
POCKET GUIDE FOR ASTHMA MANAGEMENT AND PREVENTION IN CHILDREN



A Pocket Guide for Physicians and Nurses
Revised 2006

**BASED ON THE GLOBAL STRATEGY FOR ASTHMA
MANAGEMENT AND PREVENTION**



**GLOBAL INITIATIVE
FOR ASTHMA**

GLOBAL INITIATIVE FOR ASTHMA

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PREFACE

Asthma is a major cause of chronic morbidity and mortality throughout the world and there is evidence that its prevalence has increased considerably over the past 20 years, especially in children. The **Global Initiative for Asthma** was created to increase awareness of asthma among health professionals, public health authorities, and the general public, and to improve prevention and management through a concerted worldwide effort. The Initiative prepares scientific reports on asthma, encourages dissemination and implementation of the recommendations, and promotes international collaboration on asthma research.

The **Global Initiative for Asthma** offers a framework to achieve and maintain asthma control for most patients that can be adapted to local health care systems and resources. Educational tools, such as laminated cards, or computer-based learning programs can be prepared that are tailored to these systems and resources.

The **Global Initiative for Asthma** program publications include:

- *Global Strategy for Asthma Management and Prevention* (2006). Scientific information and recommendations for asthma programs.
- *Pocket Guide for Asthma Management and Prevention* (2006). Summary of patient care information for primary health care professionals.
- *Pocket Guide for Asthma Management and Prevention in Children* (2006). Summary of patient care information for pediatricians and other health care professionals.
- *What You and Your Family Can Do About Asthma*. An information booklet for patients and their families.

Publications are available from <http://www.ginasthma.org>.

This Pocket Guide has been developed from the *Global Strategy for Asthma Management and Prevention* (2006). Technical discussions of asthma, evidence levels, and specific citations from the scientific literature are included in the source document.

Acknowledgements:

Grateful acknowledgement is given for unrestricted educational grants from Altana, AstraZeneca, Boehringer Ingelheim, Chiesi Group, GlaxoSmithKline, Meda Pharma, Merck, Sharp & Dohme, Mitsubishi Pharma, Novartis, and PharmAxis. The generous contributions of these companies assured that the GINA Committees could meet together and publications could be printed for wide distribution. However, the GINA Committee participants are solely responsible for the statements and conclusions in the publications.

WHAT IS KNOWN ABOUT ASTHMA?

Unfortunately... asthma is one of the most common chronic diseases worldwide. The prevalence of asthma symptoms in children varies from 1 to more than 30 percent in different populations and is increasing in most countries, especially among young children.

Fortunately... asthma can be effectively treated and most patients can achieve good control of their disease. When asthma is under **control** children can:

- ✓ Avoid troublesome symptoms night and day
 - ✓ Use little or no reliever medication
 - ✓ Have productive, physically active lives
 - ✓ Have (near) normal lung function
 - ✓ Avoid serious attacks
- Asthma causes recurring episodes of **wheezing, breathlessness, chest tightness, and coughing**, particularly at night or in the early morning.
 - Asthma is a **chronic inflammatory disorder** of the airways. Chronically inflamed airways are **hyperresponsive**; they become obstructed and airflow is limited (by bronchoconstriction, mucus plugs, and increased inflammation) when airways are exposed to various risk factors.
 - Common **risk factors** for asthma symptoms include exposure to allergens (such as those from house dust mites, animals with fur, cockroaches, pollens, and molds), occupational irritants, tobacco smoke, respiratory (viral) infections, exercise, strong emotional expressions, chemical irritants, and drugs (such as aspirin and beta blockers).
 - A **stepwise approach** to pharmacologic treatment to achieve and maintain control of asthma should take into account the safety of treatment, potential for adverse effects, and the cost of treatment required to achieve control.

-
- Asthma **attacks** (or exacerbations) are episodic, but airway inflammation is chronically present.
 - For many patients, **controller** medication must be taken daily to prevent symptoms, improve lung function, and prevent attacks. **Reliever** medications may occasionally be required to treat acute symptoms such as wheezing, chest tightness, and cough.
 - To reach and maintain asthma control requires the development of a **partnership** between the person with asthma and his or her health care team.
 - Asthma is not a cause for shame. Olympic athletes, famous leaders, other celebrities, and ordinary people live **successful lives** with asthma.

DIAGNOSING ASTHMA

Asthma can often be diagnosed on the basis of a patient's **symptoms** and **medical history** (Figure 1).

Figure 1. Is It Asthma?

Consider asthma if any of the following signs or symptoms are present:

- Frequent episodes of wheezing—more than once a month
- Activity-induced cough or wheeze
- Cough particularly at night during periods without viral infections
- Absence of seasonal variation in wheeze
- Symptoms that persist after age 3
- Symptoms occur or worsen in the presence of:
 - Animals with fur
 - Aerosol chemicals
 - Changes in temperature
 - Domestic dust mites
 - Drugs (aspirin, beta blockers)
 - Exercise
 - Pollen
 - Respiratory (viral) infections
 - Smoke
 - Strong emotional expression
- The child's colds repeatedly "go to the chest" or take more than 10 days to clear up
- Symptoms improve when asthma medication is given

Measurements of **lung function** provide an assessment of the severity, reversibility, and variability of airflow limitation, and help confirm the diagnosis of asthma in patients older than 5 years.

Spirometry is the preferred method of measuring airflow limitation and its reversibility to establish a diagnosis of asthma.

- An increase in FEV₁ of $\geq 12\%$ (or ≥ 200 ml) after administration of a bronchodilator indicates reversible airflow limitation consistent with asthma. (However, most asthma patients will not exhibit reversibility at each assessment, and repeated testing is advised.)

Peak expiratory flow (PEF) measurements can be an important aid in both diagnosis and monitoring of asthma.

- PEF measurements are ideally compared to the patient's own previous best measurements using his/her own peak flow meter.
- An improvement of 60 L/min (or $\geq 20\%$ of the pre-bronchodilator PEF) after inhalation of a bronchodilator, or diurnal variation in PEF of more than 20% (with twice-daily readings, more than 10%), suggests a diagnosis of asthma.

Do all children who wheeze have asthma?

No. Most children who develop wheezing after age 5 have asthma. However, diagnosis of asthma in children 5 years and younger presents a particularly difficult problem. Episodic wheezing and cough are also common in children who do not have asthma, particularly in children younger than age 3. **The younger the child, the greater the likelihood that an alternative diagnosis may explain recurrent wheeze.**

Although there is the possibility of overtreatment, episodes of wheezing may be shortened and reduced in intensity by effective use of anti-inflammatory medications and bronchodilators rather than antibiotics.

Alternative but very rare causes of recurrent wheezing, particularly in early infancy, include chronic rhino-sinusitis, cystic fibrosis, gastroesophageal reflux, recurrent viral lower respiratory tract infections, bronchopulmonary dysplasia, tuberculosis, congenital malformation causing narrowing of the intrathoracic airways, foreign body aspiration, primary ciliary dyskinesia syndrome, immune deficiency, and congenital heart disease.

In children 5 years and younger, the diagnosis of asthma has to be based largely on clinical judgment and an assessment of symptoms and physical findings. A useful method for confirming the diagnosis in this age group is a trial of treatment with short-acting bronchodilators and inhaled glucocorticosteroids. Marked clinical improvement during the treatment and deterioration when treatment is stopped supports a diagnosis of asthma. Children 4 to 5 years old can be taught to use a PEF meter, but to ensure accurate results parental supervision is required.

Other diagnostic considerations in children include:

- Diary cards to record symptoms and PEF (in children older than 5 years) readings are important tools in childhood asthma management.
- Allergy skin tests, or the measurement of specific IgE in serum, can help in the identification of risk factors so that appropriate environmental control measures can be recommended.

CLASSIFICATION OF ASTHMA BY LEVEL OF CONTROL

Traditionally, the degree of symptoms, airflow limitation, and lung function variability have allowed asthma to be classified by **severity** (e.g., as Intermittent, Mild Persistent, Moderate Persistent, or Severe Persistent).

However, it is important to recognize that asthma severity involves both the severity of the underlying disease and its responsiveness to treatment. In addition, severity is not an unvarying feature of an individual patient's asthma, but may change over months or years.

Therefore, for ongoing management of asthma, **classification of asthma by level of control** is more relevant and useful (**Figure 2**).

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 in any week
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 (PEF or FEV ₁) [†]	Normal	< 80% predicted or personal best (if known)	
Exacerbations	None	One or more/year*	One in any week [‡]

* 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.

[‡] Lung function testing is not reliable for children 5 years and younger.

Examples of validated measures for assessing clinical control of asthma include:

- Asthma Control Test (ACT): <http://www.asthmacontrol.com>
- Asthma Control Questionnaire (ACQ):
<http://www.qoltech.co.uk/Asthma1.htm>
- Asthma Therapy Assessment Questionnaire (ATAQ):
<http://www.ataqinstrument.com>
- Asthma Control Scoring System

FOUR COMPONENTS OF ASTHMA CARE

The **goal of asthma care is to achieve and maintain control** of the clinical manifestations of the disease for prolonged periods. When asthma is controlled, patients can prevent most attacks, avoid troublesome symptoms day and night, and keep physically active.

To reach this goal, four interrelated components of therapy are required:

Component 1. Develop patient/family/doctor partnership

Component 2. Identify and reduce exposure to risk factors

Component 3. Assess, treat, and monitor asthma

Component 4. Manage asthma exacerbations

Component 1: Develop Patient/Family/Doctor Partnership

With the help of everyone on the health care team, children and their families can be actively involved in managing asthma to prevent problems and enable children to live productive, physically active lives. They can learn to:

- Avoid risk factors
- Take medications correctly
- Understand the difference between “controller” and “reliever” medications
- Monitor asthma control status using symptoms and, if available, PEF in children older than 5 years of age
- Recognize signs that asthma is worsening and take action
- Seek medical help as appropriate

Education should be an integral part of all interactions between health care professionals and patients. Using a variety of methods—such as discussions (with a physician, nurse, outreach worker, counselor, or educator), demonstrations, written materials, group classes, video or audio tapes, dramas, and patient support groups—helps reinforce educational messages.

Working together, you and the child and their family/caregiver should prepare a **written personal asthma action plan** that is medically appropriate and practical. A sample asthma plan is shown in **Figure 3**.

Additional self-management plans can be found on several Websites, including:

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

<http://www.nhlbisupport.com/asthma/index.html>

<http://www.asthmanz.co.nz>

Figure 3. Example of Contents of an Action Plan to Maintain Asthma Control

Your Regular Treatment:

1. Each day take _____
2. Before exercise, take _____

WHEN TO INCREASE TREATMENT

Assess your level of Asthma Control

In the past week have you had:

Daytime asthma symptoms more than 2 times ?	No	Yes
Activity or exercise limited by asthma?	No	Yes
Waking at night because of asthma?	No	Yes
The need to use your [rescue medication] more than 2 times?	No	Yes
If you are monitoring peak flow, peak flow less than _____?	No	Yes

If you answered YES to three or more of these questions, your asthma is uncontrolled and you may need to step up your treatment.

HOW TO INCREASE TREATMENT

STEP UP your treatment as follows and assess improvement every day:

_____ [Write in next treatment step here]

Maintain this treatment for _____ days [specify number]

WHEN TO CALL THE DOCTOR/CLINIC.

Call your doctor/clinic: _____ [provide phone numbers]

If you don't respond in _____ days [specify number]

_____ [optional lines for additional instruction]

EMERGENCY/SEVERE LOSS OF CONTROL

- ✓ If you have severe shortness of breath, and can only speak in short sentences,
- ✓ If you are having a severe attack of asthma and are frightened,
- ✓ If you need your reliever medication more than every 4 hours and are not improving.

1. Take 2 to 4 puffs _____ [reliever medication]
2. Take _____mg of _____ [oral glucocorticosteroid]
3. Seek medical help: Go to _____; Address _____
Phone: _____
4. Continue to use your _____ [reliever medication] until you are able to get medical help.

Component 2: Identify and Reduce Exposure to Risk Factors

To improve control of asthma and reduce medication needs, patients should take steps to avoid the risk factors that cause their asthma symptoms (**Figure 4**). However, many asthma patients react to multiple factors that are ubiquitous in the environment, and avoiding some of these factors completely is nearly impossible. Thus, medications to maintain asthma control have an important role because patients are often less sensitive to these risk factors when their asthma is under control.

Physical activity is a common cause of asthma symptoms but patients **should not avoid exercise**. Symptoms can be prevented by taking a rapid-acting inhaled β_2 -agonist before strenuous exercise (a leukotriene modifier or cromone are alternatives).

Children over the age of 3 with severe asthma should be advised to receive an **influenza vaccination** every year, or at least when vaccination of the general population is advised. However, routine influenza vaccination of children with asthma does not appear to protect them from asthma exacerbations or improve asthma control.

Figure 4. Strategies for Avoiding Common Allergens and Pollutants

Avoidance measures that improve control of asthma and reduce medication needs:

- **Tobacco smoke:** Stay away from tobacco smoke. Patients and parents should not smoke.
- **Drugs, foods, and additives:** Avoid if they are known to cause symptoms.

Reasonable avoidance measures that can be recommended but have not been shown to have clinical benefit:

- **House dust mites:** Wash bed linens and blankets weekly in hot water and dry in a hot dryer or the sun. Encase pillows and mattresses in air-tight covers. Replace carpets with hard flooring, especially in sleeping rooms. (If possible, use vacuum cleaner with filters. Use acaricides or tannic acid to kill mites—but make sure the patient is not at home when the treatment occurs.)
- **Animals with fur:** Use air filters. (Remove animals from the home, or at least from the sleeping area. Wash the pet.)
- **Cockroaches:** Clean the home thoroughly and often. Use pesticide spray—but make sure the patient is not at home when spraying occurs.
- **Outdoor pollens and mold:** Close windows and doors and remain indoors when pollen and mold counts are highest.
- **Indoor mold:** Reduce dampness in the home; clean any damp areas frequently.

Component 3: Assess, Treat, and Monitor Asthma

The goal of asthma treatment—to achieve and maintain clinical control—can be reached in most patients through a continuous cycle that involves

- Assessing Asthma Control
- Treating to Achieve Control
- Monitoring to Maintain Control

Assessing Asthma Control

Each patient should be assessed to establish his or her current treatment regimen, adherence to the current regimen, and level of asthma control. A simplified scheme for recognizing controlled, partly controlled, and uncontrolled asthma is provided in **Figure 2**.

Treating to Achieve Control

For children over age 5, each patient is assigned to one of the treatment “steps” (**Figure 5**).

At each treatment step, **reliever medication** should be provided for quick relief of symptoms as needed. (However, be aware of how much reliever medication the patient is using—regular or increased use indicates that asthma is not well controlled.)

At Steps 2 through 5, patients also require one or more regular **controller medications**, which keep symptoms and attacks from starting. Inhaled glucocorticosteroids (**Figure 6**) are the most effective controller medications currently available.

For most patients newly diagnosed with asthma or not yet on medication, treatment should be started at Step 2 (or if the patient is very symptomatic, at Step 3). If asthma is not controlled on the current treatment regimen, treatment should be stepped up until control is achieved.

For **children age 5 and younger**, a low-dose inhaled glucocorticosteroid is the recommended initial controller treatment (**Figure 5A**). If this treatment does not control symptoms, an increase in the glucocorticosteroid dose is the best option.

A variety of controller (**Appendix A**) and reliever (**Appendix B**) medications for asthma are available. The recommended treatments are guidelines only. Local resources and individual patient circumstances should determine the specific therapy prescribed for each patient.

Inhaled medications are preferred because they deliver drugs directly to the airways where they are needed, resulting in potent therapeutic effects with fewer systemic side effects.

- Devices available to deliver inhaled medication include pressurized metered-dose inhalers (pMDIs), breath-actuated MDIs, dry powder inhalers (DPIs), and nebulizers. Spacer (or valved holding-chamber) devices make inhalers easier to use and reduce systemic absorption and side effects of inhaled glucocorticosteroids.
- Teach children and their parents how to use inhaler devices. Different devices need different inhalation techniques.
 - Give demonstrations and illustrated instructions.
 - Ask patients to show their technique at every visit.
 - Information about use of various inhaler devices is found on the GINA Website.
- For each child, select the most appropriate device. In general:
 - Children younger than 4 years of age should use a pMDI plus a spacer with face mask, or a nebulizer with face mask.
 - Children aged 4 to 6 years should use a pMDI plus a spacer with mouthpiece, a DPI, or, if necessary, a nebulizer with face mask.
 - For children using spacers, the spacer must fit the inhaler.
 - Children of any age over 6 years who have difficulty using pMDIs should use a pMDI with a spacer, a breath-actuated inhaler, a DPI, or a nebulizer. DPIs require an inspiratory effort that may be difficult to achieve during severe attacks.
 - Children who are having severe attacks should use a pMDI with a spacer or a nebulizer.
 - Particularly among children under age 5, inhaler techniques may be poor and should be monitored closely.

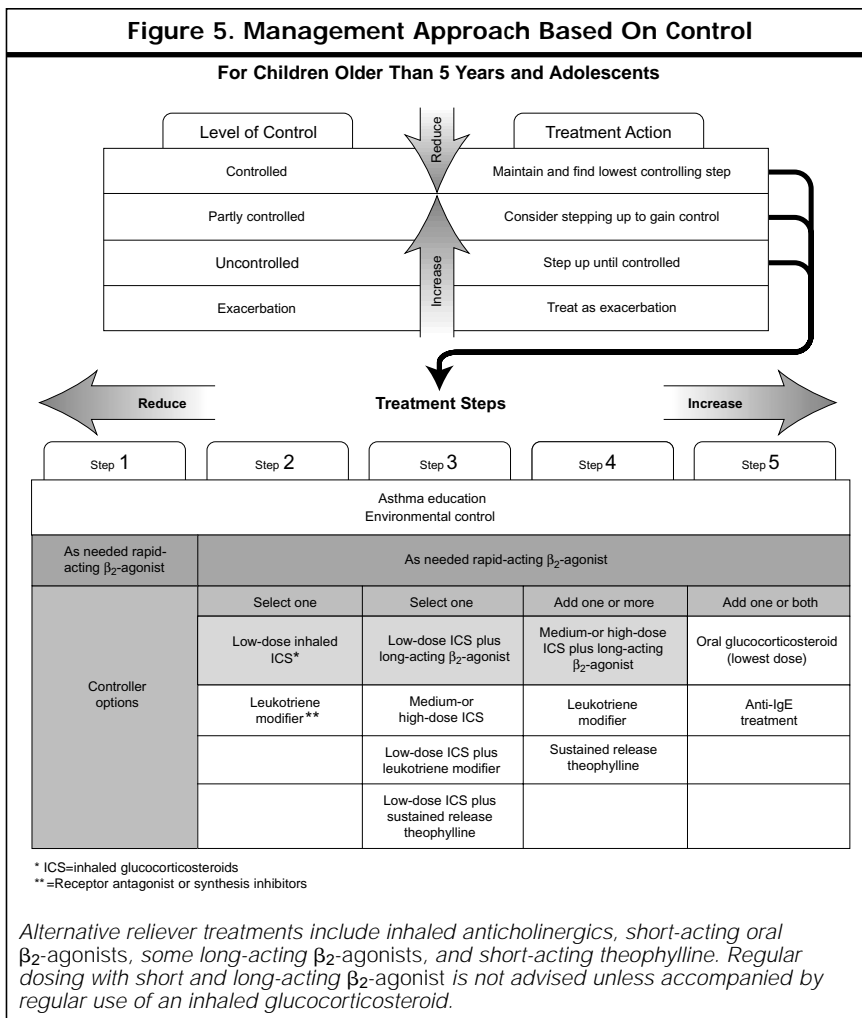


Figure 5A. Management Approach Based On Control: Children 5 Years and Younger

The available literature on treatment of asthma in children 5 years and younger precludes detailed treatment recommendations. The best documented treatment to control asthma in these age groups is inhaled glucocorticosteroids and at Step 2, a low-dose inhaled glucocorticosteroid is recommended as the initial controller treatment. Equivalent doses of inhaled glucocorticosteroids, some of which may be given as a single daily dose, are provided in **Figure 6**.

Figure 6. Estimated Equipotent Doses[†] of Inhaled Glucocorticosteroids for Children

Drug	Low Daily dose (µg)	Medium Daily dose (µg)	High Daily dose (µg) [‡]
Beclomethasone dipropionate	100-200	>200-400	>400
Budesonide*	100-200	>200-400	>400
Budesonide-Neb Inhalation suspension	250-500	>500-1000	>1000
Ciclesonide*	80-160	>160-320	>320
Flunisolide	500-750	>750-1250	>1250
Fluticasone	100-200	>200-500	>500
Mometasone furoate*	100-200	>200-400	>400
Triamcinolone acetonide	400-800	>800-1200	>1200

[†] Comparisons based on 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.

Additional 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 CFC preparations are taken from the market, medication inserts for HFA preparations should be carefully reviewed by the clinician for the correct equivalent dosage.

Monitoring to Maintain Control

Ongoing monitoring is essential to maintain control and establish the lowest step and dose of treatment to minimize cost and maximize safety.

Typically, patients should be seen one to three months after the initial visit, and every three months thereafter. After an exacerbation, follow-up should be offered within two weeks to one month.

At each visit, ask the questions listed in **Figure 7**.

Adjusting medication:

- If asthma is **not controlled** on the current treatment regimen, **step up** treatment. Generally, improvement should be seen within 1 month. But first review the patient's medication technique, compliance, and avoidance of risk factors.
- If asthma is **partly controlled**, **consider stepping up** treatment, depending on whether more effective options are available, safety and cost of possible treatment options, and the patient's satisfaction with the level of control achieved.
- If **control is maintained** for at least 3 months, **step down** with a gradual, stepwise reduction in treatment. The goal is to decrease treatment to the least medication necessary to maintain control.

Monitoring is still necessary even after control is achieved, as asthma is a variable disease; treatment has to be adjusted periodically in response to loss of control as indicated by worsening symptoms or the development of an exacerbation.

Consult with an asthma specialist when other conditions complicate asthma, if the child does not respond to therapy, or if asthma remains uncontrolled with treatment at step 3.

Figure 7. Questions for Monitoring Asthma Care**IS THE ASTHMA MANAGEMENT PLAN MEETING EXPECTED GOALS?****Ask the patient:**

Has your asthma awakened you at night?

Have you needed more reliever medications than usual?

Have you needed any urgent medical care?

Has your peak flow been below your personal best?

Are you participating in your usual physical activities?

Action to consider:

Adjust medications and management plan as needed (step up or step down). But first, compliance should be assessed.

IS THE PATIENT USING INHALERS, SPACER, OR PEAK FLOW METERS CORRECTLY?**Ask the patient:**

Please show me how you take your medicine.

Action to consider:

Demonstrate correct technique. Have patient demonstrate back.

IS THE PATIENT TAKING THE MEDICATIONS AND AVOIDING RISK FACTORS ACCORDING TO THE ASTHMA MANAGEMENT PLAN?**Ask the patient, for example:**

So that we may plan therapy, please tell me how often you actually take the medicine.

What problems have you had following the management plan or taking your medication?

During the last month, have you ever stopped taking your medicine because you were feeling better?

Action to consider:

Adjust plan to be more practical. Problem solve with the patient to overcome barriers to following the plan.

DOES THE PATIENT HAVE ANY CONCERNS?**Ask the patient:**

What concerns might you have about your asthma, medicines, or management plan?

Action to consider:

Provide additional education to relieve concerns and discussion to overcome barriers.

Component 4: Manage Exacerbations

Exacerbations of asthma (asthma attacks) are episodes of a progressive increase in shortness of breath, cough, wheezing, or chest tightness, or a combination of these symptoms.

- **Do not underestimate the severity of an attack;** severe asthma attacks may be life threatening.
- Children/adolescents at high risk for asthma-related death require closer attention and should be encouraged to seek urgent care early in the course of their exacerbations. These patients include those:
 - With a history of near-fatal asthma
 - Who have had a hospitalization or emergency visit for asthma within the past year, or prior intubation for asthma
 - Who are currently using or have recently stopped using oral glucocorticosteroids
 - Who are overdependent on on rapid-acting inhaled β_2 -agonists
 - With a history of psychosocial problems or denial of asthma or its severity
 - With a history of noncompliance with asthma medication plan

Patients should immediately seek medical care if...

- **The attack is severe (Figure 8):**
 - The patient is breathless at rest, is hunched forward, talks in words rather than sentences (infant stops feeding), agitated, drowsy or confused, has bradycardia, or a respiratory rate greater than 30 per minute
 - Wheeze is loud or absent
 - Pulse is greater than:
 - 160/min for infants
 - 120/min for children 1-2 years
 - 110/min for children 2-8 years
 - PEF is less than 60 percent of predicted or personal best even after initial treatment
 - The child is exhausted
- **The response to the initial bronchodilator treatment is not prompt** and sustained for at least 3 hours
- **There is no improvement within 2 to 6 hours** after oral glucocorticosteroid treatment is started
- **There is further deterioration**

Mild attacks, defined by a reduction in peak flow of less than 20%, nocturnal awakening, and increased use of rapid-acting β_2 -agonists, can usually be treated at home if the patient is prepared and has a personal asthma management plan that includes action steps.

Moderate attacks may require, and severe attacks usually require, care in a clinic or hospital.

Asthma attacks require prompt treatment:

- Oxygen is given at health centers or hospitals if the patient is hypoxemic (achieve O_2 saturation of 95%).
- Inhaled rapid-acting β_2 -agonists in adequate doses are essential. (Begin with 2 to 4 puffs every 20 minutes for the first hour; then mild exacerbations will require 2 to 4 puffs every 3 to 4 hours, and moderate exacerbations 6 to 10 puffs every 1 to 2 hours)
- Oral glucocorticosteroids (0.5 to 1 mg of prednisolone/kg or equivalent during a 24-hour period) introduced early in the course of a moderate or severe attack help to reverse the inflammation and speed recovery.
- Methylxanthines are not recommended if used in addition to high doses of inhaled β_2 -agonists. However, theophylline can be used if inhaled β_2 -agonists are not available. If the patient is already taking theophylline on a daily basis, serum concentration should be measured before adding short-acting theophylline.

Therapies **not recommended** for treating attacks include:

- Sedatives (strictly avoid).
- Mucolytic drugs (may worsen cough).
- Chest physical therapy/physiotherapy (may increase patient discomfort).
- Hydration with large volumes of fluid for adults and older children (may be necessary for younger children and infants).
- Antibiotics (do not treat attacks but are indicated for patients who also have pneumonia or bacterial infection such as sinusitis).
- Epinephrine (adrenaline) may be indicated for acute treatment of anaphylaxis and angioedema but is not indicated during asthma attacks.
- Intravenous magnesium sulphate has not been studied in young children.

Figure 8. Severity of Asthma Exacerbations*

Parameter	Mild	Moderate	Severe	Respiratory arrest imminent										
Breathless	Walking Can lie down	Talking Infant - softer, shorter cry; difficulty feeding Prefer sitting	At rest Infant stops feeding 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											
Normal rates of breathing in awake children: <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Age</td> <td style="text-align: center;">Normal rate</td> </tr> <tr> <td style="text-align: center;">< 2 months</td> <td style="text-align: center;">< 60/min</td> </tr> <tr> <td style="text-align: center;">2-12 months</td> <td style="text-align: center;">< 50/min</td> </tr> <tr> <td style="text-align: center;">1-5 years</td> <td style="text-align: center;">< 40/min</td> </tr> <tr> <td style="text-align: center;">6-8 years</td> <td style="text-align: center;">< 30/min</td> </tr> </table>					Age	Normal rate	< 2 months	< 60/min	2-12 months	< 50/min	1-5 years	< 40/min	6-8 years	< 30/min
Age	Normal rate													
< 2 months	< 60/min													
2-12 months	< 50/min													
1-5 years	< 40/min													
6-8 years	< 30/min													
Accessory muscles and suprasternal retractions	Usually not	Usually	Usually	Paradoxical thoraco-abdominal movement										
Wheeze	Moderate, often only and expiratory	Loud	Usually loud	Absence of wheeze										
Pulse/min.	< 100	100-120	> 120	Bradycardia										
Guide to limits of normal pulse rate in children: <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Infants</td> <td style="text-align: center;">2-12 months</td> <td style="text-align: center;">-Normal rate <160/min</td> </tr> <tr> <td style="text-align: center;">Preschool</td> <td style="text-align: center;">1-2 years</td> <td style="text-align: center;">-Normal rate <120/min</td> </tr> <tr> <td style="text-align: center;">School age</td> <td style="text-align: center;">2-8 years</td> <td style="text-align: center;">-Normal rate <110/min</td> </tr> </table>					Infants	2-12 months	-Normal rate <160/min	Preschool	1-2 years	-Normal rate <120/min	School age	2-8 years	-Normal rate <110/min	
Infants	2-12 months	-Normal rate <160/min												
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School age	2-8 years	-Normal rate <110/min												
Pulsus paradoxus	Absent < 10 mm Hg	May be present 10-25 mm Hg	Often present > 25 mm Hg (adult) 20-40 mm Hg (child)	Absence suggests respiratory muscle fatigue										
PEF after initial bronchodilator % predicted or % personal best	Over 80%	Approx. 60-80%	< 60% predicted or personal best (< 100 L/min adolescents) or response lasts < 2 hrs											
PaO ₂ (on air) [†] and/or paCO ₂ [†]	Normal Test not usually necessary < 45 mm Hg	> 60 mm Hg < 45 mm Hg	< 60 mm Hg Possible cyanosis > 45 mm Hg; Possible respiratory failure (see text)											
SaO ₂ % (on air) [†]	> 95%	91-95%	< 90%											
Hypercapnia (hypoventilation) develops more readily in young children than in adolescents.														
*Note: The presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation. †Note: Kilopascals are also used internationally, conversion would be appropriate in this regard.														

Monitor Response to Treatment

Evaluate symptoms and, as much as possible, peak flow. In the hospital, also assess oxygen saturation; consider arterial blood gas measurement in patients with suspected hypoventilation, exhaustion, severe distress, or peak flow 30-50 percent predicted.

Follow up:

After the exacerbation is resolved, the factors that precipitated the exacerbation should be identified and strategies for their future avoidance implemented, and the patient's medication plan reviewed.

SPECIAL CONSIDERATIONS IN MANAGING ASTHMA

Special considerations are required in managing asthma in relation to:

- **Surgery.** Airway hyperresponsiveness, airflow limitation, and mucus hypersecretion predispose patients with asthma to intraoperative and postoperative respiratory complications, particularly with thoracic and upper abdominal surgeries. Lung function should be evaluated several days prior to surgery, and a brief course of glucocorticosteroids prescribed if FEV₁ is less than 80% of the patient's personal best.
- **Rhinitis, Sinusitis, and Nasal Polyps.** Rhinitis and asthma often coexist in the same patient, and treatment of rhinitis may improve asthma symptoms. Both acute and chronic sinusitis can worsen asthma, and should be treated. Nasal polyps are associated with asthma and rhinitis, often with aspirin sensitivity and most frequently in adult patients. They are normally quite responsive to topical glucocorticosteroids.
- **Respiratory infections.** Respiratory infections provoke wheezing and increased asthma symptoms in many patients. Treatment of an infectious exacerbation follows the same principles as treatment of other exacerbations.
- **Gastroesophageal reflux.** Gastroesophageal reflux is nearly three times as prevalent in patients with asthma compared to the general population. Medical management should be given for the relief of reflux symptoms, although this does not consistently improve asthma control.
- **Anaphylaxis.** Anaphylaxis is a potentially life-threatening condition that can both mimic and complicate severe asthma. Prompt treatment is crucial and includes oxygen, intramuscular epinephrine, injectable antihistamine, intravenous hydrocortisone, and intravenous fluid.

Appendix A: Glossary of Asthma Medications - Controllers			
Name and Also Known As	Usual Doses	Side Effects	Comments
<p>Glucocorticosteroids Adrenocorticoids Corticosteroids Glucocorticoids</p> <p>Inhaled (ICS): Beclomethasone Budesonide Ciclesonide Flunisolide Fluticasone Mometasone Triamcinolone</p> <p>Tablets or syrups: hydrocortisone methylprednisolone prednisolone prednisone</p>	<p>Inhaled: Beginning dose dependent on asthma control then titrated down over 2-3 months to lowest effective dose once control is achieved.</p> <p>Tablets or syrups: For daily control use lowest effective dose 5-40 mg of prednisone equivalent in a.m. or qod.</p> <p>For acute attacks 40-60 mg daily in 1 or 2 divided doses for adolescents or 1-2 mg/kg daily in children.</p>	<p>Inhaled: High daily doses may be associated with skin thinning and bruises, and rarely adrenal suppression. Local side effects are hoarseness and oropharyngeal candidiasis. Low to medium doses have produced minor growth delay or suppression (av. 1cm) in children. Attainment of predicted adult height does not appear to be affected.</p> <p>Tablets or syrups: Used long term, may lead to osteoporosis, hypertension, diabetes, cataracts, adrenal suppression, growth suppression, obesity, skin thinning or muscle weakness. Consider coexisting conditions that could be worsened by oral glucocorticosteroids, e.g. herpes virus infections, Varicella, tuberculosis, hypertension, diabetes and osteoporosis</p>	<p>Inhaled: Potential but small risk of side effects is well balanced by efficacy. Valved holding-chambers with MDIs and mouth washing with DPIs after inhalation decrease oral Candidiasis. Preparations not equivalent on per puff or μg basis.</p> <p>Tablet or syrup: Long term use: alternate day a.m. dosing produces less toxicity. Short term: 3-10 day "bursts" are effective for gaining prompt control.</p>
<p>Sodium cromoglycate cromolyn cromones</p>	<p>MDI 2 mg or 5 mg 2-4 inhalations 3-4 times daily. Nebulizer 20 mg 3-4 times daily.</p>	<p>Minimal side effects. Cough may occur upon inhalation.</p>	<p>May take 4-6 weeks to determine maximum effects. Frequent daily dosing required.</p>
<p>Nedocromil cromones</p>	<p>MDI 2 mg/puff 2-4 inhalations 2-4 times daily.</p>	<p>Cough may occur upon inhalation.</p>	<p>Some patients unable to tolerate the taste.</p>
<p>Long-acting β_2-agonists beta-adrenergic sympathomimetics LABAs</p> <p>Inhaled: Formoterol (F) Salmeterol (Sm)</p> <p>Sustained-release Tablets: Salbutamol (S) Terbutaline (T)</p>	<p>Inhaled: DPI -F: 1 inhalation (12 μg) bid. MDI- F: 2 puffs bid. DPI-Sm: 1 inhalation (50 μg) bid. MDI-Sm: 2 puffs bid.</p> <p>Tablets: S: 4 mg q12h. T: 10mg q12h.</p>	<p>Inhaled: fewer, and less significant, side effects than tablets. Have been associated with an increased risk of severe exacerbations and asthma deaths when added to usual therapy.</p> <p>Tablets: may cause tachycardia, anxiety, skeletal muscle tremor, headache, hypokalemia.</p>	<p>Inhaled: Salmeterol NOT to be used to treat acute attacks. Should not use as monotherapy for controller therapy. Always use as adjunct to ICS therapy. Formoterol has onset similar to salbutamol and has been used as needed for acute symptoms.</p> <p>Tablets: As effective as sustained-release theophylline. No data for use as adjunctive therapy with inhaled glucocorticosteroids.</p>
<p>Combination ICS/LABA Fluticasone/ salmeterol (F/S)</p> <p>Budesonide/ formoterol (B/F)</p>	<p>DPI-F/S 100, 250, or 500 μg/50 μg 1 inhalation bid MDI-F/S 50, 125, or 250 μg /25 μg 2 puffs bid DPI-B/F 100 or 200 μg /6 μg 1 inhalation bid MDI-B/F 80 or 160 μg / 4.5 μg 2 puffs bid</p>	<p>Similar to those described above for individual components of the combination</p>	<p>In moderate to severe persistent asthma, combination more effective than doubling the ICS dose. Budesonide/formoterol has been approved for adjustable as needed dosing in addition to regular dosing in some countries. Dosing is dependent on level of control. Limited data in children 4-11 yrs No data in children < 4 yrs.</p>

Table continued...

Appendix A: Glossary of Asthma Medications - Controllers *(continued...)*

Name and Also Known As	Usual Doses	Side Effects	Comments
Sustained-release Theophylline Aminophylline methylxanthine xanthine	Starting dose 10 mg/kg/day with usual 800 mg maximum in 1-2 divided doses.	Nausea and vomiting are most common. Serious effects occurring at higher serum concentrations include seizures, tachycardia, and arrhythmias.	Theophylline level monitoring is often required. Absorption and metabolism may be affected by many factors, including febrile illness.
Antileukotrienes Leukotriene modifiers Montelukast (M) Pranlukast (P) Zafirlukast (Z) Zileuton (ZI)	Adolescents: M 10mg qhs P 450mg bid Z 20mg bid; ZI 600mg qid. Children: M 5 mg qhs (6-14 y) M 4 mg qhs (2-5 y) Z 10mg bid (7-11 y).	No specific adverse effects to date at recommended doses. Elevation of liver enzymes with Zafirlukast and Zileuton and limited case reports of reversible hepatitis and hyperbilirubinemia with Zileuton and hepatic failure with Zafirlukast	Antileukotrienes are most effective for patients with mild persistent asthma. They provide additive benefit when added to ICSs though not as effective as inhaled long-acting β_2 -agonists.
Immunomodulators Omalizumab Anti-IgE	Adolescents: Dose administered subcutaneously every 2 or 4 weeks dependent on weight and IgE concentration	Pain and bruising at injection site (5-20%) and very rarely anaphylaxis (0.1%).	Need to be stored under refrigeration 2-8 C and maximum of 150 mg administered per injection site.

Appendix B: Glossary of Asthma Medications - Relievers

Name and Also Known As	Usual Doses	Side Effects	Comments
Short-acting β_2-agonists Adrenergics β_2 -stimulants Sympathomimetics Albuterol/salbutamol Fenoterol Levalbuterol Metaproterenol Pirbuterol Terbutaline	Differences in potency exist but all products are essentially comparable on a per puff basis. For prn symptomatic use and pretreatment before exercise 2 puffs MDI or 1 inhalation DPI. For asthma attacks 4-8 puffs q2-4h, may administer q20min x 3 with medical supervision or the equivalent of 5 mg salbutamol by nebulizer.	Inhaled: tachycardia, skeletal muscle tremor, headache, and irritability. At very high dose hyperglycemia, hypokalemia. Systemic administration as Tablets or Syrup increases the risk of these side effects.	Drug of choice for acute bronchospasm. Inhaled route has faster onset and is more effective than tablet or syrup. Increasing use, lack of expected effect, or use of > 1 canister a month indicate poor asthma control; adjust long-term therapy accordingly. Use of ≥ 2 canisters per month is associated with an increased risk of a severe, life-threatening asthma attack.
Anticholinergics Ipratropium bromide (IB) Oxipropium bromide	IB-MDI 4-6 puffs q6h or q20 min in the emergency department. Nebulizer 500 μ g q20min x 3 then q2-4hrs for adolescents and 250-500 μ g for children.	Minimal mouth dryness or bad taste in the mouth.	May provide additive effects to β_2 -agonist but has slower onset of action. Is an alternative for patients with intolerance for β_2 -agonists.
Short-acting theophylline Aminophylline	7 mg/kg loading dose over 20 min followed by 0.4 mg/kg/hr continuous infusion.	Nausea, vomiting, headache. At higher serum concentrations: seizures, tachycardia, and arrhythmias.	Theophylline level monitoring is required. Obtain serum levels 12 and 24 hours into infusion. Maintain between 10-15 μ g/mL.
Epinephrine/adrenaline injection	1:1000 solution (1mg/mL) .01mg/kg up to 0.3-0.5 mg, can give q20min x 3.	Similar, but more significant effects than selective β_2 -agonist. In addition: hypertension, fever, vomiting in children and hallucinations.	In general, not recommended for treating asthma attacks if selective β_2 -agonists are available.

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The Global Initiative for Asthma is supported by educational grants from:



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