

CLINICAL PRACTICE GUIDELINES

Management of Asthma

Jan 2008



College of Paediatrics &
Child Health



SINGAPORE THORACIC SOCIETY



Chapter of Respiratory Physicians
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MINISTRY OF HEALTH
SINGAPORE

MOH Clinical Practice Guidelines 1/2008

Levels of evidence and grades of recommendation

Levels of evidence

Level	Type of Evidence
1 ⁺⁺	High quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias.
1 ⁺	Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias.
1 ⁻	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias.
2 ⁺⁺	High quality systematic reviews of case control or cohort studies. High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2 ⁺	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2 ⁻	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Grades of recommendation

Grade	Recommendation
A	At least one meta-analysis, systematic review of RCTs, or RCT rated as 1 ⁺⁺ and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1 ⁺ , directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2 ⁺⁺ , directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1 ⁺⁺ or 1 ⁺
C	A body of evidence including studies rated as 2 ⁺ , directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2 ⁺⁺
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2 ⁺
GPP (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

CLINICAL PRACTICE GUIDELINES

Management of Asthma

MOH Clinical Practice Guidelines 1/2008

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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. These guidelines should neither be construed as including all proper methods of care, nor exclude 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 is a chronic disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person. Often under-diagnosed and under-treated, asthma creates a substantial burden to individuals and families and possibly restricting individuals' activities for a lifetime.

According to World Health Organization (WHO) estimates, asthma affects more than 300 million people worldwide. The rate of asthma increases as the communities become more urbanised. As the proportion of urban population is increasing around the world, it is estimated that there may be an additional 100 million persons with asthma by 2025. The number of disability-adjusted life years (DALYs) lost due to asthma worldwide has been estimated to be currently about 15 million per year contributing to 1% of total DALYs lost which reflects the high prevalence and severity of asthma.

The Singapore burden of disease study estimated that asthma accounted for almost 4,400 DALYs lost in the year 2004 contributing to 1.2% of the total DALYs lost in Singapore. In order to deal effectively with the increasing burden of asthma, this set of guidelines updates the previous edition released in 2002 to include the latest evidence from scientific literature. Apart from updating the sections on diagnosis and treatment, the key change is in asthma management which now focuses on achieving control of asthma. To assess asthma control, a simple and robust tool, the Asthma Control Test, is recommended in this set of guidelines.

It is hoped that all medical practitioners will find this set of guidelines useful in managing their patients with asthma.

PROFESSOR K SATKU
DIRECTOR OF MEDICAL SERVICES

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Executive Summary of Recommendations

Details of recommendations can be found in the main text at the pages indicated.

Objectives of asthma management

GPP A successful management plan should be established for each patient in the context of a team effort that includes: the patient, relevant family member or carer, doctor, nurse/clinic assistant and pharmacist. It should involve the following elements (pg 17):

- Education-motivation
- Self assessment and management
- Environmental management
- Pharmacological management

GPP

D A new classification of asthma, guided by the level of asthma control, is recommended (refer to Table 5 on pg 29) (pg 17).

Grade D, Level 4

A All doctors treating asthma patients should provide patient education to aid behaviour change (pg 18).

Grade A, Level 1+

B House dust mite is a universal allergen. No single measure is effective to reduce exposure to mite allergens. An integrated approach including barrier methods, dust removal, environmental mite control may be partially effective and should be used (pg 22).

Grade B, Level 2+

GPP During periods of haze, patients should be advised to avoid strenuous exertion outdoors (pg 22).

GPP

C The possibility of occupational asthma should be considered in a working adult with newly diagnosed asthma. The range of occupational sensitizers is large, and complex. If occupational asthma is suspected, the patient should be referred to a specialist for further assessment (pg 22).

Grade C, Level 2+

B Smoking should be avoided in all patients with asthma especially pregnant women and children (pg 23).

Grade B, Level 2+

A Asthma medications can be given by various routes. The best route is by inhalation, because the drugs are given directly where they are needed, into the airways. This leads to faster action, with a much reduced risk of systemic side effects (pg 23).

Grade A, Level 1+

A Inhaled corticosteroids are best used at low to moderate doses (pg 24).

Grade A, Level 1+

A Long acting β_2 -agonists including salmeterol and formoterol should never be used as monotherapy in asthma (pg 26).

Grade A, Level 1+

A The strategy of “add on therapy” with long acting β_2 -agonists is recommended when a low to medium-dose of inhaled corticosteroids alone fails to achieve control of asthma (pg 26).

Grade A, Level 1++

A Formoterol is a long acting β_2 -agonist which has a rapid onset of action comparable to that of a rapid acting β_2 -agonist drug. If a combination inhaler containing formoterol and budesonide is considered, it may be used for both rescue and maintenance. This has been shown to reduce exacerbations and improve asthma control in adults and adolescents at relatively low doses of treatment (pg 26).

Grade A, Level 1+

B Theophylline has a bronchodilator action and also modest anti-inflammatory properties. It cannot however be used as a controller drug. It may be useful as an add-on drug in patients who do not achieve good control on inhaled glucocorticosteroids alone (pg 26).

Grade B, Level 2++

A Leukotriene modifiers such as montelukast have a small and variable bronchodilator effect, reducing symptoms including cough, improving lung function and reducing exacerbations and airway inflammation. It can either be used as an alternative to low dose inhaled glucocorticosteroids in patients with mild persistent asthma, or as an add-on drug when low dose inhaled glucocorticosteroids or when the combination of inhaled corticosteroids with long acting β_2 -agonist have not given the desired effect (pg 27).

Grade A, Level 1+

A The combination of inhaled ipratropium and inhaled β_2 -agonist may be used in the treatment of acute severe asthma exacerbation (pg 27).

Grade A, Level 1+

A Short-term “burst” oral corticosteroids may be given at the dose of 40-50 mg/day for 5-10 days as treatment of severe acute exacerbation of asthma and in worsening asthma (pg 28).

Grade A, Level 1+

A Regular low doses of oral steroids cause severe and intolerable long-term side effects and should not be used in primary care (pg 28).

Grade A, Level 1+

A The asthma CPG workgroup recommends the **Asthma Control Test (ACT)**, a 5-item, patient-administered survey questionnaire for assessing asthma control (Figure 1 on page 30). This is a simple, objective, robust and validated method for monitoring control by doctors (and patients) (pg 30).

Grade A, Level 1+

GPP Patients who do not achieve good asthma control despite Step 4 levels of treatment have refractory asthma and should be reviewed by a specialist. Thus, management at Step 5 should be supervised directly by specialists (pg 31).

GPP

Management of acute exacerbations

GPP Mild attacks (defined as reduction in peak flow of less than 20%, nocturnal awakening and increased use of short acting β_2 -agonist) 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 (pg 32).

GPP

GPP Patients with high risk of dying from asthma require special attention, monitoring and care, particularly intensive education, including advice to seek medical care early during an exacerbation (pg 34).

GPP

Management of adult acute asthma in the clinic

Initial treatment:

B Continuous inhaled short-acting β_2 -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 salbutamol) plus a holding chamber (spacer device) produces equally effective bronchodilation (pg 35).

Grade B, Level 2++

A Addition of ipratropium 0.5 mg in adults to an aerosolised solution of β_2 -agonist has been shown to cause additional bronchodilation, particularly in those with severe airflow obstruction, and to reduce hospitalisation (pg 35).

Grade A, Level 1++

A Systemic corticosteroids, e.g. prednisolone 30 mg, immediately and repeated for 7-10 days for all patients. No "tail" is needed and oral steroids are as rapid and effective as injections (pg 35).

Grade A, Level 1+

At the clinic visit

GPP We recommend the use of the Levels of Asthma Control table and checklist on all patients at every visit (pg 36).

Checklist:

- a) Good Inhaler Technique
- b) Compliance with preventive treatment
- c) Compliance with follow-up visits
- d) Reinforce Written Asthma Action Plan

GPP

GPP Written Asthma Action Plan should be taught so that patients can implement it for self-management of exacerbations between visits (refer to section 5.3 and Annex A). Patients should be advised to perform monthly self-audit of ACT scores between visits (pg 36).

GPP

GPP 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 (pg 36).

GPP

A Asthma patients should be provided with a symptom-based written asthma action plan (pg 39).

Grade A, Level 1++

B Doctors should ensure regular review of their patients who are unable to undertake guided self-management and adjust their medications according to their asthma control (pg 39).

Grade B, Level 2++

GPP Patients should be provided with an appointment for review at regular intervals, depending on their asthma control status. During these follow-ups, the following measures may be included in the consultation (pg 39-40):

1. Assess asthma control based on symptom frequency (referring to diary/calendar), impact on activities of daily living and/or PEFr measurements. Healthcare workers can assess asthma control using composite assessment

- tool, such as validated questionnaires like the Asthma Control Test (ACT).
2. Clarify and discuss patient's questions and asthma related problems, including the initial or previous treatment.
 3. Check and correct inhaler device technique, if inappropriate.
 4. Check patient's adherence/compliance to the medication plan.
 5. Suggest measures to reduce exposure to trigger or risk factors.
 6. Assess understanding of written asthma action plan and revise according to asthma control status.

GPP

B Asthmatic patients who are pregnant should be managed with inhalation therapy, which is safe and effective in pregnancy (pg 40).

Grade B, Level 2++

GPP Primary care physicians can treat most asthma patients but may consider referring the following subsets of patients to respiratory physicians for further evaluation and/or management: those with other co-morbidity, confusing signs and symptoms and whose control is sub-optimal despite treatment with maximal drug dosages (3Cs) (pg 40-41).

1. Co-morbidity:
 - a. Patient with concurrent heart failure, which may complicate asthma management.
 - b. Patient with a history of psychiatric disease or multiple psychosocial problems, including the use of sedative.
 - c. Patient with concurrent GERD which may mimic asthma.
2. Confusing sign and symptoms
 - a. Patient with probable occupational asthma will require further diagnostic determination of the industrial trigger agent.
 - b. Patient with atypical signs and symptoms such as unilateral wheezing to exclude other tracheobronchial pathology.
3. Control: Failure to achieve asthma control despite optimal treatment
 - a. Patient who is currently using or have recently stopped using daily oral corticosteroid therapy.
 - b. Patient with a history of near-fatal asthma requiring intubation and mechanical ventilation.
 - c. Patient with severe asthma requiring step 4 care and yet experiencing exacerbation despite compliance to treatment.

- d. Patient with poorly controlled asthma (irregardless of asthma severity classification) who had at least two hospitalizations for asthma and/or requires more than two courses of burst therapies with oral corticosteroid in the past one year.

GPP

Management of asthma in children

B A detailed medical history and clinical examination is mandatory. Additional tests like Pulmonary Function Tests (PFT), exhaled nitric oxide may be useful to support the diagnosis made or to monitor response to therapy for the more difficult patients (pg 42).

Grade B, Level 2+

A Rapid-acting inhaled β_2 -agonists are the medications of choice for relief of bronchoconstriction and for the pre-treatment of exercise induced asthma.

β_2 -agonist metered-dose-inhaler (MDI) delivered by the holding chamber/ spacer has been shown to be at least as effective as the nebuliser. Hence routine use of nebulisers is not recommended. During asthma exacerbations, as many as 4-8 puffs of salbutamol inhaler or 0.2-0.3 puffs/kg (max 10 puffs) may be used (pg 47).

Grade A, Level 1++

A Long acting inhaled β_2 -agonists may be used as add-on therapy for children with symptoms which are not controlled with low dose inhaled steroids. These should not be used without concomitant inhaled corticosteroids (pg 48).

Grade A, Level 1+

A Only formoterol may be used as a reliever medicine in view of its rapid onset of action (pg 48).

Grade A, Level 1+

A Inhaled bronchodilators are preferred as they have quicker onset of action and fewer side effects than oral or IV administration (pg 48).

Grade A, Level 2+

B For the younger children with nocturnal symptoms, oral long acting β_2 -agonists may be useful. Sustained release theophylline can be useful for a short duration. It is important to monitor for side effects such as agitation, muscle tremors, palpitations and headache (pg 48).

Grade B, Level 2+

A In older children above 5 years, leukotriene modifiers may be used as they provide clinical benefit at all levels of asthma severity. However, clinical benefits are generally less than those with inhaled corticosteroids (pg 50).

Grade A, Level 1++

A Leukotriene modifiers may be used to reduce viral induced asthma exacerbation in younger children aged 2-5 years (pg 51).

Grade A, Level 1+

A Leukotriene modifiers may be used as an add-on therapy in children on low to moderate doses of inhaled steroids. In children with poor asthma control, adding a leukotriene modifier may provide additional benefit, including reducing the number of exacerbations (pg 51).

Grade A, Level 1+

A A long acting β -agonist or a leukotriene modifier should be added rather than increasing the dose of inhaled steroids if children with mild persistent asthma do not show clinical improvement with inhaled steroids alone (pg 51).

Grade A, Level 1+

A Combination agents containing long acting β_2 -agonists and inhaled steroids may be used in children above 5 years of age whose control is not optimum with low dose inhaled steroids (pg 51).

Grade A, Level 1+

GPP Recommended in choosing an inhaler device for children (pg 52):

<4 years	MDI with spacer + a facemask
4-6 years	MDI with spacer with mouthpiece
>6 years	MDI with spacer with mouthpiece
	Dry powder inhaler, e.g. accuhaler and turbuhaler

GPP

GPP Follow-up assessment is best achieved with a review of PEFR and symptom control. 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 may enhanced drug delivery and encourage compliance (pg 52).

GPP

GPP Anti-inflammatory therapy ought to be maintained for at least 3 months after adequate control of symptoms. The child should be reviewed regularly thereafter with the view to reducing therapy to the minimum amount to maintain control of asthma. Should symptoms relapse during the tapering of maintenance doses, step-up of dosage may be necessary to achieve good control (after ensuring good compliance and inhaler technique) (pg 52).

GPP

A The initiation of long-term control therapy is recommended for reducing impairment and risk of exacerbations in infants and young children who had four or more episodes of wheezing in the past year that lasted more than 1 day and affected sleep AND who have either (pg 54):

(1) one of the following: a parental history of asthma, a physician's diagnosis of atopic dermatitis, or evidence of sensitization to aeroallergens;

OR

(2) two of the following: evidence of IgE sensitization to foods, ≥ 4 percent peripheral blood eosinophilia, or wheezing apart from colds.

Grade A, Level 1+

A Inhaled corticosteroids should be used to control symptoms, prevent exacerbations, and improve the child's quality of life, but their use should not be initiated or prolonged for the purpose of changing the progression or underlying severity of the disease (pg 55).

Grade A, Level 1+

GPP The asthmatic child should be referred to a specialist for evaluation and management advice when he or she (pg 55):

- (a) has high risk asthma with poor asthma control;
- OR
- (b) is below 3 years and requires moderate to high doses of inhaled steroids and not responding as expected;
- OR
- (c) requires high dose steroids, BDP/BUD ≥ 400 mcg/day or fluticasone ≥ 200 mcg/day, or is on prolonged inhaled steroid therapy for more than 6 months and remains symptomatic.

GPP

GPP When an acute exacerbation is expected, e.g. during an acute upper respiratory infection, the usual medications should be stepped up (pg 55):

- (a) frequent β_2 -agonist, (e.g. salbutamol MDI 0.2-0.3 puff/kg) preferably via a spacer device, given at 4 hourly intervals
- (b) for selected patients who have severe asthma or with a past history of acute sudden severe attacks, the action plan should include the need to increase the dose of inhaled steroids and rarely to start a course of oral prednisolone.

GPP

A It is strongly recommended that clear written asthma action plans be given to the family on how to manage acute exacerbations based on symptoms (pg 56).

Grade A, Level 1+

GPP It is recommended that symptom assessment and objective measurement of severity with PEFr be used in assessment of acute asthma whenever possible (pg 56).

GPP

A An inhaled bronchodilator should be given at 15-20 minute intervals and the child reviewed thereafter (pg 56).

Grade A, Level 1+

GPP We should consider admission for a child with any of the following (pg 56):

- (a) Shows no or poor response to a β_2 -agonist.
- (b) Requires an inhaled β_2 -agonist more frequently than 4 hourly.
- (c) Has acute asthma and has a past history of acute life threatening asthma.

GPP

GPP A short course of steroids should be considered when the child meets one of the following criteria (pg 57):

- (a) Requires frequent β_2 -agonist therapy (more frequent than 3 hourly).
- (b) Requires regular nebuliser therapy (3-4 hourly) for more than 36-48 hours.
- (c) Has a past history of a severe life threatening episode.
- (d) Is on high dose inhaled steroids or low dose oral steroids.

GPP

D&GPP A dose of prednisolone of 1-2 mgm/kg per day (max 40 mg) is usually given for no longer than 5 days. A child who has suffered from a severe acute attack and requires prolonged or repeated oral steroids for control should be referred to a specialist for assessment of treatment (pg 57).

**Grade D, Level 4
GPP**

1 Introduction

1.1 Revised asthma clinical practice guideline

Asthma is a major global health problem. It is common in people of all ages and in countries throughout the world. This chronic airway disorder can be severe and sometimes fatal. A number of clinical practice guidelines on the management of asthma have been published in the past. Many have been publicised and disseminated among doctors in Singapore.

However, poorly controlled asthma remains a common problem in Singapore. A population-based survey revealed that patients in Singapore and the region experience a heavy burden of disease exacerbations, days lost from work and school.¹ Moreover, asthma death is a persistent problem and increasing mortality among younger patients is especially disturbing.²

A systematic analysis in 2001 showed that patient education and optimising drug treatment consistent with what is recommended in most guidelines can have major sustained beneficial effects in patients.³ The 2006 revised Global Initiative For Asthma (GINA) guidelines also emphasizes asthma control.⁴ There is now good evidence that the clinical manifestations of asthma – symptoms, sleep disturbances, limitations of daily activity, impairment of lung function, and the use of rescue medications – can be controlled with appropriate treatment.

One important reason for the apparent failure of practice guidelines to make an impact is the lack of adherence by both doctors and their patients. Another is due to the situation of a ‘disconnect’ – that is, an overestimation of asthma control by patients and an underestimation of patients’ symptoms by doctors. 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 indicated and this set of guidelines distils from the current literature simple and practical recommendations to control asthma. The aim of this revised guideline is to give doctors at the primary care setting practical and evidence-based guidance for the management of asthma. The evidence provided from more recent studies do provide the basis for a more streamlined and cost-effective asthma program.³

1.2 Target group

Most patients with asthma will first seek help from their primary care doctors. With appropriate management, good quality asthma control can be achieved for most patients at primary care clinics. This updated guideline is therefore directed at asthma management at the primary care setting - general practitioners, paediatricians and polyclinic doctors. A simple set of guidelines is desirable as primary care clinics are multi-disciplinary and treat patients with a wide variety of conditions. As far as possible, the workgroup has recommended management steps based on the current best evidence. This set of clinical practice guidelines is a revised and updated version of the previous one, relevant to our local context and continues to address specific barriers to quality asthma care.

1.3 Guideline development

These guidelines have been produced by a committee comprising respiratory physicians, family physicians, paediatricians, and an asthma nurse appointed by the Ministry of Health. A patient with asthma assisted the committee in the patient version of the guideline. They were developed using the best available current evidence and expert opinion. This guideline is meant to be simple, and has very practical steps and evidenced-based recommendations for the family practice physician to follow.

1.4 What's new in the revised guidelines

The following is a list of major revisions or additions to the guidelines:

- (1) The key change is that asthma management is now focused on achieving control of asthma, rather than on an accurate classification of disease severity into mild, moderate or severe persistent asthma, which was in the previous CPG.
- (2) A new classification based on control of asthma is now provided: Controlled, Partly Controlled, or Uncontrolled. This is a working scheme of management based on current opinion.

- (3) The use of a validated, simple and robust tool, the Asthma Control Test (ACT), is recommended for the assessment of control at each clinic visit.
- (4) Treatment is stepped up or down depending on the level of control achieved. A new treatment algorithm, based on the ACT score, is provided.
- (5) Clinical quality indices for asthma have been revised.

1.5 Review of guidelines

Evidence-based clinical practice guidelines are only as current as the evidence that supports them. Users must keep in mind that new evidence could supersede recommendations in these guidelines. The workgroup advises that these guidelines be scheduled for review 5 years after publication, or if new evidence appears that requires substantive changes to the recommendations.

2 Definition and Diagnosis of Bronchial Asthma in Adults

2.1 Definition

Asthma is defined as 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. While asthma exacerbation may be episodic, the airway inflammation is chronically present.

2.2 Diagnosis

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

Asthma 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, congestive cardiac failure, bronchiectasis or gastroesophageal reflux.

2.3 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.

2.4 Confirmatory tests

Spirometry is the most reliable test of reversible airway obstruction. Peak expiratory flow rate is a less reliable test but an improvement by 20% or more in response to inhaled bronchodilator may be seen. Doubtful cases should be referred to a specialist (see Section 5.5 on pages 41,42).

3 Objectives of Asthma Management

3.1 Goal and management plan

The ultimate goal of asthma management should be continuous disease control i.e. to achieve and maintain clinical control. According to the revised GINA guidelines, disease control is defined as the control of several outcomes, including:

- No (twice or less/week) daytime symptoms
- No limitation of daily activities, including exercise
- No nocturnal symptoms or awakening because of asthma
- No (twice or less/week) need for reliever treatment
- No exacerbations
- Normal or near-normal lung function results

The goals of asthma management must be 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. Developing an asthma management plan is also critical to the success in asthma management.

GPP A successful management plan should be established for each patient in the context of a team effort that includes: the patient, relevant family member or carer, doctor, nurse/clinic assistant and pharmacist. It should involve the following elements:

- Education-motivation
- Self assessment and management
- Environmental management
- Pharmacological management

GPP

3.2 Measuring asthma control, treatment steps and targets

D A new classification of asthma, guided by the level of asthma control, is recommended⁴ (refer to Table 5 on pg 29).

Grade D, Level 4

Treatment options are organised into five “Steps” reflecting increasing intensity of treatment (dosages and/or number of medications) required to achieve control. At all steps, a reliever medication is given as needed. At steps 2 through 5, a variety of controller medications are available.

If asthma is not controlled on the current treatment regimen, treatment is stepped up until control is achieved. When control is maintained, treatment can be stepped down in order to find the lowest step and dose of treatment that maintains control (section 3.6 on pages 23-32).

In order to achieve good asthma control, a composite measure of all the above listed outcomes will provide a more comprehensive and clinically relevant assessment of asthma control. Several composite control measures (e.g. Asthma Control Test⁵, Asthma Control Questionnaire^{6,7}, Asthma Therapy Assessment Questionnaire⁸, Asthma Control Scoring System⁹) have been developed and are being validated for various applications.

For adults with asthma, the **Asthma Control Test** is a simple, objective means of monitoring control by clinicians (and patients), which is now being internationally adopted.⁵ While clear therapeutic targets are available for many chronic diseases (e.g. blood pressure for hypertension, HbA1c for diabetes), these are not clearly defined for asthma. Using the ACT score will provide clear targets for both doctors and patients to guide treatment, facilitate assessment of asthma control and avoid the situation of a ‘disconnect’ between doctor and patient.

3.3 Education motivation

A All doctors treating asthma patients should provide patient education to aid behaviour change.³

Grade A, Level 1+

The aims of education are to change behaviour and improve self-management skills. Patients should be aware that in the vast majority asthma can be well controlled and:

- Be free of troublesome symptoms both day and night
- Serious attacks are prevented
- Dependence on reliever medication is minimised

- Lead productive and physically active life
- Achieve and maintain normal / near normal lung function

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 management in asthma are listed in Table 1.

Table 1 Common barriers to effective asthma treatment

- | |
|--|
| <ol style="list-style-type: none"> 1. Failure to agree to a set of common goals with patient 2. Patient resistance/objection to inhalational therapy 3. Poor inhalational technique 4. Inconvenient dosing schedules 5. Underestimation of worsening symptoms 6. Steroid phobia 7. Concern about potential adverse effects during pregnancy 8. Worry about excessive costs |
|--|

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.

One should also emphasise the importance of:

- Quitting smoking, as cigarette smoke is not only a trigger, but it also induces steroid resistance
- Exercise
- Weight management

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 2. Long-term treatment with a low dose of inhaled corticosteroids is cost-effective.¹⁰

Table 2 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

3.4 Self-assessment and management

Continuous self-assessment and a written action plan for the management of acute exacerbations, for most patients, is guided by symptoms rather than the peak expiratory flow rate (PEFR) measurements. This is contrary to many older asthma guidelines but consistent with current best clinical evidence.³ The reasons are summarized in Table 3 on page 21.

Regular PEFR charting remains a very useful option for the subgroup of patients with poor perception of asthma symptoms and selected patients who choose to self-monitor with the PEFR chart. A patient's PEFR should be compared against his or her personal best rather than the predicted PEFR. A patient's personal best PEFR is obtained by monitoring PEFR over 2 to 3 weeks during good asthma control.

Acute exacerbation of asthma can be prevented if effective preventive measures are taken during the window period of worsening symptoms and falling PEFR, lasting several days.

An individualised written action plan should clearly indicate:

- when to increase treatment
- how to increase medication
- for how long treatment should be increased
- when to seek medical help

Table 3 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

Patient outcome-based randomised controlled trials have now established that guidelines are an essential tool in the management of asthma in the primary care setting. Education, motivation and provision of action point based self-management plans, empowers the patient to take control of asthma.

3.5 Management of environmental triggers

Asthma exacerbations can be caused by a wide range of environmental triggers, including allergens, food, viral infections, and air pollutants (particularly haze). Complete avoidance of such common environmental factors is impractical.

Maintaining adequate control of asthma with regular medication remains the cornerstone of management as patients are often less sensitive to these triggers when asthma is well controlled.

Exhaustive testing for triggers is not cost effective, and is not necessary in most patients.

3.5.1 Food and food additives

Real food allergy is uncommon, and exhaustive test for food allergy is unnecessary.

Most commonly locally reported food “triggers” (such as cold drinks, orange juice and ice cream) are not true IgE mediated allergic reactions. These reactions often improve when asthma is controlled.

True IgE mediated allergic reaction to food is uncommon, but can be fatal. The best example is allergy to peanut, and complete avoidance is essential. Severe food allergy should be referred to specialist care.

3.5.2 House dust mite

B House dust mite is a universal allergen. No single measure is effective to reduce exposure to mite allergens. An integrated approach including barrier methods, dust removal, environmental mite control may be partially effective and should be used.¹¹

Grade B, Level 2+

3.5.3 Air pollution

Most studies show association between air pollutants and exacerbations of asthma.¹²

GPP During periods of haze, patients should be advised to avoid strenuous exertion outdoors.

GPP

Patients with uncontrolled asthma are at higher risk of more severe exacerbation. There is no existing consensus on the optimum therapy for asthma exacerbation due to air-pollution, though the conventional approach is advocated.

3.5.4 Occupational triggers

C The possibility of occupational asthma should be considered in a working adult with newly diagnosed asthma. The range of occupational sensitizers is large, and complex. If occupational asthma is suspected, the patient should be referred to a specialist for further assessment.¹³

Grade C, Level 2+

3.5.5 Passive smoking

B Smoking should be avoided in all patients with asthma especially pregnant women and children.^{14,15}

Grade B, Level 2+

3.6 Pharmacological management of asthma

The goal of asthma treatment is to achieve and maintain clinical control. To a large extent this is done by the judicious use of the various medications available to us.

Controllers versus Relievers

Asthma medications are best classified as Controllers or Relievers.

Controllers are medications taken daily on a long-term basis to prevent exacerbations of asthma and control asthmatic symptoms. They have an anti-inflammatory effect. The most effective controller medications currently available are inhaled glucocorticosteroids.

Relievers are medications taken as required to relieve symptoms of wheeze or breathlessness. They act quickly and reverse the bronchospasm occurring during an attack of asthma. The most effective relievers are rapid acting inhaled β_2 -agonists such as salbutamol, but inhaled anticholinergics such as ipratropium may also be useful.

Under detection of poor asthma control leading to over reliance on Reliever versus Controller medication is a major deficiency in asthma management globally. In order to address this problem, GINA guidelines have been revised in 2006 to focus on asthma control as a primary goal of treatment.¹⁶

The inhalational route

A Asthma medications can be given by various routes. The best route is by inhalation, because the drugs are given directly where they are needed, into the airways. This leads to faster action, with a much reduced risk of systemic side effects.

Grade A, Level 1+

Inhaled medication is available in various forms. The most common is as pressurised metered-dose-inhalers (MDIs). Since CFCs (chlorofluocarbons) have been phased out, the medication in MDIs are now in solution in hydrofluoroalkanes. Pressurised MDIs require training and skill to coordinate the activation of the inhaler and inhalation. This may be difficult in some patients, and hence the use of a spacer device (holding chamber) may be valuable. Other methods of delivery include breath-actuated MDIs, dry powder inhalers (DPIs) and nebulised or wet aerosols. Dry Powder inhalers are easy to use but require a minimal inspiratory flow rate. Several types of devices are available as DPIs.

Recommended drugs

Inhaled glucocorticosteroids:

They are the most effective anti-inflammatory medications available for the treatment of persistent asthma. They must, however, be taken regularly every day, and this must be reinforced to the patient. They will not cure asthma, and if they are stopped for any reason, the symptoms of asthma with deterioration will occur again. Inhaled glucocorticosteroids are available in different formulations, potency and bioavailability as well as different dose per inhalation. The actual dose prescribed can be titrated depending on the severity of asthma and degree of control.

Side effects of inhaled corticosteroids include oropharyngeal candidiasis, dysphonia and cough. The incidence of local adverse effects can be reduced by mouth washing or gargling after inhalation. In the case of MDIs, the use of a spacer device is also helpful.¹⁶⁻¹⁸ Systemic effects of inhaled corticosteroids are usually not a clinical problem, especially at doses equivalent to or less than 400 mcg budesonide per day. At higher doses, there may be easy bruising, biochemical adrenal suppression and decreased bone mineral density.

A Inhaled corticosteroids are best used at low to moderate doses.^{19,20}

Grade A, Level 1+

This achieves good asthma control in most patients at minimal costs and side effects. Failure of low to moderate dose corticosteroid treatment is an indication for a review of asthma treatment and consideration for “add on therapy”.

Table 4 below lists approximately equipotent doses of different glucocorticosteroids based on available efficacy literature.

Table 4 Estimated equipotent daily doses of inhaled glucocorticosteroids for adults*

Drug	Low Daily Dose (µg)	Medium Daily Dose (µg)	High Daily Dose (µg) [†]
Beclomethasone dipropionate	200-500	>500-1000	>1000-2000
Budesonide [‡]	200-400	>400-800	>800-1600
Ciclesonide [‡]	80-160	>160-320	>320-1280
Flunisolide	500-1000	>1000-2000	>2000
Fluicasone	100-250	>250-500	>500-1000
Mometasone furoate [‡]	200-400	>400-800	>800-1200
Triamcinolone acetonide	400-1000	>1000-2000	>2000

* Comparison based upon efficacy data.
† Patients considered for high daily doses except for short periods should be referred to a specialist for assessment to consider alternative combinations of controllers. Maximum recommended doses are arbitrary but with prolonged use are associated with increased risk of systemic side effects.
‡ Approved for once-daily dosing in mild patients.

Notes

- The most important determinant of appropriate dosing is the clinician's judgment of the patient's response to therapy. The clinician must monitor the patient's response in terms of clinical control and adjust the dose accordingly. 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.
- Designation of low, medium, and high doses is provided from manufacturers' recommendations where possible. Clear demonstration of dose-response relationships is seldom provided or available. The principle is therefore to establish the minimum effective controlling dose in each patient, as higher doses may not be more effective and are likely to be associated with greater potential for adverse effects.
- As chlorofluorocarbons preparations are withdrawn from the market, medication inserts for hydrofluoroalkanes preparations should be carefully reviewed by the clinician for the equivalent correct dosage.

Source: GINA 2006 guidelines.

Long acting inhaled β_2 -agonists

A Long acting β_2 -agonists, including salmeterol and formoterol, should never be used as monotherapy in asthma.^{21,22}

Grade A, Level 1+

Long acting β_2 -agonists do not have any anti-inflammatory effects, and may produce relief of symptoms without any beneficial effect on the inflammation. However, they are very effective in combination with a low to moderate dose of inhaled glucocorticosteroids. It has also been shown that the combination treatment is more effective than increasing the dose of inhaled glucocorticosteroids alone.

A The strategy of “add on therapy” with long acting β_2 -agonists is recommended when a low to medium-dose of inhaled corticosteroids alone fails to achieve control of asthma.

Grade A, Level 1++

Fixed dose combination inhalers are more convenient for patients, increase compliance, and ensure that long acting β_2 -agonist is always accompanied by a glucocorticosteroid.

Long acting β_2 -agonists are also useful in the prevention of exercise-induced asthma.

A Formoterol is a long acting β_2 -agonist which has a rapid onset of action comparable to that of a rapid acting β_2 -agonist drug. If a combination inhaler containing formoterol and budesonide is considered, it may be used for both rescue and maintenance. This has been shown to reduce exacerbations and improve asthma control in adults and adolescents at relatively low doses of treatment.²³⁻²⁶

Grade A, Level 1+

Oral Theophyllines:

B Theophylline has a bronchodilator action and also modest anti-inflammatory properties. It cannot however be used as a controller drug. It may be useful as an add-on drug in patients who do not achieve good control on inhaled glucocorticosteroids alone.^{27,28}

Grade B, Level 2++

Side effects include gastrointestinal symptoms with nausea, vomiting and diarrhea, but cardiac arrhythmias, seizures and even death have been described. Drug monitoring is necessary when a high dose is started, when there are symptoms of toxicity, when therapeutic aims are not reached or when conditions exist, which may alter theophylline metabolism. These include concomitant use of other drugs such as theophylline, H2 blockers or quinolones, and conditions such as fever, infection, liver disease or heart failure.

Leukotrine modifiers

A Leukotrine modifiers such as montelukast have a small and variable bronchodilator effect, reducing symptoms including cough, improving lung function and reducing exacerbations and airway inflammation. It can either be used as an alternative to low dose inhaled glucocorticosteroids in patients with mild persistent asthma, or as an add-on drug when low dose inhaled glucocorticosteroids or when the combination of inhaled corticosteroids with long acting β_2 -agonist have not given the desired effect.²⁹⁻³²

Grade A, Level 1+

Leukotrine modifiers are generally safe drugs and are well tolerated.

Rapid-acting inhaled β_2 -agonists

Rapid-acting β_2 -agonists such as salbutamol are the relievers of choice for an acute asthma episode. They work rapidly, and are taken only when required. The frequency of use of rapid-acting inhalers is an indication of the degree of control of asthma. The duration of relief after administration of rapid-acting inhalers is also an indication of the degree of control. These would be indicators for adjustment in dose of the preventer medicines or the need for a short term burst treatment with oral glucocorticosteroids.

Occasionally, inhaled salbutamol may be associated with tremor, palpitations or tachycardia, which is much less than would occur with oral β_2 -agonists.

Anticholinergic drugs

A The combination of inhaled ipratropium and inhaled β_2 -agonist may be used in the treatment of acute severe asthma exacerbation.

Grade A, Level 1+

Drugs such as ipratropium bromide are sometimes used in asthma. Inhaled ipratropium is a less effective reliever than salbutamol. The onset of action is also slower. However, in the treatment of acute severe asthma exacerbations, the combination of inhaled ipratropium and inhaled β_2 -agonist shows a statistically significant and modest improvement in lung function and a significant reduction in the risk of hospital admission.

Systemic glucocorticosteroids

A Short-term “burst” oral corticosteroids may be given at the dose of 40-50 mg/day for 5-10 days as treatment of severe acute exacerbation of asthma and in worsening asthma.

Grade A, Level 1+

Oral glucocorticosteroids are important in the treatment of severe acute exacerbations of asthma and in worsening asthma. They prevent the progression of asthma exacerbation, reduce the need for emergency attendance at the ER, reduce the need for hospitalization and prevent early relapse after acute treatment. Oral glucocorticosteroids take 4-6 hours to work. Short-term “burst” oral corticosteroids do not usually have any significant adverse side effects and the dose need not be tapered down.

A Regular low doses of oral steroids cause severe and intolerable long-term side effects and should not be used in primary care.

Grade A, Level 1+

Treating to achieve control

The patient’s current treatment and level of control determine the selection of pharmacologic treatment. If asthma is not controlled on the current treatment, treatment should be stepped up until control is achieved. Control is usually maintained for at least 3 months before an attempt is made to step down the treatment, with the aim to establish the lowest step and dose of treatment that maintains control.

The latest GINA guidelines⁴ define the control of asthma into 3 categories:

- Controlled,
- Partly Controlled and
- Uncontrolled.

Asthma is *controlled* when there are *no* daytime symptoms, *no* limitation of activities, *no* nocturnal symptoms, *no* need for reliever or rescue treatment, *no* exacerbation and *normal* lung function. Asthma is *partly controlled* when daytime symptoms are more than twice/week, there is any limitation of activities, any nocturnal symptoms, the need for reliever or rescue medication more than twice a week, one or more exacerbations/year and when PEFR or FEV1 <80% predicted or personal best. Asthma is *uncontrolled* if three or more features of partly controlled asthma are present in any week, or if there are exacerbations in any week.

Table 5 Levels of asthma control

Characteristic	Controlled (All of the following)	Partly Controlled (Any measure present in any week)	Uncontrolled
Daytime symptoms	None (twice or less/week)	More than twice/week	Three or more features of partly controlled asthma present
Limitations of activities	None	Any	
Nocturnal symptoms/awakening	None	Any	
Need for reliever/rescue treatment	None (twice or less/week)	More than twice/week	
Lung function (PEFR or FEV1)*	Normal	< 80% predicted or personal best (if known)	
Exacerbations	None	One or more/year [†]	One in any week [‡]

* Lung function is not a reliable test for children 5 years and younger.

† Any exacerbation should prompt review of maintenance treatment to ensure that it is adequate.

‡ By definition, an exacerbation in any week makes that an uncontrolled asthma week.

Asthma Control Test (ACT)

Asthma control is important to assess in clinical practice. Measures of pulmonary function, symptoms, and quality of life often correlate poorly with one another and appear to provide independent information about clinical status.³³⁻³⁶ Assessing any one of these aspects alone does

not accurately gauge asthma control either. Tools that reflect the multi-dimensional nature of asthma control and that are easily and quickly administered and interpreted would be useful in the assessment of asthma control in a busy clinical practice.

A The asthma CPG workgroup recommends the **Asthma Control Test (ACT)**⁵, a 5-item, patient-administered survey questionnaire for assessing asthma control (Figure 1). This is a simple, objective, robust and validated method for monitoring control by doctors (and patients).^{4,5}

Grade A, Level 1+

Figure 1 Asthma Control Test (ACT)

Asthma Control Test (ACT)

1. In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home? score

All of the time **1**
Most of the time **2**
Some of the time **3**
A little of the time **4**
None of the time **5**

2. During the past 4 weeks, how often have you had shortness of breath?

More than once a day **1**
Once a day **2**
3 to 6 times a week **3**
Once or twice week **4**
Not at all **5**

3. During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night, or earlier than usual in the morning?

4 or more nights a week **1**
2 or 3 nights a week **2**
once a week **3**
once or twice **4**
Not at all **5**

4. During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?

3 or more times per day **1**
1 or 2 times per day **2**
2 or 3 times per week **3**
Once a week or less **4**
Not at all **5**

5. How would you rate your asthma control during the past 4 weeks?

Not controlled at all **1**
Poorly controlled **2**
Somewhat controlled **3**
Well controlled **4**
Completely controlled **5**

patient total score

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It is easily completed by patients and clinicians in both the primary care or specialist settings, without the need for lung function testing.

Based on a five-point scoring system, a maximum score of 25 will indicate ‘total control’ of asthma. ‘Well controlled’ asthma is defined as a score of 20-24, and a score of less than 20 will imply ‘poor control’. It is hoped that the test will also enhance doctor-patient dialogue by standardizing the language and expectations of the goals of asthma management, consistent with those of GINA. A practical application and management plan based on ACT assessment is provided below (Figure 2).

Treatment steps for achieving control

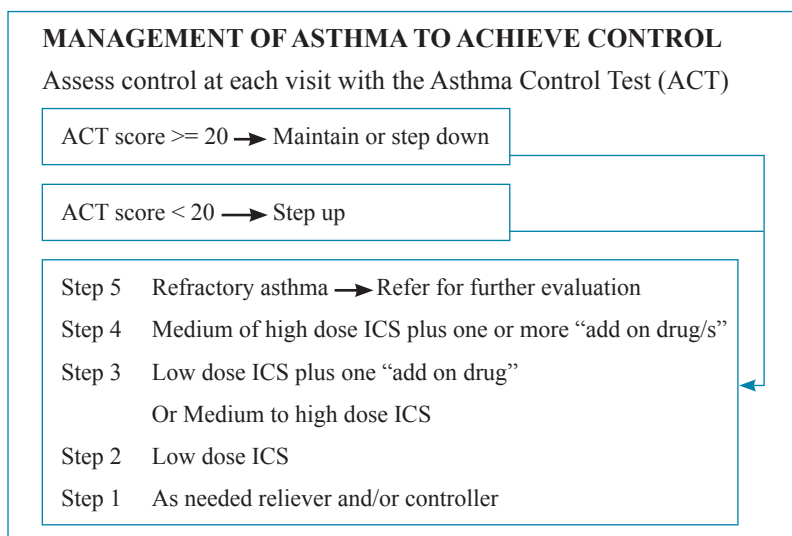
Figure 2 shows the steps 1-5 for achieving control. Each step represents treatment options, which are alternatives for controlling asthma. Steps 1-5 provide steps of increasing efficacy.

In the management scheme described in Figure 2 the dose of daily asthma medication is adjusted according to the ACT scores evaluated at each clinic visit.

GPP Patients who do not achieve good asthma control despite Step 4 levels of treatment have refractory asthma and should be reviewed by a specialist. Thus, management at Step 5 should be supervised directly by specialists.

GPP

Figure 2 Management of asthma to achieve control



4 Management of Acute Exacerbations

4.1 Management of acute exacerbations

Acute exacerbations of asthma are episodes of progressively worsening shortness of breath, cough, wheezing or chest tightness, or a combination of these symptoms. 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 6 on page 33). 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.

4.2 Treatment of acute asthma

GPP Mild attacks (defined as reduction in peak flow of less than 20%, nocturnal awakening and increased use of short acting β_2 -agonist) 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.

GPP

4.3 Treatment of acute asthma at the clinic

Initial assessment of severity is as described in Table 6 (page 33). If the patient has a 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 6 Severity of asthma attacks

Parameter*	Mild	Moderate	Severe	Respiratory Arrest Imminent
Breathless	Walking Can lie down	Talking Prefers sitting	At Rest Hunched forward	
Talks in	Sentences	Phrases	Words	
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Respiratory Rate	Increased	Increased	Often > 30/min	
Accessory Muscles and Suprasternal Retractioned	Usually not	Usually	Usually	Paradoxical Thoraco-abdominal movement
Wheeze	Moderate, often only end respiratory	Loud	Usually loud	Absence of wheeze
Pulse/min	<100	100-120	>120	Bradycardia
PEF after initial Bronchodilator Or % predicted or % personal best	Over 80%	Approximately 60-80%	<60% predicted or personal best (<100L/min adults) or response lasts <2 hours	

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

Patients with high risk of dying from asthma require special attention, monitoring and care, particularly intensive education, including advice to seek medical care early during an exacerbation.

Risk factors for death from asthma³⁷⁻⁴⁰

• Prior intubation and mechanical ventilation for asthma
• Hospitalization or emergency care visit for asthma in the past year
• Current use of systemic corticosteroids or recent withdrawal from systemic corticosteroids
• Not currently using inhaled corticosteroids
• Use of >1 canister of inhaled short-acting β_2 -agonist
• History of psychiatric disease or psychosocial problems
• History of noncompliance with an asthma medication plan

GPP Patients with high risk of dying from asthma require special attention, monitoring and care, particularly intensive education, including advice to seek medical care early during an exacerbation.

GPP

Figure 3 Management of adult acute asthma in the clinic⁴¹⁻⁴⁶

Initial treatment:

B Continuous inhaled short-acting β_2 -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 salbutamol) plus a holding chamber (spacer device) produces equally effective bronchodilation.

Grade B, Level 2++

A Addition of ipratropium 0.5 mg in adults to an aerosolised solution of β_2 -agonist has been shown to cause additional bronchodilation, particularly in those with severe airflow obstruction, and to reduce hospitalisation.

Grade A, Level 1++

A Systemic corticosteroids, e.g. prednisolone 30 mg, 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 1+

Oxygen supplementation could be considered, if available.

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 β_2 -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 patient
Physical examination:
- Symptoms severe, drowsiness, confusion
 - PEF <30%
 - pCO₂ >45 mmHg
 - O₂ saturation <90%

Action: Admit to Intensive Care

5 At the Clinic Visit

5.1 Checklist

The clinic visit can be simplified by a quick assessment of patient's current level of asthma control using the Levels of Asthma Control (Table 5 on page 29) and checklist below. This is followed by the revision of management steps and drug treatment, which can be completed in a few minutes.

GPP We recommend the use of the Levels of Asthma Control table and checklist on all patients at every visit.

Checklist:

- (a) Good Inhaler Technique
- (b) Compliance with preventive treatment
- (c) Compliance with follow-up visits
- (d) Reinforce Written Asthma Action Plan

GPP

GPP Written Asthma Action Plan should be taught so that patients can implement it for self-management of exacerbations between visits (refer to section 5.3 and Annex A). Patients should be advised to perform monthly self-audit of ACT scores between visits.

GPP

The patient's current level of asthma control and current treatment will determine the management approach as to whether treatment regimen should be stepped up or down or to select more effective drugs to achieve better asthma control.

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.

5.2 Device technique

GPP 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.

GPP

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.

5.2.1 Metered dose inhaler

Step	Description	
1	Preparation	Remove the cap and shake the inhaler several times.
2	Exhalation	Breathe out as far as possible.
3	Lip closure	Seal the mouth piece against closed lips.
4	Inhalation	Actuate the device and inhale slowly and deeply.
5	Breath holding	Hold the breath for 4 to 10 seconds after maximal inhalation.

5.2.2 Turbuhaler

Step	Description	
1	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.
2	Exhalation	Hold the turbuhaler away from your mouth. Breathe out as far as possible.
3	Lip closure	Place the mouthpiece between your teeth and close the lips around the mouthpiece.
4	Inhalation	Breathe in forcefully and deeply.
5	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.

5.2.3 Accuhaler

Step	Description	
1	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 thumb grip. 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 slides back a new blister is opened and the counter shows this.
2	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.
3	Termination	To close the accuhaler, put the thumb in the thumb grip and push the notch back towards you as far as it will go.

5.2.4 Spacer

Step	Description	
1	Assemble the spacer	A spacer is a holding chamber which can be attached to the metered dose inhaler (MDI). It makes the MDI easier to use and adds to its effectiveness. Push the notch of one half into the slot of the other half.
2	Attach the MDI	Remove the mouthpiece cover from the MDI. Shake the MDI a few times (holding it upright). Attach the MDI mouthpiece to the back opening of the spacer.
3	Exhalation	Sit upright with back straight. Breathe out as much as possible.
4	Lip closure	Close your lips around the mouthpiece of the spacer. For children below 3 years, a mask attached to the front opening of the spacer helps the child to use the device more effectively.
5	Inhalation	Actuate the device once by pressing down the metal canister firmly and fully with the index finger while inhaling slowly and deeply. Take 5-6 deep breaths slowly. Wait for at least 30 seconds to 1 minute between inhalations. If the person is unable to inhale slowly and deeply, hold the spacer in place until 6 slow normal breaths have been taken (watch or listen for valve movement).
6	Breath holding	Remove the spacer from your mouth. Hold your breath for 10 seconds. Breathe out. You may rinse your mouth.

5.3 Personal Asthma Action Plan

A Asthma patients should be provided with a symptom-based written asthma action plan.

Grade A, Level 1++

Personal asthma action plans enable patients to adjust their treatment according to their level of asthma control based on their symptoms. Patients educated in these self-management plans experienced a one-third to two-thirds decline in hospitalizations, emergency room visits, unscheduled visits to doctors for asthma, missed days of work and nocturnal awakenings.⁴⁷⁻⁵⁵ The effect is greater if healthcare professionals prescribe a written form of the action plan.⁵⁶

Peak expiratory flow rate measurement can be an alternative or adjunctive tool to guide patients in the asthma action plan, especially for those with poor perception of asthma symptoms and for those who possess a peak flow meter to monitor their PEFR regularly.⁵⁷

Different formats of these self-management plans have been used in various countries such as USA, UK and Australia. An example of the contents for a written asthma action plan that is widely used in polyclinics and restructured hospitals in Singapore is shown in the Annex A (page 62) and can be downloaded from the MOH website: www.moh.gov.sg/cpg. This template of the plan based on the “Zone System” can be adapted and adopted for use at your respective clinic or healthcare institution.

B Doctors should ensure regular review of their patients who are unable to undertake guided self-management and adjust their medications according to their asthma control.⁵⁶

Grade B, Level 2++

GPP Patients should be provided with an appointment for review at regular intervals, depending on their asthma control status. During these follow-ups, the following measures may be included in the consultation:

1. Assess asthma control based on symptom frequency (referring to diary/ calendar), impact on activities of daily living and/or PEFR measurements. Healthcare workers can assess asthma control using composite assessment tool, such as validated questionnaires like the Asthma Control Test (ACT).⁵

2. Clarify and discuss patient's questions and asthma related problems, including the initial or previous treatment.⁵⁴
3. Check and correct inhaler device technique, if inappropriate.
4. Check patient's adherence/compliance to the medication plan.
5. Suggest measures to reduce exposure to trigger or risk factors.
6. Assess understanding of written asthma action plan and revise according to asthma control status.⁵¹

GPP

It is important to review, repeat, reinforce or add educational messages to the asthma patients during each consultation.

5.4 Asthma in pregnancy

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

Grade B, Level 2++

Asthma in pregnancy is often under-recognised 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 asthma attacks can result in dangerously low foetal oxygenation. Poor asthma control is associated with pre-eclampsia, as well as greater rates of caesarean section, pre-term delivery, intra-uterine growth retardation and low birth weight. 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.⁵⁸

5.5 Referral to respiratory specialists

GPP Primary care physicians can treat most asthma patients but may consider referring the following subsets of patients to respiratory physicians for further evaluation and/or management: those with other co-morbidity, confusing signs and symptoms and whose control is sub-optimal despite treatment with maximal drug dosages (3Cs).

1. Co-morbidity:
 - a. Patient with concurrent heart failure, which may complicate asthma management.
 - b. Patient with a history of psychiatric disease or multiple psychosocial problems, including the use of sedative.
 - c. Patient with concurrent GERD which may mimic asthma.

2. Confusing sign and symptoms
 - a. Patient with probable occupational asthma will require further diagnostic determination of the industrial trigger agent.
 - b. Patient with atypical signs and symptoms such as unilateral wheezing to exclude other tracheobronchial pathology.

3. Control: Failure to achieve asthma control despite optimal treatment
 - a. Patient who is currently using or have recently stopped using daily oral corticosteroid therapy.
 - b. Patient with a history of near-fatal asthma requiring intubation and mechanical ventilation.
 - c. Patient with severe asthma requiring step 4 care and yet experiencing exacerbation despite compliance to treatment.
 - d. Patient with poorly controlled asthma (irregardless of asthma severity classification) who had at least two hospitalizations for asthma and/or requires more than two courses of burst therapies with oral corticosteroid in the past one year.

GPP

6 Management of Asthma in Children

6.1 Introduction

Management of asthma in children, particularly in children in the first five years of life, is often a challenge. Difficulties with diagnosis, efficacy and safety of drugs and drug delivery are common issues faced by the practitioner.

6.2 Definition of asthma

Definition of asthma is the same in children as in adults (see Page 15).

6.3 Diagnosis of asthma in children

B A detailed medical history and clinical examination is mandatory. Additional tests like Pulmonary Function Tests (PFT), exhaled nitric oxide may be useful to support the diagnosis made or to monitor response to therapy for the more difficult patients.^{59,60}

Grade B, Level 2+

6.3.1 History

Asthma should be considered if any of the following, cough, recurrent wheeze/breathing difficulty or chest tightness, is present. Symptoms often occur or worsen at night. Symptoms can also occur or worsen with exercise, or on exposure to various triggers, e.g. dust mite allergens. Asthma exacerbations in children are often triggered by respiratory viral and mycoplasma infections. However, it should also be noted that wheezing is commonly associated with viral respiratory illnesses especially in young children and this symptom alone without the presence of interval symptoms may not be due to asthma.

The presence of atopy (such as asthma, eczema, allergic rhinitis) or a family history of atopy supports the diagnosis of asthma.

Features highly suggestive of a diagnosis of asthma

- Frequent episodes of wheeze (more than once a month)
- Activity-induced cough or wheeze
- Nocturnal cough in periods without viral infections
- Symptoms that persist after age 3

It is also pertinent to exclude alternative causes of recurrent wheezing/coughing.

Important differential causes of wheezing and coughing

- Recurrent viral infections with wheezing
- Chronic rhino-sinusitis
- Gastroesophageal reflux
- Bronchopulmonary dysplasia/chronic lung disease
- Structural airway abnormalities
- Foreign body aspiration/recurrent silent aspiration
- Immune deficiency
- Congenital heart disease
- Bronchiectasis including: Ciliary Dyskinesia/Cystic fibrosis

6.3.2 Clinical examination

The following features may be helpful:

- features of allergic rhinitis: swollen and pale turbinates
- features of atopy: allergic shiners, eczema
- barrel or hyperinflated chest and adventitious sounds in chest
- presence of stridor - indicative of structural airway abnormality and NOT asthma
- clubbing is not a feature of asthma and may be indicative of chronic lung disease, e.g. bronchiectasis
- heart murmurs – congenital heart disease

6.3.3 Investigations

Investigations are usually not necessary except in severe or atypical cases, as well as in patients who do not respond to therapy as expected. The following may be considered:

- (a) Chest x-ray – Particularly to exclude foreign body or chronic chest infection or to exclude complications in severe acute episodes.
- (b) Pulmonary Function Tests - Peak expiratory flow rate (PEFR) / Spirometry.

The demonstration of diurnal variation of PEFR \geq 15% or bronchodilator response resulting in improvement of FEV1 (Forced expiratory volume in one second) by \geq 12% is indicative of hyper-responsiveness and airflow reversibility.

- (c) Skin Prick Test: demonstration of atopy, in particular for patients with no evidence of eczema or family history of atopy. These tests may be useful in providing advice on environmental control. Note that other allergy tests such as antigen specific IgG, IgG4, intradermal skin tests are not useful. Food allergy testing is also not useful for evaluation of asthma per se.
- (d) Exhaled nitric oxide – non-invasive assessment of airway inflammation that is not specific but useful for monitoring disease and compliance to inhaled corticosteroids.⁵⁹
- (e) Airway Challenge Tests – using exercise or with inhalation of methacholine or histamine. Exercise challenge is also useful for evaluation of exercise-induced asthma.
- (f) Others: to exclude other medical conditions
 - Mantoux test – to exclude Mycobacteria infection
 - Otolaryngologic evaluation of the sinuses and/or CT scan of the sinuses
 - Gastroesophageal reflux studies, e.g. esophageal pH monitoring
 - Bronchoscopy to exclude structural anomalies
 - Immunological investigations, e.g. HIV, Serum Immunoglobulin titres

6.4 Management of asthma

The critical success factor in the management of asthma lies in the accurate initial assessment and continuing monitoring of the disease. Timely and effective education on medication delivery and the need for long term therapy, together with strategies to avoid triggers contribute to the ultimate success and optimal outcome. Written asthma action plans for children based on symptoms or PEFr are effective in achieving good disease control. A holistic approach which encourages living a normal lifestyle will contribute to patient and family satisfaction of the total care.

6.4.1 Assessment of severity of asthma

1. Symptoms:

- (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 frequency of bronchodilator use.
Interval symptoms are important for accurate assessment and are often not given adequate attention.

2. Objective measurements:

- (a) PEFr measurement during each clinic visit
- (b) Spirometry - in children who are able to cooperate with procedure (usually >6 years old), at least once a year

3. Concomitant allergies:

- (a) Allergic rhinitis
- (b) Allergic conjunctivitis
- (c) Atopic Eczema

Treatment and control of concomitant allergic rhinitis is important to achieve overall optimal outcomes in asthma patients.

Classification of asthma severity before treatment provides a useful clue to indicate the level to which to initiate treatment (see Figure 4).

I. Intermittent asthma

These children have do not have interval symptoms and exercise limitation. Spirometry or PEFR is normal. They usually suffer from mild symptoms few times in a year. They do not require long-term preventor therapy.

For children who are observed to have increased symptom frequency or develop severe exacerbations requiring acute medical care, treatment will have to be reviewed with a view for introduction of regular anti-inflammatory therapy.

II. Persistent asthma

The child who has frequent asthma symptoms, such as nocturnal cough, early morning chest tightness, wheezing or poor exercise tolerance occurring more than once a week, or need to use beta agonists more than one 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.

Figure 4 Classification of asthma severity

Classification	Day time symptoms	Night time symptoms	PEFR
Persistent	≥ 1 time a week but < 1 time a day	> 2 times a month	≥ 80% predicted Variability 20-30%
Intermittent	< 1 time a week. Asymptomatic and normal PEFR between attacks	≤ 2 times a month	> 80% predicted Variability < 20%

The following are high-risk patients:

One who:

- a) Has 2 or more exacerbation per month needing acute care
- b) Is hospitalized for asthma on 2 or more occasions in 3 months
- c) Requires rescue medicine on 3 or more occasions per week
- d) Has severe acute exacerbation needing HD/ICU care
- e) Others: poor socioeconomic background, recalcitrant non-compliance

6.4.2 Pharmacotherapy

The general principal is to control both the symptoms (relievers) and underlying chronic airway inflammation (preventors).

The Singapore guideline will adopt the principles of the GINA guidelines published in Nov 2006.⁴

6.4.2.1 Keypoints on therapeutic agents

Relievers – Bronchodilators

Short acting inhaled rapid-acting inhaled β_2 -agonists

A Rapid-acting inhaled β_2 -agonists are the medications of choice for relief of bronchoconstriction and for the pre-treatment of exercise induced asthma.

β_2 -agonist metered-dose-inhaler (MDI) delivered by the holding chamber/spacer has been shown to be at least as effective as the nebuliser. Hence routine use of nebulisers is not recommended. During asthma exacerbations, as many as 4-8 puffs of salbutamol inhaler or 0.2-0.3 puffs/kg (max 10 puffs) may be used.^{61,62}

Grade A, Level 1++

Long acting inhaled β_2 -agonists

Clinical data on its benefits in young children (<5 years) is still limited.

A meta-analysis, of 3 studies on the use of long acting β -agonist in children who were on varied dose or not on inhaled steroid observed an increase risk of exacerbation (OR 1.22 CI 0.92 to 1.62) though the results were not statistically significant.⁶³

A Long acting inhaled β_2 -agonists may be used as add-on therapy for children with symptoms which are not controlled with low dose inhaled steroids. These should not be used without concomitant inhaled corticosteroids.⁶³

Grade A, Level 1+

A Only formoterol may be used as a reliever medicine in view of its rapid onset of action.^{23,64,64a}

Grade A, Level 1+

Oral bronchodilators

A Inhaled bronchodilators are preferred as they have quicker onset of action and fewer side effects than oral or IV administration.⁶⁵

Grade A, Level 2+

Oral therapy is seldom required as most children are able to use inhaler therapy with the appropriate spacer device.

B For the younger children with nocturnal symptoms, oral long acting β_2 -agonists may be useful.⁶⁶ Sustained release theophylline can be useful for a short duration. It is important to monitor for side effects such as agitation, muscle tremors, palpitations and headache.⁶⁷⁻⁷⁰

Grade B, Level 2+

For children who are on chronic theophylline usage, especially when doses exceed 10 mg/kg/day, a plasma theophylline level should be checked.

Increased use, especially daily use, of reliever medication is a warning of deterioration of asthma control and indicates the need to reassess treatment. Concomitant problems such as chronic sinusitis and mycoplasma infection should be considered, as these can result in worsening asthma control.

Inhaled Corticosteroids

Inhaled corticosteroids are the most effective controller medications currently available. The estimated equipotent doses of inhaled steroids for children are listed in Table 7.

Table 7 Estimated equipotent daily doses of inhaled glucocorticosteroids for children

Drug	Low daily dose (mcg)	Medium daily dose (mcg)	High daily dose (mcg)
Beclomethasone dipropionate	100-200	>200-400	>400
Budesonide	100-200	>200-400	>400
Fluticasone	100-200	>200-500	>500

The above comparisons are based upon efficacy data and are obtained from the 2006 revision of the GINA guidelines. Designation of low, medium and high doses is provided from manufacturers' recommendations where possible. Dose-response relationships are seldom available and hence the principle is to establish the minimum effective controlling dose in each patient as higher doses may not be more effective and are likely to be associated with greater potential for adverse effects.

Inhaled corticosteroids and growth in children⁷¹⁻⁷⁵

- Uncontrolled or severe asthma adversely affects growth and final adult height.
- Growth retardation may be seen with all inhaled glucocorticosteroids, especially when high doses are administered.

- Growth retardation in both short- and medium-term studies is dose dependent. No long-term controlled studies have reported any statistically or clinically significant adverse effects on growth of 100 to 200 mcg per day of inhaled glucocorticosteroids. There appears to be some variation in response to different inhaled steroids. A study on 285 children aged 2-3 years showed that children on Fluticasone at dose of 88mcg twice daily showed a mean increase in height which was 1.1 cm less than those on placebo at 24 months, but by the end of the trial, the difference had decreased to 0.7cm.⁷⁴ Similarly, another RCT on inhaled fluticasone in wheezy infants aged 0.5-4.9 years showed a significant reduction in the height Z score 6 months after treatment and at 12 months. However, there was no difference at 5 years.⁷⁵
- Different age groups may differ in their susceptibility to the growth-retarding effects of inhaled glucocorticosteroids; children aged 4 to 10 are more susceptible than adolescents.
- Glucocorticosteroid-induced changes in growth rate during the first year of treatment appear to be temporary.
- Children with asthma treated with inhaled glucocorticocoids ultimately attain normal adult height (predicted from family members) but at a later age.

Inhaled glucocorticosteroids and bone mineral density in children^{76,77}

Controlled longitudinal studies of 2 to 5 years' duration and several cross-sectional studies found no adverse effects of inhaled glucocorticosteroid treatment on bone mineral density.

Leukotriene modifiers

Leukotriene modifiers are a relatively new class of anti-asthma drugs approved for use in children aged 12 months and above. This provides an attractive option for individuals who have great concerns for steroid therapy.

A In older children above 5 years, leukotriene modifiers may be used as they provide clinical benefit at all levels of asthma severity. However, clinical benefits are generally less than those with inhaled corticosteroids.⁷⁸⁻⁸⁰

Grade A, Level 1++

A Leukotriene modifiers may be used to reduce viral induced asthma exacerbation in younger children aged 2-5 years.⁸¹

Grade A, Level 1+

A Leukotriene modifiers may be used as an add-on therapy in children on low to moderate doses of inhaled steroids. In children with poor asthma control, adding a leukotriene modifier may provide additional benefit, including reducing the number of exacerbations.⁸²

Grade A, Level 1+

Combination of long acting β -agonist and inhaled steroids:

A A long acting β -agonist or a leukotriene modifier should be added rather than increasing the dose of inhaled steroids if children with mild persistent asthma do not show clinical improvement with inhaled steroids alone.⁸³⁻⁸⁵

Grade A, Level 1+

Most children with mild persistent asthma do not show further clinical improvement with doses of inhaled steroid (beclomethasone dipropionate/budesonide or equivalent) higher than 400 mcg/day.⁸⁶

A Combination agents containing long acting inhaled β_2 -agonists and inhaled steroids may be used in children above 5 years of age whose control is not optimum with low dose inhaled steroids.^{63,87}

Grade A, Level 1+

The effect of long acting beta agonist has not been well studied in children younger than 5 years old. For the older children, it has a role in children whose control is not optimal with low dose inhaled steroids. The use of combination agent has been shown to improve asthma symptoms and reduce exacerbations.^{63,87}

In the category of combination agents, 2 formulations are available in Singapore and licensed for use in older children. Seretide (salmeterol/fluticasone) is available in MDIs and accuhaler and Symbicort (formoterol/budesonide) is currently only available in turbuhaler formulation. Only Symbicort has been shown to be effective as an acute reliever in view of the rapid onset of action of formoterol.^{64,88}

6.4.2.2 Administration of inhaler medications

Success of therapy is very much dependent on the prudent choice of inhaler device and the prescription of a holding chamber device when necessary.

GPP Recommended in choosing an inhaler device for children:

<4 years	MDI with spacer + a facemask
4-6 years	MDI with spacer with mouthpiece
>6 years	MDI with spacer with mouthpiece
	Dry powder inhaler, e.g. accuhaler and turbuhaler

GPP

It is important to educate the caregiver and the child on the use of the inhaler device and ask them to demonstrate the procedure to affirm that learning has occurred.

Follow up and monitoring

Follow up

GPP Follow-up assessment is best achieved with a review of PEFr and symptom control. 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 may enhance drug delivery and encourage compliance.

GPP

Duration of follow up and anti-inflammatory therapy

GPP Anti-inflammatory therapy ought to be maintained for at least 3 months after adequate control of symptoms. The child should be reviewed regularly thereafter with the view to reducing therapy to the minimum amount to maintain control of asthma. Should symptoms relapse during the tapering of maintenance doses, step-up of dosage may be necessary to achieve good control (after ensuring good compliance and inhaler technique).

GPP

Asthma symptoms are just the tip of the iceberg. Underlying inflammation and bronchial hyperactivity need to be controlled to achieve good and sustained improvement. PEFR/PFT returns to normal fairly quickly within a few weeks but bronchial hyperreactivity takes a longer period. It is critical to highlight this to the parents. Any exacerbation needing acute care should prompt the need to review the therapy. A child who has no acute exacerbation for at least a year is generally accepted as having achieved total control (see Table 5 on page 29).

6.4.3 Long term goals of therapy

- Achieve and maintain control of symptoms
- Maintain normal activity levels, including exercise
- Maintain pulmonary function as close to normal as possible
- Prevent asthma exacerbations
- Avoid adverse effects from asthma medications
- Prevent asthma mortality

The goals of asthma therapy are similar to adult asthma and particularly in children it is critical to avoid long term impact on growth of the child. It is important to engage the caregivers in the vision that good control is expected with treatment and with careful monitoring adverse effects can be avoided. Long term prophylactic therapy is important to control symptoms of asthma and improve quality of life. It, however, has not been shown to improve long term asthma outcome once maintenance therapy is stopped.⁸⁹

6.4.4 Specific notes on the management of asthma in children 0-4 years old

Recurrent wheezing in young children has a heterogenous etiology. Only a proportion of these children go on to have persistent atopic asthma (see clinical features). Children who wheeze only with viral infections (viral-induced wheezers in toddlers and viral bronchiolitis in infants) and do not have interval symptoms may not have asthma. Based on the natural history of wheezing phenotypes⁹⁰, these may be classified as transient

wheezers (these remit after 3 years of age), non-atopic wheezers related to virus infections (these remit in later childhood), and persistent asthma (associated with clinical manifestations of wheeze, specific IgE to common environmental, and a parental history). A subset of these children, however, may have severe wheezing episodes prolonged symptom-free intervals.⁹¹

Even though underdiagnosis and undertreatment of asthma in this age group is common, in view of the variability in wheezing phenotypes, the introduction of long term asthma therapy in these children should be instituted with caution and withdrawn if there is failure to respond (4-6 weeks trial). The clinical benefits of inhaled corticosteroids should be balanced with the possible side effects particularly when used in high doses.

A The initiation of long-term control therapy is recommended for reducing impairment and risk of exacerbations in infants and young children who had four or more episodes of wheezing in the past year that lasted more than 1 day and affected sleep AND who have either:

(1) one of the following: a parental history of asthma, a physician's diagnosis of atopic dermatitis, or evidence of sensitization to aeroallergens;

OR

(2) two of the following: evidence of IgE sensitization to foods, ≥ 4 percent peripheral blood eosinophilia, or wheezing apart from colds.⁹²

Grade A, Level 1+

It should also be appreciated that the treatment of very young children, especially infants who have asthma has not been studied adequately. Most recommendations for treatment are based on limited data and extrapolations from studies in older children and adults.

The administration of an inhaled corticosteroid early in the course of the disease will not alter the underlying progression of the disease.⁹³

A Inhaled corticosteroids should be used to control symptoms, prevent exacerbations, and improve the child's quality of life, but their use should not be initiated or prolonged for the purpose of changing the progression or underlying severity of the disease.

Grade A, Level 1+

6.5 Referral to specialist

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

- (a) has high risk asthma with poor asthma control;
- OR
- (b) is below 3 years and requires moderate to high doses of inhaled steroids and not responding as expected;
- OR
- (c) requires high dose steroids, BDP/BUD ≥ 400 mcg/day or fluticasone ≥ 200 mcg/day, or is on prolonged inhaled steroid therapy for more than 6 months and remains symptomatic.

GPP

6.6 Treatment of acute symptoms

6.6.1 Home management of acute symptoms

This is also a very important step in education of the caregiver. Empowering the caregiver is a very powerful way in building a strong partnership in the care of a child.

GPP When an acute exacerbation is expected, e.g. during an acute upper respiratory infection, the usual medications should be stepped up:

- (a) frequent β_2 -agonist, (e.g. salbutamol MDI 0.2-0.3 puff/kg) preferably via a spacer device, given at 4 hourly intervals
- (b) for selected patients who have severe asthma or with a past history of acute sudden severe attacks, the action plan should include the need to increase the dose of inhaled steroids and rarely to start a course of oral prednisolone.

GPP

6.6.2 **A** It is strongly recommended that clear written asthma action plans be given to the family on how to manage acute exacerbations based on symptoms.⁹⁴

Grade A, Level 1+

6.6.3 At Accident and Emergency Department/ Outpatient Clinic

GPP It is recommended that symptom assessment and objective measurement of severity with PEFR be used in assessment of acute asthma whenever possible.

GPP

Nebuliser therapy is not superior to use of MDI via spacer in acute asthma in children (oxygen can be delivered via spacer).^{61,62}

Nebulised β_2 -agonists should best be given with oxygen, if available, to prevent hypoxia during an acute asthmatic attack.

There is evidence that early aggressive bronchodilator therapy (β_2 -agonist, e.g. salbutamol/terbutaline, plus an anticholinergic, e.g. ipratropium bromide) is beneficial in preventing worsening of acute asthma and improving the outcome.^{95,96}

A An inhaled bronchodilator should be given at 15-20 minute intervals and the child reviewed thereafter.

Grade A, Level 1+

For moderate to severe exacerbations, oral prednisolone of 1 mg/kg for 3-5 days is adequate.

6.6.4 Acute asthma: who needs more intensive monitoring and care

GPP We should consider admission for a child with any of the following:

- (a) Shows no or poor response to a β_2 -agonist.
- (b) Requires an inhaled β_2 -agonist more frequently than 4 hourly.
- (c) Has acute asthma and has a past history of acute life threatening asthma.

GPP

6.6.5 Has chronic severe asthma. Use of oral prednisolone in acute asthma

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

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

- (a) Requires frequent β_2 -agonist therapy (more frequent than 3 hourly).
- (b) Requires regular nebuliser therapy (3-4 hourly) for more than 36-48 hours.
- (c) Has a past history of a severe life threatening episode.
- (d) Is on high dose inhaled steroids or low dose oral steroids.

GPP

D&GPP A dose of prednisolone of 1-2 mg/kg per day (max 40 mg) is usually given for no longer than 5 days.^{4,97} A child who has suffered from a severe acute attack and requires prolonged or repeated oral steroids for control should be referred to a specialist for assessment of treatment.

**Grade D, Level 4
GPP**

6.7 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 following factors would have to be explored:

- (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, gastroesophageal reflux, etc.
- (d) Psychosocial factors.

6.8 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. Children with asthma should be able to live an active lifestyle with no restriction in physical activities. Engaging the caregiver in partnership in the care of a child with asthma, regular follow up and monitoring would ensure an optimal outcome.

7 Cost-effectiveness Issues

Cost is recognised as an important barrier to the delivery of optimal evidence-based health care in almost every country. Between 35% and 50% of medical expenditures for asthma are consequences of exacerbations⁹⁸, an asthma outcome most view as representing treatment failure. Many costly asthma-related hospitalisations and unscheduled visits are preventable, and chronic disease can be shifted to the ambulatory setting.

Hospitalisation, emergency department and unscheduled clinic visits, and the use of rescue medication comprise the majority of exacerbation-related treatment costs. Besides the avoidance of these, from the societal point of view, gains in symptom-free days at reasonable cost may be considered acceptable.

Cost-effectiveness studies are frequently utilised to calculate the incremental cost-effectiveness ratio (ICER) for additional symptom-free days or other outcome parameters of interest. These studies focus on direct medical expenses and occasionally, when recorded in the clinical study, may include indirect expenses from work or school days lost or reductions in health status.

A recent economic analysis was one of the first well-controlled clinical trials to show that inhaled corticosteroids provide clinical benefit at modest costs.¹⁰

The reviewed literature also demonstrates that the combination of an inhaled corticosteroid and an long acting β_2 -agonist are more efficacious from a clinical and cost-effective perspective when compared with the inhaled corticosteroids component alone, a higher dose of inhaled corticosteroids, or an alternative combination of controller medications.⁹⁹ Further considerations for measuring long-term outcomes and dose-response relationships might be required to provide further evidence on the cost-effectiveness of combination therapy with inhaled corticosteroids plus long acting β_2 -agonists.

Cost-effectiveness studies are needed from a country-specific perspective. The economic disparities that may make an ICER acceptable in one country may be considered excessive in another country due to limited resources.

8 Clinical Quality Improvement

The workgroup proposes some possible clinical quality indicators, based on recommendations in this guideline, that healthcare providers may use in monitoring their practice and to better gauge their quality of care.

	Quality Indicator	Recommended Frequency	Remarks
A1	ACT Score	3-4 monthly	–
A2	Self-management education (Written asthma action plan)	3-4 monthly	Provide/Review patient's written asthma action plan & educate on what to do when asthma symptoms develop
A3	Inhaler Technique	6 monthly	Assessment and education on correct inhaler technique
A4	Smoking assessment	6 monthly	Assessment on smoking habits and provide counselling for current smokers to quit

The following are indices of poor clinical outcome that 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

Annex A Template for Written Asthma Action Plan

Symptoms	Medication
<p style="text-align: center; margin: 0;">WHEN WELL</p> <ul style="list-style-type: none"> No asthma symptoms Before exercise 	<p>Regular Controller Treatment EVERYDAY:</p> <ol style="list-style-type: none"> 1. 2. 3. <p>Reliever ____ puffs ONLY when necessary</p>
<p style="text-align: center; margin: 0;">CAUTION</p> <p>If you</p> <ul style="list-style-type: none"> Wake at night due to asthma symptoms Have day time asthma symptoms more than 2 times Used reliever more than 2 times Have limited activity or exercise Have flu like symptoms 	<p style="text-align: center; margin: 0;">STEP UP TREATMENT</p> <ol style="list-style-type: none"> 1. ____ puffs ____ times/day for next 7-14 days. If improved go back to regular treatment. 2. Reliever ____ puffs 4-6 hourly x 3 days. <p style="text-align: center; margin: 5px 0;">If on Symbicort®</p> <p>2-4 puffs at a time Do not exceed 12 puffs/day If improved go back to regular treatment</p>
<p style="text-align: center; margin: 0;">EXTRA CAUTION</p> <p>If NO improvement at anytime with the above treatment then add ...</p>	<p>Prednisolone 30 mg per day x 5-7 days. (for Adults)</p> <p style="text-align: center; margin-top: 10px;"><i>(Children should consult Dr. first)</i></p>
<p style="text-align: center; margin: 0;">DANGER</p> <p style="text-align: center; margin: 5px 0;">GET HELP WHEN</p> <ul style="list-style-type: none"> Severe shortness of breath Reliever medicine is not helping Can only speak in short sentence Feeling frightened 	<p style="text-align: center; margin: 0;">SEE YOUR DOCTOR DO NOT WAIT CALL 995 FOR AN AMBULANCE</p> <p>Reliever ____ puffs at 10 minutes interval till you get to the nearest Dr. or hospital.</p> <p>Prednisolone 30 mg immediately.</p>
<p>Affix Patient Stickers</p>	<p>Reinforced by: Date:</p>

Disclaimer:

All information contained herein is intended for your general information only and is not a substitute for medical advice for treatment of asthma. If you have specific questions, consult your doctor.

Annex B Asthma Resources on the Internet

Some asthma resources available (as at Jan 2008) 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.thoracic.org>

American Thoracic Society

<http://familydoctor.org>

American Academy of Family Physicians

<http://www.aaaai.org>

American Academy of Allergy, Asthma and Immunology

<http://www.worldallergy.org/>

World Allergy Organization

<http://www.aap.org>

American Academy of Paediatrics

<http://www.asthma.org.uk/>

National Asthma Campaign in the United Kingdom

http://www.qualitymetric.com/products/asthma_act.aspx

Asthma Control Test

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Self-assessment (MCQs)

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 “True” or “False.”

	True	False
1. An ACT score of 17 indicates:		
A) Good asthma control	<input type="checkbox"/>	<input type="checkbox"/>
B) A diagnosis of COPD	<input type="checkbox"/>	<input type="checkbox"/>
C) A need to step down treatment	<input type="checkbox"/>	<input type="checkbox"/>
D) A need to step up treatment	<input type="checkbox"/>	<input type="checkbox"/>
2. Regarding the use of long acting β_2 -agonists for adult asthma:		
A) It can be used as monotherapy	<input type="checkbox"/>	<input type="checkbox"/>
B) It is useful only in older patients	<input type="checkbox"/>	<input type="checkbox"/>
C) It should be added in patients whose asthma is not controlled with 400-800 mcg/d of inhaled steroids	<input type="checkbox"/>	<input type="checkbox"/>
D) It is a useful first-line medication for asthma	<input type="checkbox"/>	<input type="checkbox"/>
3. The following are risk factors for asthma death:		
A) Prior intubation for asthma	<input type="checkbox"/>	<input type="checkbox"/>
B) Allergy to cats	<input type="checkbox"/>	<input type="checkbox"/>
C) Sudden cessation of corticosteroid medication	<input type="checkbox"/>	<input type="checkbox"/>
D) Hospitalization for asthma in the past year	<input type="checkbox"/>	<input type="checkbox"/>
4. Common barriers to effective asthma therapy are:		
A) Poor inhalational technique	<input type="checkbox"/>	<input type="checkbox"/>
B) Steroid phobia	<input type="checkbox"/>	<input type="checkbox"/>
C) Good compliance to treatment	<input type="checkbox"/>	<input type="checkbox"/>
D) Inconvenient dosing schedules	<input type="checkbox"/>	<input type="checkbox"/>

	True	False
5. The following are key symptoms/signs for considering a diagnosis of asthma:		
A) Chronic cough	<input type="checkbox"/>	<input type="checkbox"/>
B) Shortness of breath	<input type="checkbox"/>	<input type="checkbox"/>
C) Purulent sputum production	<input type="checkbox"/>	<input type="checkbox"/>
D) Chest tightness	<input type="checkbox"/>	<input type="checkbox"/>
6. In the management of asthma:		
A) Oral leukotriene antagonists are more effective than inhaled corticosteroids	<input type="checkbox"/>	<input type="checkbox"/>
B) Inhaled β_2 -agonists should be given on a regular basis for patients with partially controlled asthma	<input type="checkbox"/>	<input type="checkbox"/>
C) Inhaled corticosteroids are best used at low to moderate dosages	<input type="checkbox"/>	<input type="checkbox"/>
D) Oral leukotriene antagonists are effective for acute asthma	<input type="checkbox"/>	<input type="checkbox"/>
7. In treating to achieve control:		
A) A course of oral steroids is indicated for partially controlled asthma	<input type="checkbox"/>	<input type="checkbox"/>
B) Asthma control is defined into two categories: controlled and uncontrolled	<input type="checkbox"/>	<input type="checkbox"/>
C) The patient's current treatment and level of control determine the selection of pharmacologic treatment	<input type="checkbox"/>	<input type="checkbox"/>
D) Patients should be assured that their asthma can be cured	<input type="checkbox"/>	<input type="checkbox"/>
8. In the management of asthma during pregnancy:		
A) Patients tend to be under-treated	<input type="checkbox"/>	<input type="checkbox"/>
B) Oral steroids are contraindicated	<input type="checkbox"/>	<input type="checkbox"/>
C) A LABA should be added routinely	<input type="checkbox"/>	<input type="checkbox"/>
D) Inhaled β_2 -agonists usage will delay labour	<input type="checkbox"/>	<input type="checkbox"/>

	True	False
9. Patient education is vital to asthma management and should:		
A) Teach modification of diet	<input type="checkbox"/>	<input type="checkbox"/>
B) Incorporate instructions in home use of a peak flow meter for all patients	<input type="checkbox"/>	<input type="checkbox"/>
C) Teach theory rather than practical self-management skills	<input type="checkbox"/>	<input type="checkbox"/>
D) Be provided with a written asthma action plan	<input type="checkbox"/>	<input type="checkbox"/>
10. Asthma control for patients:		
A) Requires use of lung function testing in all cases	<input type="checkbox"/>	<input type="checkbox"/>
B) Can be achieved in the majority of patients	<input type="checkbox"/>	<input type="checkbox"/>
C) May be assessed by the Asthma Control Test	<input type="checkbox"/>	<input type="checkbox"/>
D) Can only be assessed at the time of diagnosis	<input type="checkbox"/>	<input type="checkbox"/>

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Answer

1 A) F
1 B) F
1 C) F
1 D) T

page 31

2 A) F
2 B) F
2 C) T
2 D) F

page 26

3 A) T
3 B) F
3 C) T
3 D) T

page 35

4 A) T
4 B) T
4 C) F
4 D) T

page 19

5 A) T
5 B) T
5 C) F
5 D) T

page 15

6 A) F
6 B) F
6 C) T
6 D) F

page 24, 27

7 A) F
7 B) F
7 C) T
7 D) F

page 17, 28

8 A) T
8 B) F
8 C) F
8 D) F

page 41

9 A) F
9 B) F
9 C) F
9 D) T

page 18, 32

10 A) F
10 B) T
10 C) T
10 D) F

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