Management of Asthma
Statement of Intent

These guidelines are not intended to serve as a standard of medical care. Standards of medical care are determined on the basis of all clinical data available for an individual case and are subject to change as scientific knowledge advances and patterns of care evolve.

The contents of this publication are guidelines to clinical practice, based on the best available evidence at the time of development. Adherence to these guidelines may not ensure a successful outcome in every case, nor should they be construed as including all proper methods of care or excluding other acceptable methods of care. Each physician is ultimately responsible for the management of his/her unique patient in the light of the clinical data presented by the patient and the diagnostic and treatment options available.
Foreword

Asthma, bronchitis and emphysema accounted for 0.7% of total deaths in Singapore in the year 2000 and were ranked ninth of the ten principal causes of death. A recent population based survey revealed that Singapore experiences a heavy burden of disease exacerbations and days lost from work and school from asthma. Poorly controlled asthma remains a very common problem in Singapore with a disturbing trend of increasing mortality among younger patients.

Recent systematic analysis showed that patient education and optimising drug treatment consistent with what is recommended in most guidelines can have major sustained beneficial effects in patients.

It is with this in mind that a workgroup of experts was tasked to produce a set of clinical practice guidelines with evidence-based recommendations on practical aspects of asthma management relevant to Singapore. A more streamlined and cost-effective asthma program will also help reduce the disease burden contributed by asthma.

To help achieve this, the Ministry of Health is funding a "programme for optimal intervention in high burden asthma patients in specialist outpatient clinics" as part of the Health Services Development program (HSDP). This programme aims to provide optimal drug management, patient education and improve medication compliance and specialist clinic follow-up attendance for patients with severe asthma.

The Ministry is also working closely with the Health Promotion Board (HPB) to further intensify our public education efforts to raise awareness on asthma and its treatment. To work towards the goal of reducing asthma morbidity and mortality, the active involvement of paediatricians, respiratory physicians and primary care physicians is critical. Doctors have a critical role to educate patients and reinforce compliance with medication and follow-up visits. The use of the written asthma action plans will encourage patient independence and confidence in managing mild acute attacks. This will help free up the healthcare system to better deal with those with moderate to severe attacks.
I hope that doctors, particularly primary care physicians, will find these guidelines useful and incorporate them into their routine practice, and by doing so, contribute to our national efforts to reduce the asthma disease burden.

Finally, I would like to record the Ministry's gratitude to the workgroup for their hard work and commitment in producing this set of guidelines.

PROFESSOR TAN CHORH CHUAN
DIRECTOR OF MEDICAL SERVICES
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1 Introduction

1.1 The need for an asthma guideline

A large number of clinical practice guidelines (CPGs) on the management of asthma has been published in the past decade. Many of these documents have been extensively publicized and distributed among doctors in Singapore. Nevertheless, poorly controlled asthma remains a very common problem in Singapore. A recent population based survey revealed that patients in Singapore experience a heavy burden of disease exacerbations, days lost from work and school. Moreover, asthma death is a persistent problem and increasing mortality among younger patients is especially disturbing.

By contrast, a recent systematic analysis showed that patient education and optimising drug treatment consistent with what is recommended in most guidelines can have major sustained beneficial effects in patients.

An important reason for the apparent failure of practice guidelines to make an impact is the lack of adherence by doctors and their patients. Other reasons include the complexity of some recommendations and the lack of clear evidence that some steps actually will work. Thus a fresh look at practical asthma management relevant to Singapore is clearly indicated. Furthermore, evidence from recent studies provide the basis for a more streamlined and cost-effective asthma program.

1.2 Target group

Most patients with asthma first seek help from their primary care doctors. We feel that, with appropriate management, good quality asthma control can be achieved for most patients at primary care clinics. This CPG will therefore be directed at asthma management by paediatricians, general practitioners and polyclinic doctors. A simple set of guidelines would be desirable as primary care clinics are multi-disciplinary and treat patients with a wide variety of diseases. As far as possible, the workgroup has recommended management steps based upon current best evidence. This CPG is relevant to our local context and attempts to address specific barriers to quality asthma care.
2 Levels of evidence and grades of recommendation

Levels of evidence

<table>
<thead>
<tr>
<th>Level</th>
<th>Type of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ia</td>
<td>Evidence obtained from meta-analysis of randomised controlled trials.</td>
</tr>
<tr>
<td>Ib</td>
<td>Evidence obtained from at least one randomised controlled trial.</td>
</tr>
<tr>
<td>IIa</td>
<td>Evidence obtained from at least one well-designed controlled study without randomisation</td>
</tr>
<tr>
<td>IIb</td>
<td>Evidence obtained from at least one other type of well-designed quasi-experimental study.</td>
</tr>
<tr>
<td>III</td>
<td>Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.</td>
</tr>
<tr>
<td>IV</td>
<td>Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.</td>
</tr>
</tbody>
</table>

Grades of recommendation

<table>
<thead>
<tr>
<th>Grade</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Requires at least one randomised controlled trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.</td>
</tr>
<tr>
<td></td>
<td>Requires availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation.</td>
</tr>
<tr>
<td></td>
<td>Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.</td>
</tr>
<tr>
<td>GPP</td>
<td>Recommended best practice based on the clinical experience of the guideline development group.</td>
</tr>
</tbody>
</table>
3 Executive summary of recommendations

**A** All doctors treating asthma patients should provide patient education to aid behaviour change.

Grade A, Level Ia

**A** Patients with persistent asthma (defined as needing relief medication one or more times per week) should be given inhaled corticosteroids to improve asthma control and reduce mortality.

Grade A, Level Ia

**A** Long acting $\beta_2$-agonists should be added in adults whose asthma is not controlled with 400-800mcg of inhaled corticosteroids per day.

Grade A, Level Ia

**A** Low dose inhaled corticosteroid is safe and therefore should be used in all children with persistent asthma (as defined above).

Grade A, Level Ia, Ib

**A** Leukotriene receptor antagonists may be considered as an additional therapy in children on moderate dose (200-400mcg per day) of inhaled corticosteroids.

Grade A, Level Ib

**B** Doctors should avoid excessive use of short acting $\beta_2$-agonists (>2 units of metered dose inhalers per month or home nebulisation) due to association with risk of asthma death.

Grade B, Level IIa

**C** Drug treatment should be guided by regular assessment of asthma severity and control using a step classification system.

Grade C, Level IV
4 Definition & diagnosis of bronchial asthma in adults

4.1 Definition

Asthma is a condition characterised by recurrent or chronic wheeze and/or cough, with recognisable variable airway obstruction due to bronchial hyper-reactivity secondary to airway inflammation. It is important to recognise that asthma is a chronic inflammatory airway disease. Asthma exacerbation may be episodic, but airway inflammation is chronically present.

4.2 Diagnosis

A diagnosis of asthma can be based upon symptoms and physical signs. This can be further confirmed by demonstration of reversible airway obstruction of pulmonary function testing. A possibility of bronchial asthma should be entertained in all patients with chronic cough, wheezing, unexplained dyspnoea and chest tightness. Symptoms are often transient, and tend to be worse at night or in the early mornings.

Symptoms may be precipitated or aggravated by upper respiratory tract infections, cigarette smoke, exercise, occupational exposure to triggers, drugs (aspirin, NSAIDS, β-blockers, ACE inhibitors) and pets.

Cough and dyspnoea may be the predominant complaints in the elderly. Wheezing may be drug induced or due to exacerbation of chronic obstructive pulmonary disease (COPD), congestive cardiac failure, bronchiectasis or gastroesophageal reflux.

4.3 Clinical examination

As symptoms of asthma are often transient, physical signs may be absent at the time of examination. Hence, the lack of physical signs does not exclude a diagnosis of asthma.
4.4 Confirmatory tests

Spirometry is the most reliable test of reversible airway obstruction. Peak expiratory flow rate is a less reliable test but an improvement in by 20% or more in response to inhaled bronchodilator may be seen. Doubtful cases should be referred to a specialist. (see Section 7.5)
Objectives of asthma management

The goals of asthma management must be itemized and discussed thoroughly with the patient at the very start of the management program. Finding common ground with patients and aiming for specific targets are critical steps in achieving long term control of asthma. The main objectives of an asthma management plan are listed in Table 1.

TABLE 1 Objectives of Asthma Management

<table>
<thead>
<tr>
<th>To be established for each doctor/clinic and shared with the patient-family:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Achieve long term control of asthma symptoms</td>
</tr>
<tr>
<td>2. Prevent asthma exacerbations</td>
</tr>
<tr>
<td>3. Maintain normal activity including exercise and work/school/vacations</td>
</tr>
<tr>
<td>4. Avoid side effects of asthma drugs (including excessive cost)</td>
</tr>
<tr>
<td>5. Prevent asthma death</td>
</tr>
<tr>
<td>6. Maintain normal pulmonary function (optional)</td>
</tr>
</tbody>
</table>

We recommend that a successful asthma program should be established for each patient in the context of a team effort which includes: the patient, relevant family member, doctor, nurse/clinic assistant and pharmacist. It should incorporate the following four interactive elements listed in Table 2.

TABLE 2 Four Key Elements of an Asthma Program

| 1. Education-motivation |
| 2. Self assessment & management |
| 3. Environmental management |
| 4. Pharmacological management |

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TABLE 2 Four Key Elements of an Asthma Program

| 1. Education-motivation |
| 2. Self assessment & management |
| 3. Environmental management |
| 4. Pharmacological management |
5.1 **Education motivation**

**A** All doctors treating asthma patients should provide patient education to aid behavior change.

*Grade A, Level Ia*

The aims of education are to change behaviour and improve self-management skills. Patients with persistent asthma (one or more wheezy episodes per week) must switch over from intermittent quick relief medication to long term preventive therapy. In order to do this effectively doctors need to help patients:

(a) identify symptoms of persistent asthma
(b) recognize that the sole reliance on quick relief medication is inappropriate
(c) agree to a set of long term management goals (Table 1) and
(d) address directly the barriers to effective preventive treatment.

The most common barriers to effective management in asthma are listed in Table 3.

**TABLE 3** Common Barriers to Effective Asthma Treatment

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Failure to agree to a set of common goals with patient</td>
</tr>
<tr>
<td>2.</td>
<td>Patient resistance/objection to inhalational therapy</td>
</tr>
<tr>
<td>3.</td>
<td>Poor inhalational technique</td>
</tr>
<tr>
<td>4.</td>
<td>Steroid phobia</td>
</tr>
<tr>
<td>5.</td>
<td>Worry about excessive costs</td>
</tr>
</tbody>
</table>

The only effective way to deal with these problems is by more intensive patient education. Strong motivation and intense, repeated, sustained education is necessary to overcome every one of these barriers. Doctors need to be convinced themselves of the benefits of long term preventive treatment over quick relief treatment in asthma in order to convince their asthmatic patients to change their habits. The benefits of a sustained preventive treatment program are listed in Table 4. Long term treatment with a low dose of inhaled corticosteroids is cost-effective.
TABLE 4 Beneﬁts of Long Term Preventive Treatment of Asthma

| 1. Improved quality of life |
| 2. Reduced frequency and severity of asthma exacerbations |
| 3. Reduced risk of emergency room visits |
| 4. Reduced risk of hospital admissions |
| 5. Prevent loss of productivity from days missed work/school |
| 6. Reduce total cost of asthma treatment in the longer term |
| 7. Reduce risk of death from asthma |

5.2 Self assessment and management

We recommend that continuous self assessment and action plan for the management of acute exacerbations should, for most patients, be guided by symptoms rather than the peak expiratory flow rate (PEFR) measurements. This is contrary to most asthma CPGs but consistent with current best clinical evidence. The reasons are summarized in Table 5. Regular PEFR charting remains a very useful option for patients with poor perception of asthma symptoms and selected patients who choose to self monitor with the PEFR chart.

TABLE 5 Why NOT Home PEFR Charting For All Patients?

| 1. Non predictive of acute attacks |
| 2. Not used regularly by patients |
| 3. Unreliable information on lung function |
| 4. Risk of over treatment if strict adherence |
| 5. No agreed boundaries for intervention |
| 6. No consistent evidence of beneﬁt on top of self assessment |
| 7. Efficacy of education programs without mandated PEFR charting |
5.3 **Management of environmental triggers**

It is important to identify and reduce exposures to relevant allergens and irritants and to control other factors that have been shown to increase asthma symptoms and/or precipitate asthma exacerbations. These factors fall into 4 categories listed in Table 6.

**TABLE 6  Environmental Triggers**

<table>
<thead>
<tr>
<th>1. Inhalant allergens</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) House dust mites</td>
</tr>
<tr>
<td>(b) Cockroach allergens</td>
</tr>
<tr>
<td>(c) Animal dander allergens</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Irritants</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Tobacco smoke</td>
</tr>
<tr>
<td>(b) Indoor/outdoor pollution and irritants</td>
</tr>
</tbody>
</table>

| 3. Viral respiratory infections |
| 4. Occupational exposures     |

5.3.1 **Inhalant allergens**

*Relationship of all allergens to asthma*

**A** Asthma symptoms, peak expiratory flow rate, and bronchial hyper-responsiveness improve when patients avoid environmental allergens to which they are allergic.⁴

Grade A, Level Ia

**A** Food allergens are NOT a common precipitant of asthma symptoms.

Grade A, Level Ia

5.3.1.1 **Indoor allergens**

House dust mite allergens are most commonly found in bedding and carpets.⁵,⁶
• The most effective method is to wash blankets, bed-sheets, pillow cases and mattress pads at least weekly using water at 65°C and install impervious covers over mattresses and pillows.
• Remove carpets and soft toys (wash them weekly if present)
• Avoid prolonged contact with upholstered furniture.

Cockroach allergen is reduced by cockroach extermination followed by routine cleaning.

Animal allergens from animals with fur, including small rodents, cats, and dogs, should be removed from the home. If these cannot be removed, weekly house-washing may help. There is no data on allergen avoidance studies.

Indoor air cleaning devices (ie High Efficiency Particle Arresting [HEPA] and electrostatic precipitating filters) cannot substitute for good cleaning/hygiene practices, as described above. Most studies on air filters have failed to demonstrate an effect on asthma symptoms or pulmonary function.

Specific Allergen Immunotherapy

Special allergen immunotherapy may be considered in patients whose asthma is driven by allergic triggers, and other forms of therapy do not provide sufficient control. This form of therapy is still not standard treatment in Singapore. Standardised allergen extracts for common allergens such as the domestic mite, Blomia tropicalis, are still not commercially available.

5.3.1.2 Irritants

Cigarette smoke

Doctors should advise all asthmatics (children and adults) not to smoke and to avoid environmental exposure to tobacco smoke where possible.
Exposure to maternal cigarette smoke has been shown to be a risk factor for the development of asthma in infancy and childhood.\textsuperscript{10} (Level IIa)

5.3.1.4 Outdoor air pollution

GPP Asthmatics should avoid exertion or exercise outdoors when levels of air pollution are high (PSI >100). Increased pollution levels is reported to precipitate symptoms of asthma, increase emergency room visits and hospitalisation.\textsuperscript{11,12}

5.3.2 Viral infections

GPP Annual influenza vaccinations should be considered in patients with moderate and severe persistent asthma.

5.3.3 Occupational exposures

Early recognition and control of exposures are particularly important in occupationally induced asthma, because the likelihood of complete resolution of symptoms decreases with time.

Suspected cases of occupational asthma may be referred for evaluation at the Occupational Lung Clinic at Tan Tock Seng Hospital Suite 2B; Tel: 63578010/1 or Singapore General Hospital Tel: 63214377/6321 4392.

5.4 Pharmacological management of asthma

\textit{LONG TERM PREVENTIVE TREATMENT}

Under diagnosis and under treatment are major contributors to asthma morbidity and mortality. Long term preventive treatment is the cornerstone of good asthma control.
Drug treatment should be guided by regular assessment of asthma severity and control using a step classification system.

Grade C, Level IV

Patient’s current state of asthma control should be reviewed at each consultation. This is achieved by the STEP classification (Figure 1) of asthma severity derived from an assessment of the patient’s frequency of daytime and night-time symptoms such as wheeze or cough, and peak flow rate measurement (if available). **Persistent asthma is defined as the patient needing relief medication one or more times per week.** Asthma severity is classified into intermittent, mild persistent, moderate persistent or severe persistent and a stepwise approach to pharmacological therapy is recommended. Treatment should be instituted at the step corresponding to the asthma severity (Figure 1 & Table 7). The presence of one of the features of severity is sufficient to place a patient in that category.

**STEP-UP**

If control is not achieved, consider stepping up drug therapy. Prior to stepping up drug therapy, it is important to review patient’s device technique, compliance and environmental control such as avoidance of allergens or other trigger factors. The aim is to establish control as soon as possible, then decrease treatment to the least mount of medication necessary to maintain control. A rescue course of prednisolone may be needed for acute exacerbations with stepped up treatment. Patients should avoid or control triggers at each step. All therapy must include patient education.

**STEP-DOWN**

Treatment should be reviewed every 3 to 6 months. If control is sustained for at least 3 months, a gradual stepwise reduction in treatment may be possible. Discontinuation of long term preventive treatment with inhaled corticosteroids should be attempted with great caution. After stopping inhaled steroids patients are at an increased risk of severe asthma and even fatal, asthma relapse.
### FIGURE 1  
**STEP Classification of Asthma Severity**

<table>
<thead>
<tr>
<th>STEP</th>
<th>Day-time symptoms</th>
<th>Night-time symptoms</th>
<th>PEF</th>
</tr>
</thead>
</table>
| STEP 1  
Intermittent | <1 time a week  
Asymptomatic and normal PEF between attacks |  | >80% predicted variability <20% |
| STEP 2  
Mild Persistent | ≥1 time a week but <1 time a day | >2 times a month | ≥80% predicted variability 20-30% |
| STEP 3  
Moderate Persistent | Daily symptoms  
Use β2 agonist daily  
Attacks affect daily activities | >1 time per week | >60%–<80% predicted variability >30% |
| STEP 4  
Severe Persistent | Continuous limited physical activity | Frequent | ≤60% predicted variability 30% |

Adapted from GINA (Global Strategy for Asthma Management and Prevention) guideline, for children below 5 yrs PEF does not apply.  
Symptoms: wheeze, dyspnoea and/or cough.  
The highest level of current severity defines the STEP category for each patient.
<table>
<thead>
<tr>
<th>TABLE 7</th>
<th>Appropriate Drug Treatment at Each Step of Asthma Severity in Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long-Term Preventive (Controllers)</td>
</tr>
<tr>
<td><strong>STEP 4</strong></td>
<td><strong>Severe Persistent</strong></td>
</tr>
<tr>
<td>Daily medications:</td>
<td></td>
</tr>
<tr>
<td>• Inhaled corticosteroid &gt;800mcg</td>
<td></td>
</tr>
<tr>
<td>• Long-acting bronchodilator: either long-acting inhaled β2-agonist and/or sustained-release theophylline, and/or long-acting β2-agonist tablets</td>
<td></td>
</tr>
<tr>
<td>• Corticosteroid tablets</td>
<td></td>
</tr>
<tr>
<td><strong>STEP 3</strong></td>
<td><strong>Moderate Persistent</strong></td>
</tr>
<tr>
<td>Daily medications:</td>
<td></td>
</tr>
<tr>
<td>• Inhaled corticosteroid, 400-800mcg AND, if needed</td>
<td></td>
</tr>
<tr>
<td>• Long-acting bronchodilator: either long-acting β2-agonist, sustained-release theophylline, or long-acting β2-agonist tablets</td>
<td></td>
</tr>
<tr>
<td>• Consider anti-leukotrienes.</td>
<td></td>
</tr>
<tr>
<td><strong>STEP 2</strong></td>
<td><strong>Mild Persistent</strong></td>
</tr>
<tr>
<td>Daily medication:</td>
<td></td>
</tr>
<tr>
<td>• Inhaled corticosteroid, 200-400 mcg, with or without sustained release theophylline.</td>
<td></td>
</tr>
<tr>
<td>• Consider anti-leukotrienes</td>
<td></td>
</tr>
<tr>
<td><strong>STEP 1</strong></td>
<td><strong>Intermittent</strong></td>
</tr>
<tr>
<td>None needed</td>
<td></td>
</tr>
<tr>
<td>• Inhaled β2-agonist or cromoglycate before exercise or exposure to allergen</td>
<td></td>
</tr>
</tbody>
</table>

Treatment is reviewed every 3 to 6 months. If control is sustained for at least 3 months, a gradual stepwise reduction in treatment may be possible. On the other hand, if control is not achieved, step up therapy is advised after reviewing patient medication technique, compliance and environmental control.
RECOMMENDED DRUGS

5.4.1 Inhaled corticosteroids

A Patients with persistent asthma should be given low dose inhaled corticosteroids to improve asthma control.

Grade A, Level Ia

All patients with persistent asthma and need one or more puffs of a quick relief drug per week (STEP 2) should be started on inhaled corticosteroids.
- Becotide MDI - Beclomethasone dipropionate 50mcg/inhalation
- Becloforte MDI - Beclomethasone dipropionate 250mcg/inhalation
- Flixotide MDI - Fluticasone propionate 50mcg/dose, 25mcg/dose, 250mcg/dose
- Flixotide Accuhaler - Fluticasone propionate 50mcg/dose, 100mcg/dose, 250mcg/dose, 500mcg/dose
- Pulmicort Turbuhaler - Budesonide 100mcg/dose, 200mcg/dose

5.4.2 Long-acting β₂-agonists

A Adult asthmatics with symptoms not controlled with 400-800mcg of inhaled corticosteroids per day should be given long acting β₂ agonists.

Grade A, Level Ia

Adding long acting β₂ agonists result in better asthma control and reduction in severe exacerbations when compared with doubling the dose of inhaled steroids.13,14

Inhaled
- Serevent MDI – 25mcg/actuation
- Serevent Accuhaler – 50mcg/blister
- Oxis Turbuhaler – Oxis is an effective β2-agonist with a fast onset (within 1-3 minutes) and a long duration (more than 12 hours) of action.
Oral

• Bambec – Bambuterol 10mg tablets/Syrup formulation available for children 2 years and above

5.4.3 Combination drugs

The use of combinations may be more effective than 2 drugs separately and also improve compliance.15

• Seretide Accuhaler – 50mcg salmeterol/100/250/500mcg fluticasone
• Evohaler MDI - 25mcg salmeterol/50mcg/125mcg/250mcg fluticasone
• Symbicort Turbuhaler – 4.5mcg formoterol/160mcg budesonide

5.4.4 Methylxanthines

Methylxanthines are useful for long term control and prevention of symptoms, especially nocturnal symptoms. There is a need to monitor serum levels in sustained release theophylline (250mg/tab).

5.4.5 Oral steroids

Prednisolone tablets:

• For short term (0.5mg/kg/day for 3-10 days) "burst" to gain prompt control of inadequately controlled persistent asthma or severe acute exacerbations. If more than 2 to 3 short courses are required in a year, further optimisation of treatment is indicated.
• All patients who need long term oral steroids should be referred to a specialist.

Side effects:

Short-term use – Reversible, abnormalities in glucose metabolism, increased appetite, fluid retention, weight gain, mood alteration, hypertension, peptic ulcer, and rarely aseptic necrosis of femur

Long-term use – Adrenal axis suppression, growth suppression, dermal thinning, hypertension, diabetes, Cushing’s syndrome, cataracts, muscle weakness, and impaired immune function
Conditions could be worsened by systemic corticosteroids, such as herpes virus infections, varicella, tuberculosis, hypertension, peptic ulcer, and strongyloides.

5.4.6 Leukotriene modifiers

These drugs are useful for long-term control and prevention of symptoms in patients with mild persistent asthma ≥7 years (for Singulair) and ≥12 years of age. (for Accolate)

- Singulair (Montelukast) 10mg ON
- Accolate (Zafirlukast) 20mg BD

5.4.7 Short-acting inhaled \( \beta_2 \)-agonists

Doctors should avoid excessive use of short acting \( \beta_2 \)-agonists (>2 units of metered dose inhalers per month or home nebulisation) due to association with risk of asthma death.

Grade B, Level IIa

Short-acting inhaled \( \beta_2 \)-agonists are useful for relief of acute symptoms or can be used as a quick-relief medication. It can also be used as a preventive treatment prior to exercise for exercise-induced bronchospasm. There is a dose-effect relationship between excessive use of quick relief medication and risk of asthma death. More than 1-2 units per of a metered dose inhaler month is considered excessive.

- Ventolin MDI – Contains 100mcg/actuation
- Bricanyl turbuhaler

5.4.8 Nebulised Medication

Home nebuliser use is not recommended as it offers no advantage over the use of MDI with spacer for children with acute asthma.

Grade A, Level Ia, Ib

There is no role for the self administration of nebulised quick relief medication for adult asthmatics in Singapore. Several studies in North
America and Australia have shown a correlation between regular home nebulisation and asthma mortality. They should only be used under direct medical supervision and not at home.
Management of acute exacerbations

Acute asthma attacks are episodes of progressively worsening shortness of breath, cough, wheezing or chest tightness. The speed of progression of the attack is variable and can be anything from a few minutes to a few hours or days. Such attacks are accompanied by decreases in expiratory airflow. Often, the perception of asthma severity by patients, relatives, or even health-care workers is poor and this results in under-estimation of the severity of an acute attack.

Assessment of the severity of an acute attack of asthma is important (Table 8). Hence, the patient and family must be familiar with the asthma action plan and act on the earliest sign of deterioration before the attack requires emergency care or hospitalisation.

6.1 Treatment of acute asthma

Mild attacks can be treated at home. Beginning treatment at home also avoids treatment delays, prevents exacerbations from becoming severe, and also adds to patients’ sense of control over their asthma.

6.2 Treatment of acute asthma at the clinic

Initial assessment of severity as described in Table 8. If patient has severe attack or respiratory arrest is imminent, make arrangements to transfer to a hospital preferably a medical intensive care unit as soon as possible, and start treatment immediately in the interim.
TABLE 8  Severity of Asthma Attacks

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Respiratory Arrest Imminent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathless</td>
<td>Walking</td>
<td>Talking</td>
<td>At Rest</td>
<td>Hunched forward</td>
</tr>
<tr>
<td></td>
<td>Can lie down</td>
<td>Prefers sitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talks in</td>
<td>Sentences</td>
<td>Phrases</td>
<td>Words</td>
<td></td>
</tr>
<tr>
<td>Alertness</td>
<td>May be agitated</td>
<td>Usually agitated</td>
<td>Usually agitated</td>
<td>Drowsy or Confused</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>Increased</td>
<td>Increased</td>
<td>Often &gt;30/min</td>
<td></td>
</tr>
<tr>
<td>Accessory Muscles and Suprasternal Retractioned</td>
<td>Usually not</td>
<td>Usually</td>
<td>Paradoxical Thoraco-abdominal movement</td>
<td></td>
</tr>
<tr>
<td>Wheeze</td>
<td>Moderate, often only end respiratory</td>
<td>Loud</td>
<td>Usually loud</td>
<td>Absence of wheeze</td>
</tr>
<tr>
<td>Pulse/min.</td>
<td>&lt;100</td>
<td>100-120</td>
<td>&gt;120</td>
<td>Bradycardia</td>
</tr>
<tr>
<td>Pulsus Paradoxus</td>
<td>Absent &lt;10mmHg</td>
<td>May be present 10-25mmHg</td>
<td>Often present &gt;25mmHg</td>
<td>Absence suggests respiratory muscle fatigue</td>
</tr>
<tr>
<td>PEF after initial Bronchodilator Or % predicted or % personal best</td>
<td>Over 80%</td>
<td>Approximately 60-80%</td>
<td>&lt;60% predicted or personal best (&lt;100L/min adults) or response lasts &lt;2 hours</td>
<td></td>
</tr>
</tbody>
</table>

*The presence of several parameters, but not necessarily all, indicate the general classification of the attack*

Patients at high risk of dying with asthma require special attention, monitoring and care, particularly intensive education, including advice to seek medical care early during an exacerbation. Table 9 lists risk factors of death from asthma.
TABLE 9. Risk Factors For Death From Asthma\textsuperscript{2,16} Grade C, Level IV

- Past history of sudden severe exacerbation
- Prior intubation for asthma
- Two or more hospitalisations for asthma in the past year
- Three or more emergency care visits for asthma in the past year
- Hospitalisation or an emergency care visit for asthma within the past month
- Use of >2 canisters per month of inhaled short-acting $\beta_2$-agonist
- Current use of systemic corticosteroids or recent withdrawal from systemic corticosteroids
- Known difficulty perceiving airflow obstruction or its severity
- Comorbidity, as from cardiovascular diseases or chronic obstructive pulmonary disease
- Serious psychiatric disease or psychosocial problems
- Low socioeconomic status
- Illicit drug use
**Initial treatment:**

- **Grade B Level IIa**
  - Continuous inhaled short-acting β-agonist by nebulisation, one dose (e.g. Salbutamol 5-10 mg) every 20 minutes for 1 hour; alternatively, the use of an inhaler (e.g. 20 puffs of Ventolin) plus a holding chamber (spacer device) produces equally effective bronchodilation.

- **Grade A Level Ia**
  - Addition of ipratropium 0.5mg in adults to an aerosolised solution of β-agonist has been shown to cause additional bronchodilation, particularly in those with severe airflow obstruction, and to reduce hospitalisation.

- **Grade A Level Ib**
  - Systemic corticosteroids e.g. prednisolone 40mg immediately and repeated for 7-10 days for all patients. No “tail” is needed and oral steroids are as rapid and effective as injections.

**Repeat Clinical Assessment is made:**

- Symptoms, physical examination, PEF, O₂ saturation, other tests as needed

**A Good response:**
- Response sustained 60 minutes after last treatment
- Physical examination is normal
- PEF > 70% predicted
- No distress
- O₂ saturation > 90%

**Action:** Patient can be discharged home. Must continue treatment with inhaled β₂-agonist. Consider course of oral steroids in most cases. Reinforce patient education, action plan and close follow-up.

**Incomplete response within 1-2 hours:**

- **History of high risk patient**
  - Physical examination:
    - Mild to moderate symptoms
    - PEF > 50% - 70%
    - O₂ saturation not improving

**Action:** Admit to Hospital

**Poor response within 1 hour:**

- **History of high-risk**
  - **Physical examination:**
    - Symptoms severe, drowsiness, confusion
    - PEF < 30%
    - pCO₂ > 45mmHg
    - O₂ saturation <90%

**Action:** Admit to Intensive Care
7 At the clinic visit

7.1 Checklist

This CPG simplifies the clinic visit by providing basic tools (check box & check list; Figure 3) for quick patient review and revision of management steps and drug treatment which can be completed in a few minutes. We recommend the use of this check-box/list on all patients at every visit.

The doctor matches the severity of the patient’s current asthma symptoms (Figure 1) with the intensity of current asthma treatment (Table 7). Most patients who are in clinical remission merely need a repeat prescription accompanied by a check on:

(a) their proficiency with the inhaled device,
(b) compliance with the preventive drug and
(c) skills with self management of an acute exacerbation as prescribed in the written asthma action plan.

Note that indicators of asthma severity (regular day symptoms, night symptoms and home peak flow) for the STEP classification system are different form the indicators of asthma control (severe exacerbations, days missed from work/school). Patients who may have low asthma severity but experience poor control with frequent exacerbations also need further education and optimisation of their treatment.

7.2 Device technique

Device proficiency should be emphasized at the first and every consultation. Education should include verbal instruction and demonstration of proper use of the devices by the health care providers. Patient should be encouraged to demonstrate their proficiency in the inhaler devices usage at every clinic visit.

Drug delivery through metered dose inhalers can be greatly improved with the use of spacers.

The use of dry powder drug delivery via turbuhaler/accuhaler offers several advantages. No chlorofluorocarbon, which is detrimental to
the ozone layer, is used and less coordination between the hand and breath actuation is needed. Drug delivery via the turbuhaler is at least twice that via the meter-dosed inhaler.

The inhaler technique is described here in discrete steps but should be performed as a continuous sequence of manoeuvres.

### 7.2.1 Metered Dose Inhaler

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation Remove the cap and shake the inhaler several times</td>
</tr>
<tr>
<td>2</td>
<td>Exhalation Breathe out as far as possible</td>
</tr>
<tr>
<td>3</td>
<td>Lip closure Seal the mouth piece against closed lips</td>
</tr>
<tr>
<td>4</td>
<td>Inhalation Actuate the device and inhale slowly and deeply</td>
</tr>
<tr>
<td>5</td>
<td>Breath Holding Hold the breath for 4 to 10 seconds after maximal inhalation</td>
</tr>
</tbody>
</table>

### 7.2.2 Turbuhaler

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation Unscrew the protective cover. Hold the turbuhaler in an upright position. Twist the turning grip in one direction as far as it will go and then back to the original position. A “click” sound is heard and the turbuhaler is ready for use.</td>
</tr>
<tr>
<td>2</td>
<td>Exhalation Breathe out as far as possible</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Lip closure Place the mouthpiece between your teeth and close the lips around the mouthpiece.</td>
</tr>
<tr>
<td>4</td>
<td>Inhalation Breathe in forcefully and deeply.</td>
</tr>
<tr>
<td>5</td>
<td>Termination Remove turbuhaler from your mouth and breathe out. Replace the protective cover properly. You may rinse your mouth with water and spit it out.</td>
</tr>
</tbody>
</table>

### 7.2.3 Accuhaler

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation and place the thumb, Open the accuhaler, hold the outer case in one hand and place the thumb of your other hand on the thumbgrip. Push the notch away from you as far as it will go until you hear a click. Hold the accuhaler with the mouthpiece towards you. Slide the priming lever until it clicks. Every time the lever is slide back a new blister is opened and this is shown by the counter.</td>
</tr>
<tr>
<td>2</td>
<td>Inhalation Hold the accuhaler away from your mouth. Breathe out as far as is comfortable. Put the mouthpiece to your lips. Suck in steadily and deeply through the accuhaler.</td>
</tr>
<tr>
<td>3</td>
<td>Termination To close the accuhaler, put the thumb in the thumbgrip and push the notch back towards you as far as it will go.</td>
</tr>
</tbody>
</table>
**Visit #**

**CONTACT NUMBERS:**

<table>
<thead>
<tr>
<th>Current treatment</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventer Drug(s)</td>
<td></td>
</tr>
</tbody>
</table>

| Quick Relief Drug(s) |

**Height**

<table>
<thead>
<tr>
<th>Days off (MC) in past month</th>
<th>Day wheeze/cough/SOB (Per month or week)</th>
<th>Night wheeze/cough/SOB (Per month or week)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Daily activities stopped Per month or week</th>
<th>Good Compliance</th>
<th>Good Inhaler technique</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PEFR ¼ Best/Fred (Optimal)</th>
<th>Since the last clinic visit: Nebulisation/EMD/Admit (Date/s)</th>
<th>Follow up</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DEFINITION OF PERSISTENT ASTHMA (GINA; Figure 1)**

- **DAY SYMPTOMS**: >1 PER WEEK (>STEP 2 in Figure 1)
- **NIGHT SYMPTOMS**: >2 PER MONTH (>STEP 2 in Figure 1)

**CHECKLIST**

(a) Good inhaler technique
(b) Compliance with preventive treatment
(c) Compliance with follow up visits
(d) Reinforce *written asthma action plan*
7.3 Written asthma action plan

Asthma control can be achieved by self management using a written action plan with or without peak flow monitoring.

Grade A, Level Ib

The use of asthma action plans will lead to reduction in hospital admissions, emergency room visits, unscheduled visits to the doctor for asthma, days off work, nocturnal wakening and in the risk of death. It is an individualized written self-management guide for asthmatic patients by their doctors. It grades patient’s severity of asthma into the green, yellow and red zones, according to their symptoms and, if desired, the peak flow rates (see Figure 4) and describes the dose, frequency and duration of the appropriate treatment. The main aim of the asthma action plan is to abort exacerbations by rapid step up of both reliever and preventor medication. It also prompts the patient to seek urgent hospital treatment in case of severe exacerbations and/or failure of self-medication.

7.4 Asthma in Pregnancy

Asthmatic patients who are pregnant should be managed with inhalation therapy, which is safe and effective in pregnancy.

Grade B, Level IIa

Asthma in pregnancy is often under-recognized and sub-optimally treated. The course of asthma during pregnancy is variable; it improves, remains stable, or worsens in similar proportions of women. The risk of an asthma exacerbation is high immediately postpartum. Acute asthmatic attacks can result in dangerously low foetal oxygenation. Poor control is associated with pre-eclampsia, and uterine haemorrhage, as well as greater rates of caesarian section, pre-term delivery, intrauterine growth retardation, low birth weight, and congenital malformation. Women with well-controlled asthma during pregnancy, however, have outcomes as good as those in their non-asthmatic counterparts. Inhaled therapies remain the cornerstone of treatment and most appear to be safe in pregnancy.
### Figure 4  
**Written Asthma Action Plan**

<table>
<thead>
<tr>
<th>ZONE</th>
<th>GREEN Good Control</th>
<th>YELLOW Asthma Getting Worse</th>
<th>RED Asthma Is Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No wheeze/coughing night/day</td>
<td>Any wheeze/cough/shortness of breath/chest tightness day/night time</td>
<td>Cannot talk/walk</td>
</tr>
<tr>
<td></td>
<td>Perform all activities</td>
<td>Usual activities affected</td>
<td>Unable to sleep</td>
</tr>
<tr>
<td></td>
<td>Sleep well</td>
<td>Sleep disturbed</td>
<td>Use of reliever &lt;3hourly. Little response of symptoms to reliever</td>
</tr>
<tr>
<td></td>
<td>Peak flow &gt;80% best</td>
<td>Peak flow &lt;80% best</td>
<td>Peak of flow &lt;60% best</td>
</tr>
</tbody>
</table>

**What You Should Do**

- **Continue usual medications**
  - **Preventer**
    - Dose [ ]
  - **Reliever**
    - Dose [ ]
  - **Other medications**
    - [ ]
  - **Avoid/control triggers**
    - [ ]

- **Increase usual medications**
  - **Preventer**
    - Dose [ ]
  - **Reliever**
    - Dose [ ]
  - **Other medications**
    - [ ]

- **SEEK EMERGENCY TREATMENT**
  - Go the nearest clinic / A&E
  - Call ambulance 995 IF YOU HAVE:
    - Severe shortness of breath, or unable to speak comfortably, or blueness of the lips/fingers
    - CONTINUE Reliever
      - Dose [ ]
    - Stat dose medication [ ] until you reach hospital

- **If you respond, continue this regime for 1 week then return to green zone regime**
- **If you do not respond within 60 minutes GO TO THE RED ZONE!**
- **If you need reliever >1x/week for more than 1 month you should get an earlier app to see your Dr to improve the long term control of your asthma**
### 7.5 Referral to specialists

These are situations where a referral to the respiratory physician for review and assessment may be warranted:

- Patients who show atypical signs and symptoms such as unilateral wheezing.
- Patient whose diagnosis of asthma is doubtful or co-morbid conditions that complicate asthma such as heart failure.
- Patient whose asthma may have an occupational cause requiring additional diagnostic testing.
- Patient whose goals of therapy remain unattainable despite 3 to 6 months of appropriate treatment.
- Patient with severe asthma requiring STEP 4 care
- Patient on steroid therapy:
  - (a) continuous oral corticosteroid therapy
  - (b) requires more than two bursts of oral corticosteroids in one year
  - (c) high dose (≥800mcg per day) inhaled corticosteroids
- Patient with a life-threatening asthma exacerbation or status asthmaticus
- Patient with frequent exacerbations (poorly controlled asthma):
  - (a) acute exacerbations 2-3 times a year or
  - (b) more than once every 6 months despite compliance with appropriate medications and device technique
8 Management of asthma in children

8.1 Introduction

The first Singapore guidelines on Management of Bronchial Asthma in Children was formulated in 1992. It was revised in 1997 and published as a Ministry of Health CPG in 1998. This new set of guidelines aims to incorporate the latest asthma medication which has been approved for use in children.

8.2 Diagnosis of asthma in children

8.2.1 History

Asthma should be considered if any of the following are present:
- History of the following
  - Cough, worse particularly at night
  - Recurrent wheeze
  - Recurrent difficulty in breathing
  - Recurrent chest tightness
- Symptoms occur or worsen at night, awakening the patient
- Symptoms occur or worsen in the presence of:
  - Exercise
  - Viral infections
  - Domestic dust mites (in mattresses, pillows, carpets)
  - Smoke (tobacco or ambient haze)
  - Aerosols, chemicals (including paint, perfumes)
  - Strong emotional expression (laughing or school examination stress)
  - Animal fur, dander
- Eczema, allergic rhinitis, or a family history of asthma or atopic diseases are often associated with asthma
- Exclusion of other medical conditions eg:
  - heart disease
  - inhalation of foreign body
  - gastro-oesophageal reflux
- broncho-pulmonary dysplasia/chronic lung disease

Although recurrent cough and wheezing is the commonest presentation of asthma in children, several other causes have to be carefully excluded, particularly in young children.

**TABLE 10** Common Cause of Wheezing in Children

<table>
<thead>
<tr>
<th>Common Causes of Wheezing in Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>In young children, especially infant, the diagnosis of asthma is made only after excluding other common causes of wheezing. These include:</td>
</tr>
<tr>
<td>• Post-viral wheezing</td>
</tr>
<tr>
<td>• Acute bronchiolitis</td>
</tr>
<tr>
<td>• Foreign body inhalation</td>
</tr>
<tr>
<td>• Gastro-oesophageal reflux</td>
</tr>
<tr>
<td>• Tracheobronchomalacia</td>
</tr>
<tr>
<td>• Vascular rings</td>
</tr>
<tr>
<td>• Mediastinal masses</td>
</tr>
<tr>
<td>• Tracheal webs and bronchial stenosis</td>
</tr>
<tr>
<td>• Cardiac failure</td>
</tr>
<tr>
<td>• Cystic fibrosis (Caucasians)</td>
</tr>
</tbody>
</table>

**8.2.2 Clinical examination**

The following features should be noted:

- height and weight (assessment of growth)
- nose, throat and paranasal sinuses (features of allergic rhinitis)
- features of atopy (allergic shiners, eczema)
- presence or absence of stridor, clubbing or chest deformity
- heart murmurs and auscultatory findings of the lungs

Diagnosis of asthma in young children may not be easy. It may be difficult to differentiate between an infant or young child with recurrent post viral wheeze and one with atopy and asthma. A child with recurrent post viral wheeze usually improves by about three years of age. On the other hand, a child with atopy and recurrent, severe wheeze and maternal history of asthma is likely to continue wheezing into later childhood.¹
8.2.3 Investigations

Investigations are usually not necessary. They should however be considered in severe or atypical cases as well as patients who do not respond as expected to therapy. These may include:

(a) Chest X-ray - particularly to exclude foreign body or chronic infection
(b) Pulmonary Function Tests

8.3 Management of asthma

8.3.1 Assessment of severity of asthma

This should be based on:

1. Clinical grounds:
   (a) Acute asthma - frequency and severity of acute attacks
   (b) Interval symptoms - sleep disturbance, due to nocturnal cough, exercise tolerance, early morning chest tightness, school absenteeism and bronchodilator usage

2. Objective measurements:
   (a) PEFR measurements during each clinic visit
   (b) Spirometric measurement, particularly in children above the age of 7 years with frequent symptoms of asthma

8.3.2 Classification of the patterns of asthma (Figure 1)

1. Intermittent asthma
   (a) Infrequent or mild episodic asthma
      This child has intermittent, infrequent attacks, occurring not more than once a month. These attacks are easily controlled with the use of bronchodilator therapy alone. He or she is asymptomatic between episodes and has normal PEFR >80% of predicted value. This is the most common pattern of asthma in children.

   (b) Frequent episodic asthma
      This is also intermittent in nature but the attacks are more frequent (more than once a month but less than once a week)
and/or the episodes were more severe and do not respond to bronchodilator therapy alone or requires emergency care/hospitalisation. The child is also well in between attacks and has normal PEFR ≥80% predicted value.

II Persistent asthma

This child who has very frequent asthma symptoms, such as nocturnal cough, early morning chest tightness, poor exercise tolerance, occurring more than once a week, or need to use beta agonist more than once time in a week is considered to have persistent asthma. Pulmonary function is persistently abnormal or PEFR ≤80% predicted value. A child who has had one severe life threatening attack within the last year should be included in this group.

Classification of persistent as in GINA for adults and children more than 5 years. For children younger than 5 years, PEF variability is not one of the features for classification and PEF recordings are not reliable in this age group. Refer to figure 1.

8.4 Treatment of Asthma - General recommendations

8.4.1 Anti-inflammatory therapy

This is the most important modality for the long term treatment of asthma.

a. Non steroidal inflammatory agents

C Sodium cromoglycate may be used as the first line drug for a trial of 4-6 weeks in patients with frequent episodic asthma, failing which inhaled steroids should be considered.

Grade C, Level IV

B Nedocromil sodium may be used as an alternative to sodium cromoglycate in children >6 years old. It has also been shown to reduce the need for acute care and oral steroids.

Grade B, Level III
This group of patients has intermittent symptoms but severe exacerbations needing emergency care or hospitalisation and often require oral steroids. Inhaled corticosteroids and sodium cromoglycate have been shown to be associated with reduced need on hospitalisation and acute care. Sodium cromoglycate also has few side effects. Some children may benefit from the use of sodium cromoglycate or nedocromil sodium, sparing the need for inhaled steroids.

A Leukotriene receptor antagonists may be considered as an additional therapy in children with chronic asthma. On moderate dose (200-400 mcg per day) of inhaled steroids.

Grade A, Level Ib

Leukotriene modifiers are a new class of anti-asthma drugs that has become available. It has been approved by FDA for use in children aged 2 years and above. It may have a role in young children with recurrent wheezing but more clinical studies are required to establish its position in the treatment of asthma. Inhaled steroids have been shown to be better than anti leukotriene agents in the treatment of recurrent or chronic asthma. There is no difference in side affects and rate of exacerbations but patients on inhaled steroid have less nocturnal symptoms and rescue β agonist usage. (Level Ia)

b. Steroidal anti-inflammatory agents

A Low dose inhaled corticosteroid is safe (does not retard growth) and effective in children.

Grade A, Level Ia

• Inhaled corticosteroid

A Inhaled steroids should be given via a spacer device in young children to improve delivery and reduce the incidence of oral candidiasis and hoarseness of voice.

Grade A, Level Ia/Ib
This has been proven as the most effective therapeutic agent in treatment of most children with asthma. Doses of inhaled steroid, such as budesonide up to 400mcg per day has not been associated with stunting of growth. Older children may use dry-powder inhalers such as turbuhaler or accuhaler.

Increasing the dose of inhaled steroid beyond BDP 400mcg or its equivalent, should be done with care. The dose response curve is sigmoidal and higher doses are associated with more systemic side effects with less significant increase in clinical efficacy. There is little evidence of additional clinical efficacy of doses of beclomethasone or budesonide beyond 400mcg.

Inhalation steroid preparations are also not equivalent on per puff or mcg basis.

- **Combination of long acting beta agonist and inhaled steroids**

  A **Doctors should consider a combination of long acting beta agonist and inhaled steroids in children who remain symptomatic on moderate doses of inhaled steroids.**

  Grade A, Level Ib

There is clinical evidence of the better efficacy as compared to increasing the dose of steroid or adding an anti-leukotriene agent.

**Duration of anti-inflammatory therapy**

Anti-inflammatory therapy ought to be maintained for at least 3 months after adequate control and the child reviewed regularly thereafter with the view to reducing therapy to the minimum amount to maintain control of asthma.
8.4.2 Bronchodilator therapy

- **β₂ agonist**
  
  A β₂ agonist is the most effective bronchodilator and should be given by inhalation as far as possible.
  
  Grade A, Level Ia/Ib

Intermittent usage is recommended because of possibility of increased bronchial hyper-reactivity with chronic use. Ipratropium bromide may be added as an adjuvant to β₂ agonist nebulisation therapy for acute asthma.

There is little advantage in using a nebuliser to deliver β₂ agonists in acute asthma. Routine use of home nebulisers is not recommended. During asthma exacerbations, as many as 4-8 puffs of salbutamol inhaler or 0.2-0.3 puffs/kg may be used. (Level Ia/Ib)

- **Methylxanthines**
  
  A Methylxanthines in acute asthma do not provide additional benefit when optimal doses of bronchodilators and steroids are used.
  
  Grade A, Level Ia

However, intravenous methylxanthines should be considered in children with acute severe asthma, particularly if they are not responding to the initial treatment.

- **Long acting bronchodilators**
  
  A Long acting β₂ agonists which are safer and more effective, should be considered as long term treatment in place of long acting theophylline.

  Grade A, Level Ia

A Long acting bronchodilators cannot be used as rescue medication with the exception of formoterol. Formoterol, a
long acting $\beta_2$-agonist with a rapid onset of action, may be used for acute relief of symptoms when indicated.\textsuperscript{51, 52}

Grade A, Level Ib

Long acting bronchodilators used in conjunction with inhaled steroids improve symptom control and lung function\textsuperscript{14-17}. Long term use of a long acting theophylline for chronic asthma should be done under close monitoring of side effects and serum levels\textsuperscript{46-48}.

8.4.3 Aerosol Holding Chambers

Holding chambers are to be used with metered dose inhalers in young children as well as older children or adults who are unable to coordinate inhalation with actuation of the metered dose inhaler (MDI). They also increase lung delivery of aerosolised medication in patients with poor MDI technique as well as decrease oro-pharyngeal deposition and reduce potential systemic absorption of inhaled corticosteroids.

Children <5 years of age would usually require a chamber with a face mask (eg Aerochamber, Babyhaler) while older children may be able to inhale through a mouth-piece (eg Volumatic spacer).

The patient needs to take slow inhalations (3 to 5 sec) or tidal breaths immediately following actuation. They should actuate only one puff at a time, allowing between 5 to 6 breaths per actuation.

Simple extension tubes used with MDIs do not obviate the coordination between actuation and inhalation and are not useful in children.
8.4.4 Other treatments

Antibiotics, antihistamines, mucolytics and anti-tussives, have no special role in asthma therapy. Ketotifen may have a role in the treatment of allergic rhinitis in young children. Currently, specific immunotherapy is not routinely recommended.

Pharmacotherapy of childhood asthma (Please refer to Table 11)

This is based on disease severity at the point of diagnosis. Asthma control should be monitored every 6-12 weeks. When symptom control has been achieved for at least 3 months, steps should be taken to step down treatment. Close monitoring and follow up is important.
### TABLE 11  Appropriate Drug Treatment At Each Step Of Asthma Severity In Children

<table>
<thead>
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<th>Quick-Relief (Relievers)</th>
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<td><strong>Daily medications:</strong>&lt;br&gt;• Consider combination of long acting $\beta_2$-agonist and moderate dose inhaled corticosteroids or&lt;br&gt;• High dose inhaled corticosteroid 800-1200mcg or more/day, and&lt;br&gt;• Long-acting bronchodilator: either long-acting inhaled $\beta_2$-agonist and/or sustained-release theophylline&lt;br&gt;• Corticosteroid tablets as last option</td>
<td><strong>Short-acting bronchodilator: inhaled $\beta_2$-agonist as needed for symptoms</strong></td>
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<td><strong>STEP 3</strong>&lt;br&gt;Moderate Persistent</td>
<td><strong>Daily medications:</strong>&lt;br&gt;• Consider combination of long acting $\beta_2$-agonist and low dose inhaled corticosteroids&lt;br&gt;• Moderate dose inhaled corticosteroid, 400-800mcg/day AND, if needed&lt;br&gt;• Long-acting bronchodilator: either long-acting $\beta_2$-agonist&lt;br&gt;• Consider anti-leukotrienes.</td>
<td><strong>Short-acting bronchodilator: inhaled $\beta_2$-agonist as needed for symptoms, not to exceed 3-4 times in 1 day</strong></td>
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<td><strong>STEP 2</strong>&lt;br&gt;Mild Persistent</td>
<td><strong>Daily medication:</strong>&lt;br&gt;• Low dosed Inhaled corticosteroid, 200-400 mcg/day&lt;br&gt;• A trial of cromoglycate or nedocromil may be considered&lt;br&gt;• Consider anti-leukotrienes but treatment benefit has not been established</td>
<td><strong>Short-acting bronchodilator: inhaled $\beta_2$-agonist as needed for symptoms, not to exceed 3-4 times in 1 day</strong></td>
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<td><strong>STEP 1</strong>&lt;br&gt;Intermittent</td>
<td><strong>None needed except in children with frequent episodic attacks</strong>&lt;br&gt;• Cromoglycate or nedocromil as first option, consider low dose inhaled steroid if not improved</td>
<td><strong>Short-acting bronchodilator: inhaled $\beta_2$-agonist as needed for symptoms, but less than once a week&lt;br&gt;• Inhaled $\beta_2$-agonist or sodium cromoglycate before exercise or exposure to allergen</strong></td>
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Treatment is reviewed every 3 to 6 months. If control is sustained for at least 3 months, a gradual stepwise reduction in treatment may be possible. On the other hand, if control is not achieved, step up therapy is advised after reviewing patient medication technique, compliance and environmental control.
8.4.5 Exercise-induced asthma (EIA)

Exercise-induced bronchospasm usually occurs minutes after vigorous exercise, reaching its peak 5 to 10 minutes after stopping the activity, and usually resolves in another 20 to 30 minutes. The time sequence is usually useful in differentiating it from complaints related to poor physical fitness alone. EIA can be confirmed by an exercise challenge test. Exercise may be the only precipitant in some asthmatics but is more often a marker of inadequately controlled asthma. Short-acting β-agonists taken shortly before exercise can prevent EIA for up to 4-6 hours while long acting beta-agonists are effective up to 10-12 hours. Cromolyn and nedocromil taken shortly before exercise are also effective in preventing EIA.

It is important to note that, when properly managed, EIA should not limit either participation or success in physical exercises.

8.5 Referral to Specialist

The asthmatic child should be referred to a specialist for evaluation and management advice when he or she:

(a) has poor asthma control
   - has 2 or more exacerbation per month needing acute care
   - hospitalised for asthma on 2 or more occasions in 3 months
   - requires rescue medicine on 3 or more occasions per week
   - has severe acute exacerbation needing HD/ICU care

(b) is below 3 years and requires moderate to high doses of inhaled steroids and not responding as expected

(c) requires high dose steroids, BDP/BUD ≥400mcg/day or fluticasone ≥200mcg/day, or is on prolonged inhaled steroid therapy for more than 6 months and remain symptomatic
8.6 Treatment of Acute Asthma

8.6.1 Home management

**A** Home nebuliser use is not recommended as it offers no advantage over the use of MDI with spacer for children with acute asthma.

Grade A, Level Ia, Ib

**A** Frequent $\beta_2$ agonist, (e.g. Salbutamol MDI 0.2-0.3puffs/kg) should be given at 4 hourly intervals, preferably via a spacer device. Nebuliser therapy is not superior to use of MDI via spacer in acute asthma in children.\(^5^3\)

Grade A, Level Ia, Ib

When an acute exacerbation is expected e.g. during an acute upper respiratory infection, the usual medications should be stepped up. For selected patients who have severe asthma or with a past history of acute sudden severe attacks, the action plan should to include the need to double the dose of inhaled steroids and the indications to start a course of oral prednisolone.

It is strongly recommended that clear written instructions be given to the family on how to manage acute exacerbation based on symptoms ± PEFR i.e. a written action plan. However this should not replace a clear and comprehensive explanation from the doctor and a need to review and explain to the caregiver at repeat visits.

8.6.2 At Accident and Emergency Department/Outpatient Clinic

**A** Early aggressive bronchodilator therapy ($\beta_2$ agonist - Salbutamol/terbutaline plus an anticholinergic eg. Ipratropium bromide) is crucial in preventing worsening of acute asthma and improving the outcome.\(^5^2, ^5^4\)

Grade A, Level Ia, Ib

It is therefore recommended that a nebulised bronchodilator should be given at 15-20 minute intervals and the child reviewed thereafter (See Figure 6).
It is also recommended that symptom assessment and objective measurement of severity with PEF monitoring be used in assessment of acute asthma whenever possible. The doctor should be cautious in the interpretation of PEF in young children and in those using PEF meters for the first time.

A nebulised $\beta_2$-agonist should be given with oxygen to prevent hypoxia during an acute asthmatic attack. It should be emphasized that all clinics attending to children with acute asthma should have the facility to give oxygen-driven bronchodilator nebulisation when necessary.

8.6.3 Who should be admitted?

We should admit a child with any of the following:

- shows no response to a $\beta_2$ agonist or PEFR does not improve to at least 70% of his personal best.
- requires an inhaled $\beta_2$ agonist more frequently than 4 hourly.
- has acute asthma and has a past history of acute life threatening asthma.
- has chronic severe asthma with PEFR $\leq$ 50% of predicted normal.

Use of oral prednisolone in acute asthma

Although oral steroids are very effective in the treatment of acute asthma, they have to be used very carefully and selectively because of undesirable potential side effects.

A short course of steroids should be considered when the child meets one of the following criteria:

- requires frequent $\beta_2$ agonist therapy (more frequent than 3 hourly).
- requires regular nebuliser therapy (3-4 hourly) for more than 36-48 hours.
- has a past history of a severe life-threatening episode.
- is on high dose inhaled steroids or low dose oral steroids.

A dose of prednisolone of 1-2mgm/kg per day (max 40mgm) is usually given for no longer than 5 days. A child who has suffered from a severe acute attack and requires prolonged oral steroids for
control should be referred to a specialist for assessment of treatment. Children who require more than 4 courses per year should be very carefully monitored with a view to stepping up anti-inflammatory therapy.

8.6.4 Causes of apparent failure of therapy

Sometimes, children who receive appropriate therapy continue to have troublesome symptoms. Before changing therapy or increasing dosage of inhaled steroids, the doctor should look into the following factors:

(a) poor compliance  
(b) incorrect inhaler technique or failure to use a spacer  
(c) other concomitant medical problems e.g. chronic sinusitis, chronic rhinitis, pulmonary tuberculosis, gastro-oesophageal reflux etc.  
(d) psychosocial factors

Note:  
It is important to check for compliance, inhaler technique and correct use of a spacer device at each visit. The treatment should be kept as simple as possible, preferably once or twice a day dosing. For older children, new inhaler devices e.g. turbuhalers and other breath-activated devices improve drug delivery and are simpler to use and thus encourage compliance.

8.7 Conclusion

Asthma continues to be under-diagnosed and under-treated throughout childhood. Practitioners should strive to optimise the use of existing therapeutic options. Asthma can be treated and controlled with appropriate pharmacological therapy, education and trigger avoidance. Almost all children with asthma can lead normal lives with little or no restriction in daily activities, including sports and diet. Proper supervision through follow up and monitoring would ensure an optimal outcome.
Figure 6  Management Of Acute Asthma In Children

Assess Severity

NO

Mild/moderate

Salbutamol 0.5-1ml
Or Terbutaline 0.25-0.5ml
+ Ipratropium bromide 0.3-1ml

15 mins

Improved

Discharge with appropriate advice and follow up

Improved

NO IMPROVEMENT

Some improvement at 15 mins

Repeat Nebulisation 1x

NO IMPROVEMENT

Yes

Severe Asthma

High flow O2 40-60%
Salbutamol/Terbutaline 0.5ml to 1ml
+ Ipratropium bromide 0.5ml to 1ml via oxygen driven Nebuliser
IV Hydrocortisone 5mg/m/kg stat

NO IMPROVEMENT

Admit

Any of the above

Too breathless to talk/feed
Use of accessory muscles
SaO2 <92%
Silent chest
Altered conscious level
Fatigue or exhaustion
Cyanosis - late sign

Some improvement at 15 mins

Dischargewith appropriate advice and follow up
Quality indicators for asthma management

1. Patients who require acute relief medication one or more times a week should be started on inhalation corticosteroid therapy (See section 5.4.1). (C/IV)
2. Asthmatics who present to the clinic with sudden severe episodes of acute exacerbation should be given a one week course of oral corticosteroids. (A/Ia)
3. All patients requiring asthma treatment should be given patient education which includes a written asthma action plan. (A/Ia)

The following are indices of poor clinical outcome which should be monitored in each patient:

1. Excessive use of inhaled quick relief agents ≥2 units per month
2. Severe acute exacerbations requiring nebulisation ≥2 per year
3. Status asthmaticus: failure to improve after treatment with β-agonists
4. Short bursts of oral steroids ≥2 per year
5. No patient should be on long term oral corticosteroids in primary care
6. Hospital admission/re-admission for asthma
Some asthma resources (as at Dec 2001) available on the internet:

http://www.ginasthma.com
Global Initiative for Asthma, National Institutes of Health, National Heart, Lung, and Blood Institute, Bethesda, Maryland

http://www.docguide.com
The Doctors’ Guide

http://familydoctor.org/
American Academy of Family Physicians

http://www.ama-assn.org/special/asthma/treatmnt/treatmnt.htm
Asthma Information Centre

http://www.thoracic.org
American Thoracic Society

http://www.worldallergy.org/
World Allergy Organization

http://www.aap.org
American Academy of Paediatrics

http://www.aaai.org
American Academy of Allergy, Asthma and Immunology

http://www.actionasthma.co.uk/actionasthma/inc/public.asp
Action Asthma in the United Kingdom

http://www.asthma-help.co.uk/
Asthma-Help in the United Kingdom

http://www.asthma.org.uk/
National Asthma Campaign in the United Kingdom
After reading the Clinical Practice Guidelines, you can claim one CME point under Category III (Self-Study) of the SMC Online CME System. Before you login to claim the CME point, we encourage you to evaluate whether you have mastered the key points in the Guidelines by completing this set of MCQs. This is an extension of the learning process and is not intended to “judge” your knowledge and is not compulsory. The answers can be found at the end of the questionnaire.

**Instruction: Choose the best answer**

1. Mild persistent asthma is defined as
   A. FEV1 > 75% predicted
   B. the need to use quick relief medication one or more time/s per week
   C. the need to use quick relief medication two or more times per week
   D. more that one per week arousal with nocturnal asthma

2. ALL patients with mild persistent asthma should be treated with
   A. inhaled salbutamol on a need only basis
   B. an inhaled corticosteroid on a need only basis
   C. an inhaled corticosteroid on a daily basis
   D. an oral slow release theophylline

3. During long term preventive treatment of asthma, the maximal dose of an inhaled steroid for an adult per day is:
   A. 200mcg
   B. 400mcg
   C. 800mcg
   D. 1000mcg
4. A 34 year old housewife with asthma has regular (2-3 times per week) nocturnal wheeze despite taking 400mcg of inhaled budesonide twice per day via the turbuhaler. Her medication should be changed to
A. 1000mcg of the fluticasone BD
B. nebulized budesonide
C. inhaled formoterol/salmeterol BD alone
D. combination of inhaled steroid plus a long acting beta-agonist

5. The following are risk factors for asthma death except
A. use of home nebuliser
B. frequent hospital admission for asthma
C. sudden cessation of inhaled corticosteroid medication
D. allergy to animals

6. In the management of an acute asthma attack,
A. ipratropium bromide inhalation has added benefits to salbutamol
B. oral prednisolone should only be give to the most severe cases
C. the dose of oral prednisolone should be tailed over 7 days
D. antibiotics should be prescribed for all patients with fever

7. In the management of asthma during pregnancy,
A. patients tend to be under-treated
B. oral steroids must be avoided at all costs
C. beta agonists will delay labour
D. the inhaled corticosteroid dose should be reduced

8. Patients on the following medication should be referred to a specialist except
A. home nebuliser
B. oral prednisolone >3 times per year
C. inhaled corticosteroids >500mcg per day
D. inhaled salbutamol ≥3 units per month
9. Oral leukotriene antagonists are
   A. more effective than inhaled corticosteroids
   B. less cost–effective than inhaled corticosteroids
   C. effective only in mild asthma
   D. effective for acute asthma

10. During routine clinic visits for asthma,
    A. patients tend to exaggerate their asthma severity
    B. the emphasis should be on quick symptom relief medication
    C. patients should be assured that their asthma can be cured
    D. inhaled steroids should be reduced gradually but not discontinued

11. Which of the following is incorrect. Low dose inhaled corticosteroid therapy in asthma
    A. will reduce asthma mortality
    B. will prevent severe exacerbations
    C. is cost-effective in the long term
    D. will result in stunted growth

12. In discussing common goals of asthma treatment with patients,
    A. it is best conducted after several clinic visits
    B. it is difficult to get patients to agree to a regimen which will improve their symptoms, sleep and quality of life
    C. patients should consider long term total reduction of costs of medical care rather than short term increased cost of asthma medication for the initial visit
    D. patients should be offered a complete cure for asthma rather then excellent control

13. Asthma education for patients
    A. should teach theory rather than practical self management skills
    B. should teach the modification of diet
    C. must incorporate instructions in the use of a peak flow meter
    D. is a recommendation based upon level I of clinical evidence
14. The action plan for asthma self management
   A. is a verbal set of instructions
   B. will reduce asthma mortality
   C. is based upon home nebulisation
   D. is based primarily upon rapid increase in quick relief medication

15. In the environmental management for asthma,
   A. eradication of house dust mites is highly effective in improving asthma control
   B. cats are more allergenic than dogs
   C. kids with asthma should not attend school when the PSI is >100
   D. immuno-therapy will cure most patients with allergic asthma
Answers:

1. B 11. D
2. C 12. C
3. C 13. D
5. D 15. B
6. A
7. A
8. C
9. B
10. D
1. **Asthma insights and reality in Asia Pacific (preliminary data)**


The members of the workgroup are:

Chairperson:  Prof Lim Tow Keang

Members:  Clin Prof Tan Cheng Lim
Clin Assoc Prof Wang Yee Tang
Assoc Prof Daniel Goh Yam Thiam
Adj Assoc Prof Lee Bee Wah
Dr Philip Eng
Dr Chay Oh Moh
Dr K Narendra
Dr KN Sin Fai Lam
Dr Chong Phui Nah
Dr Tan Ngap Chuan
Dr Siaw Tung Yeng

Secretariat:  Dr Allen Wang
Executive summary of recommendations

A All doctors treating asthma patients should provide patient education to aid behaviour change.

Grade A, Level Ia

A Patients with persistent asthma (defined as needing relief medication one or more times per week) should be given inhaled corticosteroids to improve asthma control and reduce mortality.

Grade A, Level Ia

A Long acting β₂-agonists should be added in adults whose asthma is not controlled with 400-800mcg of inhaled corticosteroids per day.

Grade A, Level Ia

A Low dose inhaled corticosteroid is safe and therefore should be used in all children with persistent asthma (defined as above).

Grade A, Level Ia, Ib

A Leukotriene receptor antagonist may be considered as an additional therapy in children on moderate dose (200-400mcg per day) of inhaled steroids.

Grade A, Level Ib
Doctors should avoid excessive use of short acting $\beta_2$-agonists (>2 units of metered dose inhalers per month or home nebulisation) due to association with risk of asthma death.

Grade B, Level IIa

Drug treatment should be guided by regular assessment of asthma severity and control using a step classification system.

Grade C, Level IV

**STEP CLASSIFICATION OF ASTHMA SEVERITY**

<table>
<thead>
<tr>
<th>STEP</th>
<th>Day-time symptoms</th>
<th>Night-time symptoms</th>
<th>PEF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEP 4</strong>&lt;br&gt;Severe Persistent</td>
<td>Continuous limited physical activity</td>
<td>Frequent</td>
<td>≤60% predicted variability 30%</td>
</tr>
<tr>
<td><strong>STEP 3</strong>&lt;br&gt;Moderate Persistent</td>
<td>Daily symptoms&lt;br&gt;Use $\beta_2$ agonist daily.&lt;br&gt;Attacks affect daily activities</td>
<td>&gt;1 time per week</td>
<td>&gt;60%–&lt;80% predicted variability &gt;30%</td>
</tr>
<tr>
<td><strong>STEP 2</strong>&lt;br&gt;Mild Persistent</td>
<td>≥1 time a week but&lt;br&gt;&lt;1 time a day</td>
<td>&gt;2 times a month</td>
<td>≥80% predicted variability 20-30%</td>
</tr>
<tr>
<td><strong>STEP 1</strong>&lt;br&gt;Intermittent</td>
<td>&lt;1 time a week.&lt;br&gt;Asymptomatic and normal PEF between attacks</td>
<td>≤2 times a month</td>
<td>&gt;80% predicted variability &lt;20%</td>
</tr>
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</table>

Adapted from GINA (Global Strategy for Asthma Management and Prevention) guideline, for children below 5 yrs PEF does not apply.
Symptoms: wheeze, dyspnoea and/or cough.
The highest level of current severity defines the STEP category for each patient.
<table>
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<th>Daily medications:</th>
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<td>• <strong>Inhaled corticosteroid</strong> &gt;800 mcg</td>
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<td>• Long-acting bronchodilator: either long-acting inhaled β2-agonist and/or sustained-release theophylline, and/or long-acting β2-agonist tablets and</td>
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<td>• Inhaled corticosteroid, 400–800 mcg AND, if needed</td>
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<td>• Long-acting bronchodilator: either long-acting β2-agonist, sustained-release theophylline, or long-acting β2-agonist tablets</td>
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Treatment is reviewed every 3 to 6 months. If control is sustained for at least 3 months, a gradual stepwise reduction in treatment may be possible. On the other hand, if control is not achieved, step up therapy is advised after reviewing patient medication technique, compliance and environmental control.
## APPROPRIATE DRUG TREATMENT AT EACH STEP OF ASTHMA SEVERITY IN CHILDREN

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<th>Severity</th>
<th>Long-Term Preventive (Controllers)</th>
<th>Quick-Relief (Relievers)</th>
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</thead>
</table>
| STEP 4 | Severe Persistent | Daily medications:  
- Consider combination of long acting β₂-agonist and moderate dose inhaled steroids or  
- High dose inhaled corticosteroid 800-1200mcg or more/day, and  
- Long-acting bronchodilator: either long-acting inhaled β₂-agonist and/or sustained-release theophylline  
- Corticosteroid tablets as last option | Short-acting bronchodilator: inhaled β₂-agonist as needed for symptoms |
| STEP 3 | Moderate Persistent | Daily medications:  
- Consider combination of long acting β₂-agonist and low dose inhaled corticosteroids  
- Moderate dose inhaled corticosteroid, 400-800mcg/day AND, if needed  
- Long-acting bronchodilator: either long-acting β₂-agonist  
- Consider anti-leukotrienes | Short-acting bronchodilator: inhaled β₂-agonist as needed for symptoms, not to exceed 3-4 times in 1 day |
| STEP 2 | Mild Persistent | Daily medication:  
- Low dosed Inhaled corticosteroid, 200-400 mcg/day  
- A trial of cromoglycate or nedocromil may be considered  
- Consider anti-leukotrienes but treatment benefit has not been established | Short-acting bronchodilator: inhaled β₂-agonist as needed for symptoms, not to exceed 3-4 times in 1 day |
| STEP 1 | Intermittent | None needed except in children with frequent episodic attacks  
- Cromoglycate or nedocromil as first option, consider low dose inhaled steroid if not improved | Short-acting bronchodilator: inhaled β₂-agonist as needed for symptoms, but less than once a week  
- Inhaled β₂-agonist or sodium cromoglycate before exercise or exposure to allergen |

Treatment is reviewed every 3 to 6 months. If control is sustained for at least 3 months, a gradual stepwise reduction in treatment may be possible. On the other hand, if control is not achieved, step up therapy is advised after reviewing patient medication technique, compliance and environmental control.
**Initial treatment:**

- **C** Continuous inhaled short-acting beta₂-agonist by nebulisation, one dose eg. Salbutamol 5-10 mg every 20 minutes for 1 hour; alternatively, the use of an inhaler (eg 20 puffs of Ventolin) plus a holding chamber (spacer device) produces equally effective bronchodilation

  
  Grade B Level IIa

- **A** Addition of ipratropium 0.5mg in adults to an aerosolised solution of beta₂-agonist has been shown to cause additional bronchodilation, particularly in those with severe airflow obstruction, and to reduce hospitalisation.

  Grade A Level Ia

- **A** Systemic corticosteroids eg prednisolone 40mg immediately and repeated for 7-10 days for all patients. No "tail" is needed and oral steroids are as rapid and effective as injections.

  Grade A Level Ib

**A Repeat Clinical Assessment is made:**
Symptoms, physical examination, PEF, O₂ saturation, other tests as needed

**A Good response:**
Response sustained 60 minutes after last treatment
Physical examination is normal
PEF>70% predicted
No distress
O₂ saturation > 90%

**Action:** Patient can be discharged home.
Must continue treatment with inhaled beta₂-agonist.
Consider course of oral steroids in most cases.
Reinforce patient education, action plan and close follow-up

**Incomplete response within 1-2 hours:**
History of high risk patient
Physical examination: mild to moderate symptoms
PEF > 50% - 70%
O₂ saturation not improving

**Action:** Admit to Hospital

**Poor Response within 1 hour:**
History of high-risk Physical exam:
symptoms severe, drowsiness, confusion
PEF < 30%
PCO₂ > 45 mmHg
O₂ saturation < 90%

**Action:** Admit to Intensive Care
MANAGEMENT OF ACUTE ASTHMA IN CHILDREN

Assess Severity

NO

Too breathless to talk/feed
Use of accessory muscles
SaO₂ < 92%
Silent chest
Altered conscious level
Fatigue or exhaustion
Cyanosis - late sign
Any of the above

Mild/moderate

Salbutamol 0.5-1ml
Or Terbutaline 0.25-0.5ml
+ Ipratropium bromide 0.3-1ml

15 mins

NO

IMPROVEMENT

Severe Asthma

High flow O₂ 40-60%
Salbutamol/Terbutaline
0.5ml to 1ml
+ Ipratropium bromide
0.5ml to 1ml via
oxygen driven Nebuliser
IV Hydrocortisone
5mg/kg stat

Discharge
with appropriate advice and follow up

Improve

Repeat Nebulisation 1x

Some improvement at 15 mins

Admit

NO

IMPROVEMENT

Admit