. aspirin, β blockers

INDICATIONS FOR REFERRAL TO A PAEDIATRICIAN FOR SPECIALIST MANAGEMENT

- **When the diagnosis is uncertain**



- Failure to respond to conventional treatment, particularly bronchodilators and/or inhaled steroids
- Associated failure to thrive
- Parental anxiety or need for reassurance

DIAGNOSIS OF PAEDIATRIC ASTHMA

The diagnosis is primarily clinical as objective tests are often difficult to perform in children.

Diagnosis of asthma in children is based on [4]:

- the presence of key features and careful consideration of alternative diagnoses
- improvement with bronchodilators
- repeated assessment of the child, questioning the diagnosis if management is ineffective

Other causes of recurrent wheeze in children

- Intra bronchial foreign body
- Recurrent lower respiratory tract infections
- Mediastinal masses
- Heart failure
- Gastro oesophageal reflux
- H-type tracheo oesophageal fistula
- Immune deficiency
- Loeffler syndrome
- Vascular rings
- Cystic fibrosis
- Ciliary dyskinesia



Objective Tests:

- May be possible in children more than 5 years of age.
- Asthma causes a decrease in peak expiratory flow (PEF) and forced expiratory volume in the first second (FEV₁). One or both could be measured. However, these measurements may be normal between episodes of bronchospasm.
- **Variability of PEF and FEV₁, either spontaneously over time or in response to bronchodilator therapy is a characteristic feature of asthma.**
- The percentage PEF variability (**amplitude % best**) of 20% or more is highly suggestive of asthma [5,6,7,8].

Diagnosis of asthma using PEF⁴

$$\text{Percentage PEF variability (Amplitude \% best)} = \frac{(\text{Highest} - \text{lowest})}{\text{Highest}} \times 100$$

An example is illustrated below:

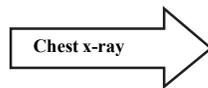
Highest PEF = 400 L/min

Lowest PEF = 300 L/min

Amplitude = 400 L/min - 300 L/min = 100 L/min

Percentage PEF variability (Amplitude % best) = {100 / 400} x 100 = 25%

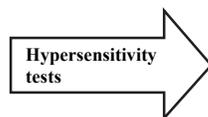
Other investigations:



Chest x-ray

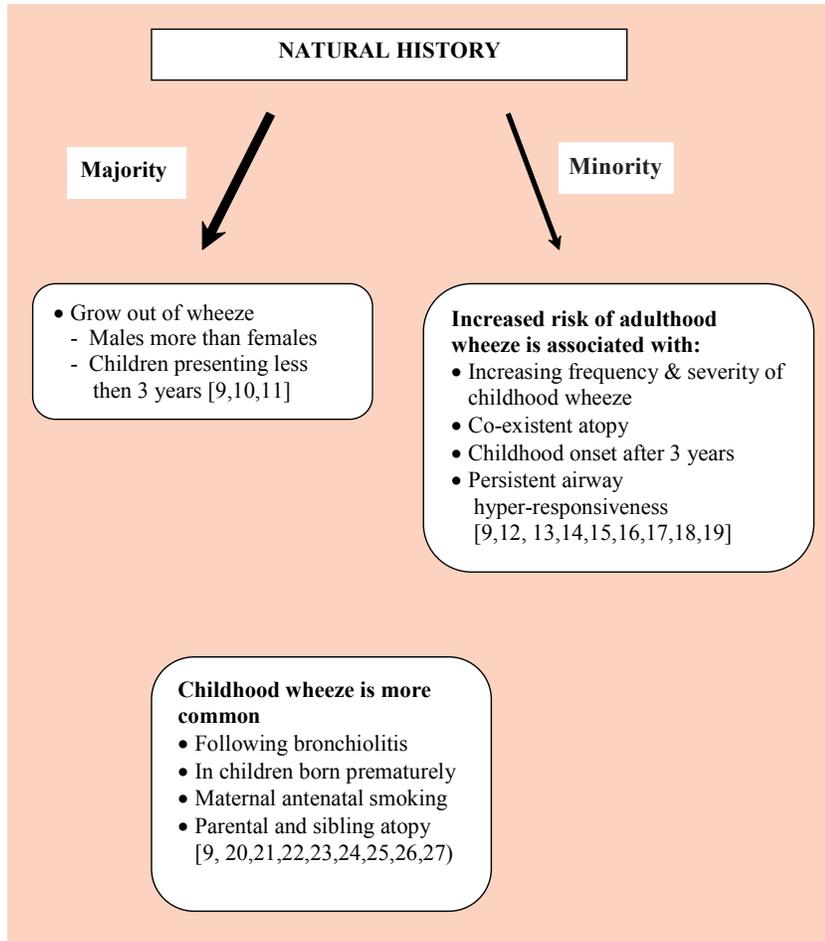
Indications

- When the diagnosis is uncertain (At least one x-ray to rule out other conditions)
- Severe/life threatening episode responding poorly to therapy (To rule out conditions like pneumothorax & pneumonia)



Hypersensitivity tests

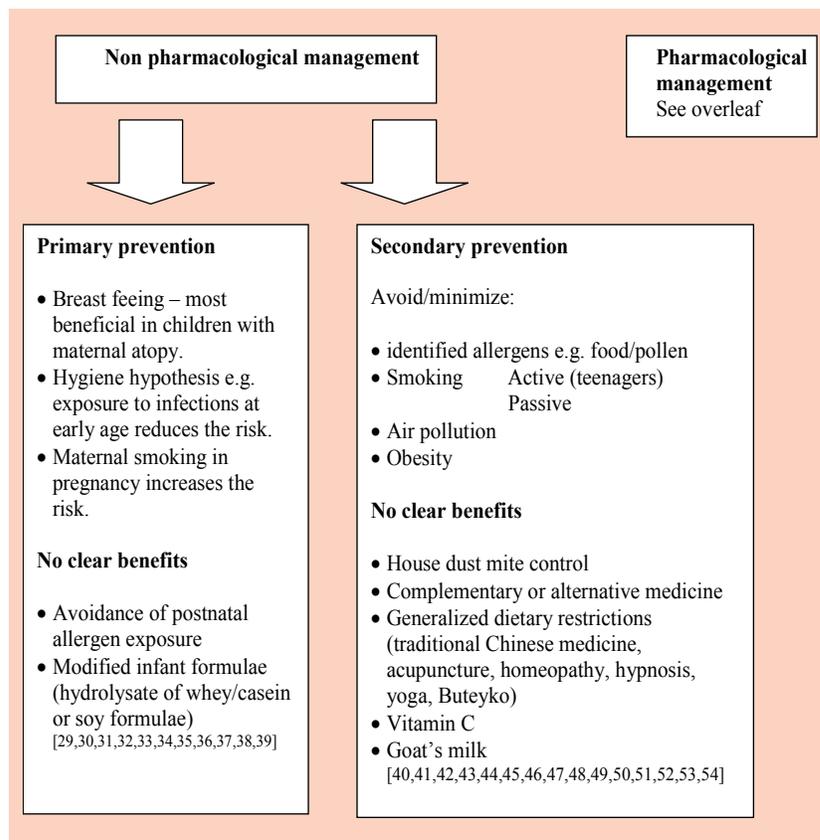
- RAST test and allergic skin tests may be useful in children with atopy.
- However these are often not available in Sri Lanka.
- Instead, trigger factors could often be obtained from parents and children.



MANAGEMENT

Goals of asthma therapy in children [4,28]

Minimal, ideally no, symptoms during the day or at night
Minimal, ideally no exacerbations
Minimal use or no necessity for the use of reliever short acting β_2 agonist
FEV₁ and/or PEF over 80% of personal best or predicted normal
Minimal, ideally no adverse effects from medications
Normal activities and rare school absences
Optimum growth of the child
Minimal effects on other family members



PHARMACOLOGICAL MANAGEMENT

- Management of an acute exacerbation
- Long term management

Management of an acute exacerbation

Exacerbations could be mild, moderate or severe according to the intensity of symptoms and signs [4,55].

Severity of an acute exacerbation

	Mild		Moderate		Severe	
	< 2 year	≥ 2 years	< 2 year	≥ 2 years	< 2 year	≥ 2 years
Age	< 2 year	≥ 2 years	< 2 year	≥ 2 years	< 2 year	≥ 2 years
Activity	Normal	Normal	Disturbed	Disturbed	Severely disturbed	Severely disturbed
Feeding	Normal	Normal	Disturbed	Disturbed	Severely disturbed	Severely disturbed
Speech	-	Normal	-	Halting	-	1-2 word dyspnoea
Audible wheeze	Nil	Nil	Present	Present	Marked	Marked
Cyanosis	Nil	Nil	Nil	Nil	Present	Present
Respiratory rate/min	< 50	< 40	50-60	40-50	> 60	> 50
Use of accessory muscles	Nil	Nil	Present	Present	Marked	Marked
Chest in drawing	Nil	Nil	Present	Present	Marked	Marked
Air entry	Good	Good	Good	Good	Poor	Poor
Lung signs	+	+	++	++	+++	+++
Pulse/min	< 110	< 100	110-130	100-120	> 130	> 120
PEF	-	70-90% of predicted	-	50 to 70% of predicted	-	< 50% of predicted
SpO₂	>92%	>92%	≥ 92%	≥ 92%	< 92%	<92%

If a child has features across categories he/she should be managed according to the most severe category.

MANAGEMENT OF A MILD EXACERBATION

Place of management:

- Primary care unit
OR
- Emergency treatment unit
OR
- Outpatient department
OR
- General practice.

The mainstay of therapy is short acting β_2 adrenoceptor agonists (salbutamol or terbutaline).

- Ideal method of administration is through inhalers. As required dosage is recommended (<4 times/day), unless individual patients are shown to benefit from taking regular inhaled short acting β_2 agonists during the day (e.g. 4-6 hourly).
- Oral short acting β_2 agonists are often used in Sri Lanka due to economic constraints.
- Oral theophylline could be added to produce a synergistic effect.

These drugs should be continued until symptoms subside (usually 1-2 weeks).

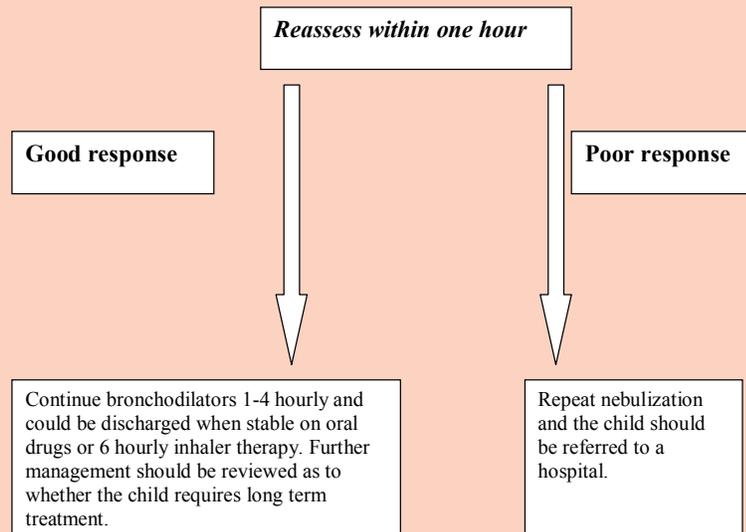
Dosage of bronchodilator therapy for a mild exacerbation

Drug [55, 56]	Dosage		
Oral salbutamol	<2 yrs	2-6 yrs	> 6 yrs
	100 μ g/kg tds/qds	1 to 2 mg tds/qds	2 mg tds/qds
Salbutamol inhaler	2-4 puffs every 4-6 hours		
Oral terbutaline	75 μ g /kg	75 μ g /kg	2.5 mg
	tds	tds	bd/tds
Theophylline	10 to 20 mg/kg/day divided tds/qds dosage		
Slow release theophylline	10 to 20 mg/kg/day two divided doses		

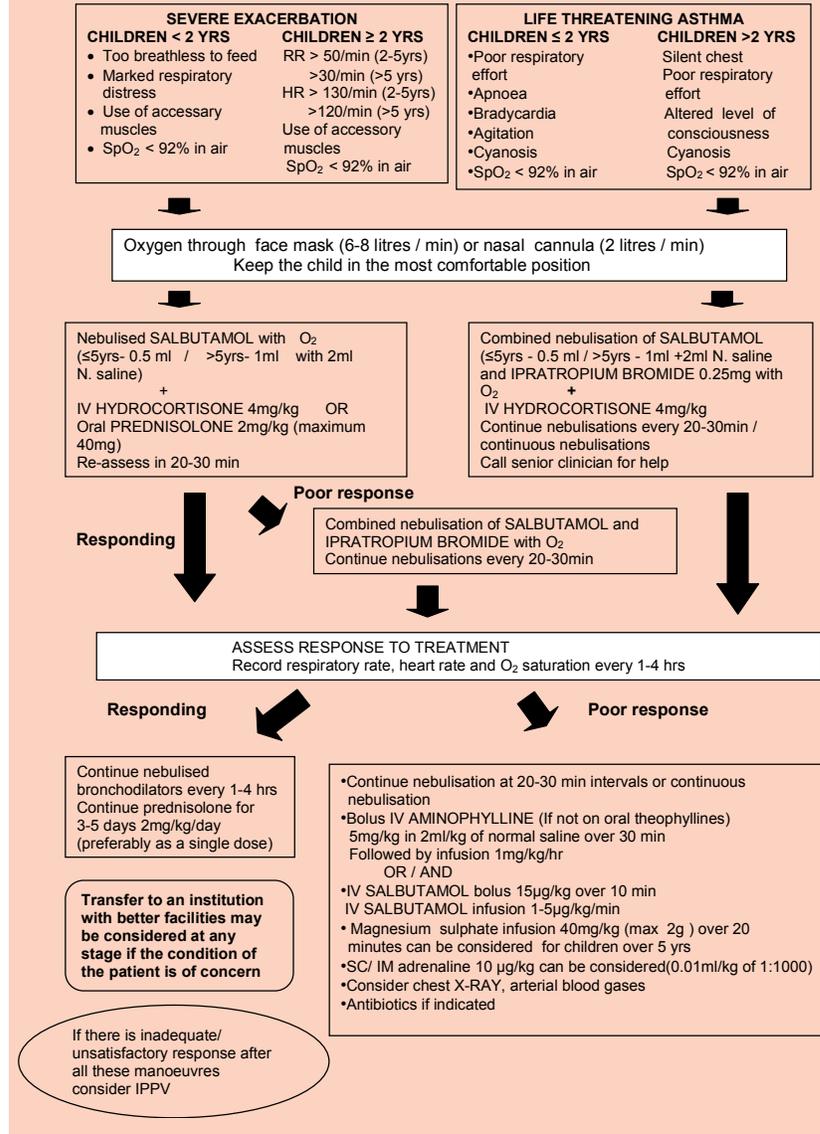
MANAGEMENT OF A MODERATE EXACERBATION [4,55]

- **Place of management:** primary care unit / emergency treatment unit / outpatient department / general practice.
- **Inhaled β_2 agonists via**
 - Metered dose inhaler (MDI) + spacer
 - Dose: 2-4 puffs, increase by 2 puffs every 2 minutes up to 10 puffs according to response.*
 - Nebulizers
 - Dose: Salbutamol nebulizer solution (5mg in 1 ml)*
 - <= 5 yrs - 0.5 ml salbutamol + normal saline 2 ml for 10 minutes*
 - > 5 yrs - 1.0 ml salbutamol + normal saline 2 ml for 10 minutes*
- Prednisolone 2mg/kg/day 3-5 days, preferably given as morning single dose
(no need to taper the dose at discontinuation)

Children under 3 years are likely to require a facemask connected to the mouthpiece of the spacer for successful drug delivery. Inhalers should be actuated into the spacer in individual puffs and inhaled immediately by tidal breathing.



MANAGEMENT OF SEVERE AND LIFE THREATENING ATTACK OF ASTHMA



Special points to remember

- **Oxygen**

Children with severe asthma or $SpO_2 < 92\%$ should receive high flow oxygen, 6-8 litres/minute via a tight fitting face mask with expiratory vents or 1-2 litres/minute through nasal cannulae.

- **Beta₂ agonist bronchodilators**

All nebulisations should be undertaken either through oxygen driven nebuliser chambers with an oxygen flow rate of 6 to 8 litres per minute nebuliser or with added oxygen when the chamber is driven with compressed air by an electric compressor. Salbutamol nebulization is known to cause pulmonary vasodilatation and increase cardiac output. Hence, salbutamol nebulization without oxygen could produce ventilation perfusion mismatch (V/Q mismatch) or make the mismatch worse [3].

- **Intravenous salbutamol**

The early addition of a bolus dose of intravenous salbutamol (15 µg/kg) can be an effective adjunct to treatment in severe cases⁴. Continuous infusion should be considered when there is uncertainty about reliable inhalation or for severe refractory asthma. This should be given preferably in an ICU setting with regular monitoring of oxygen saturation (S_pO_2) and electrolytes in view of the possible occurrence of hypokalaemia [3,4].

- **Steroid therapy**

Benefits can be apparent within 4-6 hours.

Oral and IV steroids are of similar efficacy [57,58]. Treatment up to 3 days is usually sufficient, but the length of the course should be tailored to the number of days necessary to bring about recovery.

Larger doses do not appear to offer a therapeutic advantage for the majority [59].

Do not initiate inhaled steroids in preference to oral or IV steroids to treat acute asthma [59,60].

- **Ipratropium bromide**

If symptoms are refractory to initial β_2 agonist inhaled therapy, add nebulised ipratropium bromide (0.25 mg/dose mixed with β_2 agonist solution). Frequent doses up to every 20- 30 minutes should be used early. The dose frequency should be reduced as clinical improvement occurs [60].

- **Intravenous aminophylline**

Aminophylline IV is not recommended for children with mild to moderate acute asthma. Consider aminophylline for children with acute severe or life threatening bronchospasm unresponsive to maximal doses of bronchodilators and systemic steroids [4,60].

- **Antibiotics**

Do not give antibiotics routinely in the management of acute asthma. Antibiotics are indicated when there is evidence of bacterial infection. The commonly used drugs are crystalline penicillin, amoxicillin, erythromycin and the cephalosporins.

- **Intravenous fluids**

Children with prolonged severe asthma and those who have persistent vomiting will require intravenous fluids. It is advisable to be careful about fluid administration in view of the possible occurrence of the syndrome of inappropriate ADH secretion in some cases (hence, the normal daily requirement of fluid or two third of the requirement is recommended). Serum electrolytes should be measured and hypokalaemia should be corrected.

- **Intravenous magnesium sulphate**

This is a form of treatment for acute asthma although its use is currently restricted to refractory acute severe asthma. Doses of 25-40 mg/kg (maximum 2g) by slow infusion is recommended [4,61,62].

- **Discharge home**

Children should be discharged when they have sustained improvement in symptoms, are stable on oral/inhaled bronchodilator \pm steroid therapy, $SpO_2 > 92\%$ in room air for 4 hours and PEF more than 75% of predicted normal.

Long-term management

Key Recommendations [4,28]

- Persistent asthma is most effectively controlled with daily anti-inflammatory therapy.
 - A stepwise approach to pharmacological therapy is recommended to gain and maintain control of asthma.
 - The amount and frequency of medication is dictated by asthma severity.
 - Long term treatment should be continued at least for a period of 1 year.
 - There are two appropriate approaches to gain control of asthma with inhaled steroids.
1. **Step up method:** Therapy is initiated at the step most appropriate to the initial severity of asthma. Stepping up is done as necessary and stepping down is performed when control is good.
 2. **Step down method:** Therapy is initiated at a higher level than the patient's step of severity at the onset. Once control is gained, step down the therapy. This approach will more rapidly suppress airway inflammation, restore pulmonary function, and allow for eventual asthma control at a lower dose of anti-inflammatory therapy (American asthma guide). This is likely to improve patient compliance.
 - Regular follow up visits at 1 to 3 monthly intervals are necessary. Therapeutic strategies should be considered in concordance with clinician patient partnership strategies. Education of patients and parents is essential for achieving optimal pharmacological therapy.
 - At each step, patients and parents should be advised to avoid or control precipitating factors.
 - Referral to a paediatrician or co-management of the patient (GP+specialist) is recommended if there are difficulties in achieving or maintaining control of asthma or if the patient requires step 4 care (see below). For infants and young children, referral is recommended if the patient requires step 3 or 4 care and may even be considered if the patient requires step 2 care.

Grading of asthma and stepwise long-term management [4,28,59,63]

Step of care	* Symptoms/Day ** Symptoms/Night	Daily medications	Other aspects
Step 1 Mild Intermittent	* twice a week or less. ** twice a month or less. FEV ₁ or PEF < 80% predicted. PEF variability <20%.	• No daily medication needed.	a. Management of exacerbations (see pages 9-11). b. Frequent use of bronchodilators (2-3 times/day) warrants therapy at a higher step. Education: teach basic facts about asthma.
Step 2 Mild Persistent	* more than twice a week but less than once a day. ** more than twice a month. Exacerbations may affect activity. FEV ₁ or PEF < 80% predicted. PEFR variability 20-30%.	Preferred treatment: - Low dose inhaled steroids. Alternative treatment: - Sustained release theophylline - leukotriene receptor antagonist. - Ketotifen may be effective in younger children with atopy.	a & b Education: teach basic facts about asthma and proper technique of using inhaler/spacer. Avoid exposure to known precipitating factors. Discuss home management plan (see page 21)
Step 3 Moderate Persistent	* once a day. ** more than once a week. Daily need of β_2 agonist. Exacerbations affecting normal activities and twice or more a week; may last days. FEV ₁ or PEF 60% to 80% predicted. PEF variability > 30%.	Preferred treatment: - Medium dose inhaled steroids OR - Low dose inhaled steroids and long acting β_2 agonist Alternative treatment: - Low dose inhaled steroids and either leukotriene receptor antagonist or theophylline. Preferred treatment for patients with recurrent severe exacerbations: - Medium dose inhaled steroids and long acting β_2 agonist. Alternative treatment: - Medium dose inhaled steroids and either leukotriene receptor antagonist or theophylline	a & b Education: see step 2.
Step 4 Severe Persistent	* Continual ** frequent Limited physical activities. Frequent exacerbations. FEV ₁ or PEF < 60% predicted. PEF variability >30%.	Preferred treatment: - High dose inhaled steroids and long acting β_2 agonist. - May need oral steroids.	A & b Education: see step 2

Special group of patients

Those with intermittent asthma with moderate to severe exacerbations triggered by viral infections may benefit from longterm leukotriene receptor antagonists.

- *The characteristics noted in the above table are general and may overlap because asthma is highly variable. Grading in a patient may change over time.*
- *The presence of one of the features of severity is sufficient to place a patient in that category. An individual should be assigned to the most severe grade in which any feature occurs.*
- *Patients at any level of grading can have mild, moderate or severe exacerbations.*

Practice points to remember

- *Long acting β_2 agonists are not licensed to use for children more than 4 years. However when there is a poor response to conventional therapy with no other alternative, it is justifiable to use these drugs in the management of younger patients.*
- *If asthma control remains sub-optimal after addition of an inhaled long acting β_2 agonist then the dose of steroid should be increased [4].*
- *If a trial of an add-on treatment is ineffective, stop the drug (or in the case of increased dose of inhaled steroids, reduce to the original dose) [4].*
- *The most important determinant of appropriate dosing is the clinician's judgment of the patient's response to therapy. The stepwise approach to therapy emphasizes that once control of asthma is achieved, the dose of medication should be carefully titrated to the minimum dose required to maintain control, thus reducing the potential for adverse effects.*

- **Step down therapy:** review treatment every 1-3 months. If control is sustained for at least 3 months, a gradual stepwise reduction in the treatment may be possible. The dose of inhaled steroids may be reduced by about 25% every 2-3 months to the lowest dose required to maintain control. The drug should be continued for at least 12-24 months. It is important to advise parents that there is a possibility of relapses even when steroid dosage has been tapered down and withdrawn.
- **Step up therapy:** if control is not achieved (e.g. within one month), consider stepping up. However, one must first review patient medication technique, compliance and environmental control*. Reasons for poor control may be:

Poor compliance Improper technique
 Inadequate dosage Inappropriate pharmacological management
 Poor environmental control Wrong diagnosis.

To regain control of asthma, a short course of predniselone is often effective.

Usual dosages for long term control medications [28,55]

Inhaled steroids: preferred first line therapy

Drug	Frequency of administration	Low dose (µg)	Medium dose (µg)	High dose (µg)
Beclomethasone HFA	bd	50-200	200-400	>400
Budesonide	bd	100-200	200-600	>600
Fluticasone	bd	100-200	200-400	>400

Other long term control medications

Combined medications	Fluticasone / salmeterol (µg)
Fluticasone/salmeterol MDI/bid	50/25, 125/25, 250/25
Fluticasone/salmeterol DPI/bid	100/50, 200/50
Budesonide/formeterol	80/4.5, 160/4.5

Leukotriene modifiers	Daily oral dosage
Montelukast	4 mg oral granules once a day (12 months-5 years) 4 mg chewable tablet once a day (2-5 years) 5 mg chewable tablet once a day (6-14 years)
Zafirlukast	10 mg tablet b.d for 7-11 years

MANAGING SPECIAL SITUATIONS IN ASTHMA

Cough Variant Asthma

- Cough is the principal symptom.
- Frequently occurs at night.
- Examination during the day may be normal.
- Therapeutic trials with bronchodilator medications may be helpful in diagnosis.
- Once the diagnosis is established, treat according to the stepwise approach to long-term management of asthma [28].

Exercise-Induced Asthma (EIA)

- Many children with asthma experience cough, wheeze, or excessive fatigue when they exercise.
- Exercise may be the only precipitant of asthma symptoms for some patients.
- EIB if untreated can limit and disrupt otherwise normal lives.
- EIB usually occurs during or minutes after vigorous activity, reaches its peak 5 to 10 minutes after stopping the activity, and usually resolves in another 20 to 30 minutes.

Advice to parents and physical education teachers:

If the child exhibits signs of asthma during exercise

- The child should be allowed to rest.
- Use his/her reliever medication
- Should not be forced to continue physical activity

Prevention and treatment:

- Optimise asthma control of the patient as EIA may indicate under-treated asthma.
- Pre-exercise medications:

Short acting β_2 agonists:

200 mcg of salbutamol 15 minutes before exercise

or

500 mcg terbutaline 15 minutes before exercise

Long acting β_2 agonists:

50 mcg salmeterol half an hour to 2 hours before exercise

Sodium cromoglycate and nedocromil, 2-4 inhalations, taken shortly before exercise, are also acceptable.

A lengthy warm up period before exercise may benefit.

Inhaler devices

- **Technique and training**

Prescribe inhalers only after patients have received adequate and specific training in the use of the device and have demonstrated satisfactory technique.

- Devices < 2 years - metered dose inhaler (MDI) + Holding chamber
2-5 years - MDI + Spacer device (with a face mask up to 3 years)
> 5 years - MDI + Spacer device / dry powder inhaler (DPI)
> 8 years - MDI alone may be possible

- **Frequency of dosing of inhaled steroids**

Prescribe initially twice a day. Once a day inhaled steroids at the same total daily dose can be considered if good control is established.

- **Prescribing devices**

The choice of the device may be determined by the choice of the drug. If the patient is unable to use a device satisfactorily, an alternative should be found.

Reassess inhaler technique as part of the clinical review.

- **Use and care of spacers**

The spacer should be compatible with the MDI being used. The drug should be administered by single actuation of the MDI into the spacer, each followed by inhalation.

There should be minimal delay between MDI actuation and inhalation.

Tidal breathing is as effective as single breaths.

Spacers should be cleaned monthly rather than weekly. They should be washed with liquid detergent and allowed to dry in air. The mouthpiece should be wiped clean before use.

Spacers are recommended to be replaced at least every 12 months but some may need changing every 6 months.

ASTHMA ACTION PLAN / HOME MANAGEMENT PLAN

Name: _____ DOB: _____
 Ward/clinic: _____ Date: _____
 Hospital: _____

Green Zone: Doing well

Continue present schedule of treatment if applicable

- No cough or wheeze or chest tightness during day or night
- Can do usual activities



Medicine	How much to take	When to take

- Exercise induced



Medicine	How much to take	When to take

Yellow zone: asthma is getting worse

Add quick relief medications and continue green zone medication if applicable

- Child has any of these
- cough
 - Mild wheeze
 - Chest tightness
 - Coughing at night
 - First sign of a cold (if it is a known trigger)



- Oral salbutamol ----- 8/H **OR** Oral terbutaline -----
 ----- 8/H **OR**
- Salbutamol inhaler ----- 2-4 puffs every 2-4 hours
- Oral theophylline -----



- **If symptoms improve**
 Continue oral medication/ inhaler as above 5-7days
- **If symptoms persist or worsen go to a doctor**

Red zone: needs medical attention

Immediately go to the hospital

- Very short of breath **OR**
- Quick relief medications have not helped (see yellow zone) **OR**
- Cannot do usual activities **OR**
- Symptoms are worse or same after 24 hrs in the yellow zone



- Continue present treatment if applicable
 - Give one dose of prednisolone -----
 - Immediately go to the hospital
- Prednisolone should not be repeated without doctor's advice**

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