
POCKET GUIDE FOR ASTHMA MANAGEMENT AND PREVENTION



A Pocket Guide for Physicians and Nurses

Revised 2002

**BASED ON THE WORKSHOP REPORT:
GLOBAL STRATEGY FOR ASTHMA MANAGEMENT AND PREVENTION
REVISED (2002)**

NATIONAL INSTITUTES OF HEALTH
NATIONAL HEART, LUNG, AND BLOOD INSTITUTE



**GLOBAL INITIATIVE
FOR ASTHMA**



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The 2002 report is available on: <http://www.ginasthma.com>

TABLE OF CONTENTS

PREFACE	2
WHAT IS KNOWN ABOUT ASTHMA?	4
DIAGNOSING ASTHMA	6
Figure 1. Is it Asthma?	6
Figure 2. Peak Flow Meters: Uses and Technique	7
CLASSIFY ASTHMA SEVERITY	9
Figure 3. Classify Severity	9
A SIX PART PROGRAM TO MANAGE AND CONTROL ASTHMA	10
Part 1: Educate Patients To Develop a Partnership in Asthma Care	10
Part 2: Assess and Monitor Asthma Severity	12
Figure 4. Questions for Monitoring Asthma Care	13
Part 3: Avoid Exposure To Risk Factors	14
Figure 5. Common Asthma Risk Factors and Actions to Reduce Exposure	14
Part 4: Establish Individual Medication Plans for Long-term Management in Children and Adults	15
Select Medications	16
Figure 6. Glossary of Asthma Medications.....	17
Figure 7. Estimated Comparative Daily Dosages for Inhaled Glucocorticosteroids	19
Stepwise Approach to Long-term Management of Asthma	20
Figure 8. Recommended Medications by Level of Severity Adults and Children Older Than 5 Years of Age	20
Figure 9. Recommended Medications by Level of Severity Children Younger Than 5 Years of Age	21
Part 5: Establish Individual Plans To Manage Asthma Attacks	22
Figure 10. Severity of Asthma Attacks	24
Figure 12. Management of an Asthma Attack: Home Treatment	25
Figure 12. Management of Asthma Attacks: Hospital-Based Care.....	26
Part 6: Provide Regular Followup Care	27
SPECIAL CONSIDERATIONS IN MANAGING ASTHMA	27

PREFACE

Asthma is a major cause of chronic morbidity and mortality throughout the world. 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 adoption of the reports, and promotes international collaboration on asthma research.

While asthma has been recognized for many years, public health officials are concerned about recent and continuing increases in its prevalence. The **Global Initiative for Asthma** offers a framework for asthma management 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:

- *Workshop Report: Global Strategy for Asthma Management and Prevention* (updated 2002). Scientific information and recommendations for asthma programs. NIH Publication No. 02-3659
- *Pocket Guide for Asthma Management and Prevention*. Summary of patient care information for primary health care professionals. (updated 2002). NIH Publication No. 02-3659A
- *Pocket Guide for Asthma Management and Prevention in Children*. Summary of patient care information for pediatricians and other health care professionals. (Available fall 2002). NIH Publication No. 02-3659B
- *Asthma Management and Prevention: A Practical Guide for Public Health Officials and Health Care Professionals*. NIH Publication No. 96-3659B
- *What You and Your Family Can Do About Asthma*. An information booklet for patients and their families. NIH Publication No. 96-3659C

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

This *Pocket Guide* has been developed from the *Workshop Report: Global Strategy for Asthma Management and Prevention* (updated March 2002). Technical discussions of asthma, evidence levels, and specific citations from the scientific literature are included in the Workshop Report.

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WHAT IS KNOWN ABOUT ASTHMA?

Unfortunately...asthma is one of the most common chronic diseases worldwide and the prevalence is increasing, especially among children.

Fortunately...asthma can be treated and controlled so that almost all patients can:

- Prevent troublesome symptoms night and day
- Prevent serious attacks
- Require little or no reliever medication
- Have productive, physically active lives
- Have (near) normal lung function.

■ 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** include exposure to allergens such as domestic dust mites (in bedding, carpets, and fabric-upholstered furnishings), animals with fur, cockroach, pollens and molds; occupational irritants; tobacco smoke; air pollution; respiratory (viral) infections; exercise, strong emotional expressions; chemical irritants and drugs (such as aspirin and beta blockers). There is good evidence that asthma occurs in families.

■ Asthma **severity** can be intermittent, or it can be persistently mild, moderate, or severe. Severity varies among individuals, does not necessarily relate to the frequency or persistence of symptoms, and can change in one individual over time. Treatment decisions are made based on severity.

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- A stepwise approach to **pharmacologic treatment** to achieve and maintain control of asthma should take into account current treatment, pharmacologic properties and availability of anti-asthma treatments, and economic considerations.
 - Asthma **attacks** (or exacerbations) are episodic, but airway inflammation is chronically present. For many patients, medication must be taken every day to *control* symptoms, improve lung function, and prevent attacks. Medications may also be required to *relieve* acute symptoms, such as wheezing, chest tightness, and cough.
 - Asthma care requires a **partnership** between the patient and the health care professional. The aim is to provide patients the ability to control their asthma with guidance from the health care professional.
 - Asthma is not a cause for shame. Olympic athletes, famous leaders, other celebrities, and ordinary people live successful lives with asthma.
 - Asthma may be **preventable**. For infants with a family history of asthma or atopy, it is thought that avoiding exposure to passive smoking and to domestic dust mite, cat, and cockroach allergens may help prevent the initial development of asthma. For adults, avoiding exposure to smoke and to chemical sensitizers in the workplace is helpful.

DIAGNOSING ASTHMA

Asthma can often be diagnosed on the basis of symptoms. However, measurements of lung function, and particularly the reversibility of lung function abnormalities, greatly enhance diagnostic confidence.

Figure 1. Is It Asthma?

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

- Wheezing—high-pitched whistling sounds when breathing out—especially in children. (A normal chest examination does not exclude asthma.)
- History of any of the following:
 - Cough, worse particularly at night
 - Recurrent wheeze
 - Recurrent difficult breathing
 - Recurrent chest tightness.

(Note: Eczema, hay fever or a family history of asthma or atopic diseases are often associated with asthma.)

- Symptoms occur or worsen at night, awakening the patient.
- 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
- Reversible and variable airflow limitation—as measured by using a spirometer (FEV₁ and FVC) or a peak expiratory flow (PEF) meter. When using a peak flow meter, consider asthma if:
 - PEF increases more than 15 percent 15 to 20 minutes after inhalation of a rapid-acting β_2 -agonist, *or*
 - PEF varies more than 20 percent from morning measurement upon arising to measurement 12 hours later in patients taking a bronchodilator (more than 10 percent in patients who are not taking a bronchodilator), *or*
 - PEF decreases more than 15 percent after 6 minutes of sustained running or exercise.

Figure 2. Peak Flow Meters: Uses and Technique

- Lung function measurements assess airflow limitation and help diagnose and monitor the course of asthma.
- To assess the level of airflow limitation, two methods are used. Peak flow meters measure peak expiratory flow (PEF), and spirometers measure forced expiratory volume in 1 second (FEV₁) and its accompanying forced vital capacity (FVC). The accuracy of all lung function measurements depend on patient effort and correct technique.
- Several kinds of peak flow meters and spirometers are available, and the technique for use is similar for all. To use a peak flow meter:
 - Stand up and hold the peak flow meter without restricting movement of the marker. Make sure the marker is at the bottom of the scale.
 - Take a deep breath, put the peak flow meter in your mouth, seal your lips around the mouthpiece, and breathe out as hard and fast as possible. Do not put your tongue inside the mouthpiece.
 - Record the result. Return the marker to zero.
 - Repeat twice more. Choose the highest of the three readings.
- Daily PEF monitoring for 2 to 3 weeks is useful, when it is available, for establishing a diagnosis and treatment. If during 2 to 3 weeks a patient cannot achieve 80 per cent of predicted PEF (predicted values are provided with all peak flow meters), it may be necessary to determine a patient's personal best value, e.g. by a course of oral glucocorticosteroid.
- Long-term PEF monitoring is useful, along with review of symptoms, for evaluating a patient's response to therapy. PEF monitoring can also help detect early signs of worsening before symptoms occur.

Note: Examples of available peak flow meters and instructions for use of inhalers and spacers can be found on www.ginasthma.com.

Diagnostic challenges include the following:

- Young children whose primary symptom is recurrent or persistent cough or who wheeze with respiratory infections are often misdiagnosed as having bronchitis or pneumonia (including acute respiratory infection –ARI) and thus ineffectively treated with antibiotics or cough suppressants. Treatment with asthma medication can be beneficial and diagnostic.
- Many infants and young children who wheeze with viral respiratory infections may not develop asthma that persists through childhood. But they may benefit from asthma medications for their wheezing episodes. There is no certain way to predict which children will have persistent asthma, but allergy, a family history of allergy or asthma, and perinatal exposure to passive smoke and allergens are more strongly associated with continuing asthma.
- Asthma should be considered if the patient's colds repeatedly "go to the chest" or take more than 10 days to clear up, or if the patient improves when asthma medication is given.
- Tobacco smokers and elderly patients frequently suffer from chronic obstructive pulmonary disease (COPD) with symptoms similar to asthma. Yet they may also have asthma and benefit from treatment. Improvement in PEF after asthma treatment is diagnostic.
- Workers who are exposed to inhalant chemicals or allergens in the workplace can develop asthma and may be misdiagnosed as having chronic bronchitis or chronic obstructive pulmonary disease. Early recognition (PEF measurements at work and home), strict avoidance of further exposure, and early treatment are essential.
- Asthma attacks may be difficult to diagnose. For example, acute shortness of breath, chest tightness and wheezing can also be caused by croup, bronchitis, heart attacks, and vocal cord dysfunction. Using spirometry, establishing reversibility of symptoms with bronchodilators, and assessing the history of the attack (e.g. whether it was related to exposures that commonly make asthma worse) aid the diagnosis. A chest xray can help rule out infection, large airway lesions, congestive heart failure, or aspiration of a foreign object.

CLASSIFY ASTHMA SEVERITY

Classify asthma as intermittent, mild persistent, moderate persistent, or severe persistent based on the combined assessments of symptoms and lung function. **Severity of asthma will determine the type of treatment required.**

When the patient is already on treatment, the classification of severity should be based on the clinical features present and the step of the daily medication regimen that the patient is currently on.

Figure 3: Classify Asthma Severity

	Symptoms/Day	Symptoms/Night	PEF or FEV ₁ PEF variability
STEP 1 Intermittent	< 1 time a week Asymptomatic and normal PEF between attacks	≤ 2 times a month	≥ 80% <hr/> < 20%
STEP 2 Mild Persistent	> 1 time a week but < 1 time a day Attacks may affect activity	> 2 times a month	≥ 80% <hr/> 20-30%
STEP 3 Moderate Persistent	Daily Attacks affect activity	> 1 time a week	60%-80% <hr/> > 30%
STEP 4 Severe Persistent	Continuous Limited physical activity	Frequent	≤ 60% <hr/> > 30%

- The presence of one of the features of severity is sufficient to place a patient in that category.
- Patients at any level of severity—even intermittent asthma—can have severe attacks.

A SIX-PART PROGRAM TO MANAGE AND CONTROL ASTHMA

Appropriate asthma care can help patients prevent most attacks, stay free of troublesome night and day symptoms, and keep physically active. A six-part management program includes:

- Part 1. Educate patients to develop a partnership in asthma care.**
- Part 2. Assess and monitor asthma severity.**
- Part 3. Avoid exposure to risk factors.**
- Part 4. Establish individual medication plans for long-term management in children and adults.**
- Part 5. Establish individual plans to manage asthma attacks.**
- Part 6. Provide regular followup care.**

The goals for successful management of asthma are:

- Minimal or no symptoms, including nighttime symptoms
- Minimal asthma episodes or attacks
- No emergency visits to physicians or hospitals
- Minimal need for reliever medications
- No limitations on physical activities and exercise
- Nearly normal lung function
- Minimal or no side effects from medication.

Part 1: Educate Patients To Develop a Partnership in Asthma Care.

- With your help, and the help of others on the health care team, patients can be actively involved in managing their asthma to prevent problems and can live productive, physically active lives. They can learn to:

- Avoid risk factors.
- Take medications correctly.
- Understand the difference between "controller" and "reliever" medications.
- Monitor their status using symptoms and, if available, PEF.
- Recognize signs that asthma is worsening and take action.
- Seek medical help as appropriate.

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- Working together, you and your patient should prepare a written personal asthma management plan that is medically appropriate and practical.

 - An asthma management plan should cover:
 - **Prevention steps** for long-term control
 - Asthma risk factors to avoid
 - Daily medications to take

 - **Action steps** to stop attacks
 - **How to recognize worsening asthma.** List indicators such as increasing cough, chest tightness, wheeze, difficult breathing, sleep disturbance, or PEF below personal best despite increased use of medications.
 - **How to treat worsening asthma.** List the names and doses of reliever medications and glucocorticosteroid tablets and when to use them.
 - **How and when to seek medical attention.** List indicators such as an attack with sudden onset, shortness of breath while resting or speaking a few words, feeling panicky, PEF below a specified level, or a history of severe attacks. List the name, location, and telephone number of the physician's office or clinic or hospital.

 - Educational methods should be appropriate for your patients. Using a variety of methods—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 your education.

 - Ongoing education, presented at every patient visit, is the key to success in all aspects of asthma management.

Sample self-management plans can be found on several web sites, e.g.
<http://www.asthma.org.uk>;
<http://www.nhlbisupport.com/asthma/index.html>; and
<http://www.asthmanz.co.nz>.

Part 2: Assess and Monitor Asthma Severity.

- Control of asthma requires continual long-term care and monitoring.
- Monitoring includes review of symptoms and, as much as possible, measurement of lung function.
 - PEF monitoring at every physician visit, (spirometry is preferred but not always available), along with review of symptoms, helps in evaluating the patient's response to therapy and adjusting treatment accordingly. PEF consistently greater than 80 percent of the patient's personal best suggests good control.
 - Long-term PEF monitoring at home can help patients recognize early signs of worsening asthma (PEF less than 80 percent of personal best) before symptoms occur. Patients can act promptly according to their personal asthma management plan to avoid serious attacks. Home PEF monitoring is not always practical, but for patients who cannot perceive symptoms and for those who have ever been hospitalized, home PEF monitoring has a high priority.
- Regular visits (at 1- to 6-month intervals as appropriate) are essential, even after control of asthma is established. At each visit review the questions in figure 4.
- Compliance/adherence with asthma management plans is improved when patients have the opportunity to talk about their concerns, fears, and expectations related to their asthma.

Figure 4. 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.

Part 3: Avoid Exposure to Risk Factors.

- To improve the control of asthma and reduce medication needs, patients should avoid exposure to risk factors (allergens and irritants that make asthma worse).

Figure 5. Common Asthma Risk Factors and Actions to Reduce Exposure

RISK FACTOR	ACTIONS
Domestic dust mite allergens (so small they are not visible to the naked eye)	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 linoleum or wood flooring, especially in sleeping rooms. Use vinyl, leather, or plain wooden furniture instead of fabric-upholstered furniture. If possible, use vacuum cleaner with filters.
Tobacco smoke (whether the patient smokes or breathes in the smoke from others)	Stay away from tobacco smoke. Patients and parents should not smoke.
Allergens from animals with fur	Remove animals from the home, or at least from the sleeping area.
Cockroach allergen	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.
Physical activity	Do not avoid physical activity. Symptoms can be prevented by taking a rapid-acting inhaled β_2 -agonist, a cromone, or a leukotriene modifier before strenuous exercise.
Drugs	Do not take beta blockers or aspirin or NSAIDs if these medicines cause asthma symptoms.

- **Specific immunotherapy**, directed at treating an underlying allergy to grass and other pollen, domestic mites, animal dander, or *Alternaria*, may be considered when avoiding allergens is not possible or appropriate medications fail to control asthma symptoms. Specific immunotherapy should be performed only by health professionals trained in its use.

- **Primary prevention** of asthma is not yet possible, but promising leads are being actively investigated. There is evidence that environmental tobacco smoke exposure both prenatally and postnatally has an adverse influence on the development of wheezing illnesses.

Part 4: Establish Individual Medication Plans for Long-term Management in Children and Adults.

- A **stepwise approach** is used to classify asthma severity and guide treatment. The number and frequency of medications increase (step up) as the need for asthma therapy increases, and decreases (step down) when asthma is under control.

Persistent asthma is more effectively controlled by long-term treatment to suppress and reverse the inflammation than by only treating acute bronchoconstriction and related symptoms. **Anti-inflammatory agents, particularly inhaled glucocorticosteroids, are currently the most effective long-term preventive medications and are effective in reducing asthma attacks.**

The recommended treatments are guidelines only. Local resources and individual patient circumstances determine specific therapy.

- **Gain control** – There are two approaches to gaining control of asthma. The first approach is preferred.
 - Establish control promptly with a high level of therapy (for example, add a short course of oral glucocorticosteroid and/or a higher dose of inhaled glucocorticosteroids plus long-acting β_2 -agonist to the therapy that corresponds with the patient's level of asthma severity) and then step down.
- Or • Start treatment at the step most appropriate to the level of asthma severity and step up if necessary.
- **Step up** if control is not achieved and sustained. Generally, improvement should be achieved within 1 month. But first review the patient's medication technique, compliance, and avoidance of risk factors.
- **Step down** if control is sustained for at least 3 months; follow a gradual stepwise reduction in treatment. The goal is to decrease treatment to the least medication necessary to maintain control.
- **Review** treatment every 3 to 6 months once asthma is under control.
- Consult with an asthma specialist when other conditions complicate asthma (e.g., sinusitis), the patient does not respond to therapy, or treatment at steps 3 or 4 is required.

Select Medications

- Two types of medication help control asthma: **controller** medications that keep symptoms and attacks from starting, and **reliever** medications that work quickly to treat attacks or relieve symptoms.
- **Inhaled medications** are preferred because of their high therapeutic ratio: high concentrations of drug are delivered directly to the airways with potent therapeutic effects and few systemic side effects.
 - Devices available to deliver inhaled medication include pressurized metered-dose inhalers (pMDIs), breath-actuated metered dose inhalers, dry powder inhalers, and nebulizers. Spacer (or holding chamber) devices make inhalers easier to use. Spacers also reduce systemic absorption and side effects of inhaled glucocorticosteroids.
 - Teach patients (and 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.
 - For each patient, 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 4-6 years should use a pMDI plus a spacer with mouthpiece or, if necessary, a nebulizer with face mask.
 - For patients using spacers, the spacer must fit the inhaler. The size of the spacer must increase as a child grows and lung size increases.
 - Patients of any age over 6 years who have difficulty using pMDIs should use a pMDI with a spacer, a breath-actuated inhaler, a dry powder inhaler, or a nebulizer. Dry powder inhalers require an inspiratory effort that may be difficult to achieve during severe attacks and for children under the age of 6 years.
 - Patients who are having severe attacks should use a pMDI with a spacer or a nebulizer.

Figure 6: Glossary of Asthma Medications - Controller Medications

Name and Also Known As	Usual Doses	Side Effects	Comments
<p>Glucocorticosteroids Adrenocorticoids Corticosteroids Glucocorticoids</p> <p>Inhaled: Beclomethasone Budesonide Flunisolide Fluticasone Triamcinolone</p> <p>Tablets or syrups: hydrocortisone methylprednisolone prednisolone prednisone</p>	<p>Inhaled: Beginning dose dependent on asthma severity (Fig. 7 & 8) 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 adults 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. Medium and high 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.</p>	<p>Inhaled: Potential but small risk of side effects is well balanced by efficacy. Spacer devices with MDIs and mouth washing with DPIs after inhalation decrease oral Candidiasis. Preparations not equivalent on per puff or µg basis (see figure 7).</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. Nebuliser 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 β₂-agonists beta-adrenergic sympathomimetics</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.</p> <p>Tablets: may cause tachycardia, anxiety, skeletal muscle tremor, headache, hypokalemia.</p>	<p>Inhaled: Always use as adjunct to anti-inflammatory therapy. Combined with low-medium doses of inhaled-glucocorticosteroid is more effective than increasing the dose of inhaled-glucocorticosteroids.</p> <p>Tablets: As effective as sustained-release theophylline. No data for use as adjunctive therapy with inhaled-glucocorticosteroids.</p>
<p>Sustained-release Theophylline Aminophylline Methylxanthine</p>	<p>Starting dose 10 mg/kg/day with usual 800 mg maximum in 1-2 divided doses.</p>	<p>Nausea and vomiting are most common. Serious effects occurring at higher serum concentrations include seizures, tachycardia, and arrhythmias.</p>	<p>Theophylline level monitoring is often required. Absorption and metabolism may be affected by many factors, including febrile illness.</p>

Table continued...

Figure 6: Glossary of Asthma Medications - Controller Medications (continued...)

Name and Also Known As	Usual Doses	Side Effects	Comments
Antileukotrienes Leukotriene modifiers Montelukast (M) Pranlukast (P) Zafirlukast (Z) Zileuton (Zi)	Adults: 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).	Data are limited; no specific adverse effects to date at recommended doses. Elevation of liver enzymes with Z and Zi and limited case reports of reversible hepatitis and hyperbilirubinemia with Zi.	The position of anti-leukotrienes in asthma therapy is not fully established. They provide additive benefit when added to inhaled glucocorticosteroids though not as effective as inhaled long-acting β_2 -agonists.

Figure 6: Glossary of Asthma Medications - Reliever Medications

Name and Also Known As	Usual Doses	Side Effects	Comments
Short-acting β_2-agonists adrenergics β_2 -stimulants Sympathomimetics Albuterol Bitolterol Fenoterol Isoetharine Metaproterenol Pirbuterol Salbutamol 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) Oxitropium bromide	IB-MDI 4-6 puffs q6h or q20 min in the emergency department. Nebuliser 500 mcg q20min x 3 then q2-4hrs for adults and 250 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 mcg/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.

Figure 7: Estimated Comparative Daily Dosages for Inhaled Glucocorticosteroids¹

Drug ²	Low Daily Dose (µg)		Medium Daily Dose (µg)		High Daily Dose (µg)	
	Adult	Child	Adult	Child	Adult	Child
Beclomethasone-CFC 42 or 84 µg/puff	168-504	84-336	504-840	336-672	>840	>672
Beclomethasone-HFA 40 or 80 µg/puff	80-320	80-160	240-480	160-320	>480	>320
Budesonide-DPI 200 µg/inhalation	200-600	100-400	600-1200	400-800	>1200	>800
Budesonide-Neb Inhalation suspension	--	500	--	1000	--	2000
Flunisolide 250 µg/puff	500-1000	500-750	1000-2000	1000-1250	>2000	>1250
Fluticasone MDI: 44, 110 or 200 µg/puff DPI: 50, 100 or 250 µg/inhalation	88-264	88-176	264-660	176-440	>660	>440
Triamcinolone acetonide 100 µg/puff	400-1000	400-800	1000-2000	800-1200	>2000	>1200

¹ From National Asthma Education and Prevention Program, Updated 2002. NIH Publication No. 02-5075.
Web: <http://www.nhlbi.nih.gov>

² Check µg/puff in preparation available locally.

Stepwise Approach to Long-Term Management of Asthma

Figure 8 presents the stepwise approach to therapy to achieve and maintain control of asthma in adults. **The step system for classifying asthma severity (Figure 3) takes into account the treatment that the patient is currently receiving.**

Figure 8: Recommended Medications by Level of Severity: Adults and Children Older Than 5 Years of Age		
All Levels: In addition to regular daily controller therapy, rapid-acting inhaled β_2 -agonist ¹ should be taken as needed to relieve symptoms, but should not be taken more than 3-4 times a day. Patient education is essential at every step.		
Level of Severity	Daily Controller Medications ²	Other Treatment Options ³
STEP 1 Intermittent ⁴	<ul style="list-style-type: none"> None necessary. 	
STEP 2 Mild Persistent	<ul style="list-style-type: none"> Low-dose inhaled glucocorticosteroid 	<ul style="list-style-type: none"> Sustained-release theophylline <i>or</i> Cromone <i>or</i> Leukotriene modifier
STEP 3 Moderate Persistent	<ul style="list-style-type: none"> Low-to medium-dose glucocorticosteroid <i>plus</i> long-acting inhaled β_2-agonist 	<ul style="list-style-type: none"> Medium-dose inhaled glucocorticosteroid <i>plus</i> sustained-release theophylline, <i>or</i> Medium-dose inhaled glucocorticosteroid <i>plus</i> long-acting oral β_2-agonist, <i>or</i> High-dose inhaled glucocorticosteroid <i>or</i> Medium-dose inhaled glucocorticosteroid <i>plus</i> leukotriene modifier
STEP 4 Severe Persistent	<ul style="list-style-type: none"> High-dose inhaled glucocorticosteroid <i>plus</i> long-acting inhaled β_2-agonist, <i>plus</i> one or more of the following if needed: <ul style="list-style-type: none"> Sustained-release theophylline Leukotriene modifier Long-acting oral β_2-agonist Oral glucocorticosteroid 	
All steps: Once control of asthma is achieved and maintained for at least 3 months, a gradual reduction of the maintenance therapy should be tried to identify the minimum therapy required to maintain control.		

¹Other options for reliever medications are (in increasing order of cost): short-acting theophylline, inhaled anticholinergic, and short-acting oral β_2 -agonist.

²See Figure 7: Estimated Equipotent Doses of Inhaled glucocorticosteroids

³Other treatment options listed in order of increasing cost. Relative medication costs may vary from country to country.

⁴Patients with intermittent asthma but severe exacerbations should be treated as having moderate persistent asthma.

Figure 9 presents the stepwise approach to therapy to achieve and maintain control of asthma in children younger than 5 years of age. The step system for classifying asthma severity (Figure 3) takes into account the treatment that the patient is currently receiving.

Figure 9: Recommended Medications by Level of Severity: Children Younger Than 5 Years of Age ¹		
All Levels: In addition to regular daily controller therapy, rapid-acting inhaled β_2 -agonist ² should be taken as needed to relieve symptoms, but should not be taken more than 3-4 times a day. Patient education is essential at every step		
Level of Severity	Daily Controller Medications ³	Other Treatment Options ⁴
STEP 1 Intermittent ⁵	<ul style="list-style-type: none"> • None necessary. 	
STEP 2 Mild Persistent	<ul style="list-style-type: none"> • Low-dose inhaled glucocorticosteroid 	<ul style="list-style-type: none"> • Sustained-release theophylline, or • Cromone, or • Leukotriene modifier
STEP 3 Moderate Persistent	<ul style="list-style-type: none"> • Medium-dose inhaled glucocorticosteroid 	<ul style="list-style-type: none"> • Medium-dose inhaled glucocorticosteroid <i>plus</i> sustained-release theophylline, or • Medium-dose inhaled glucocorticosteroid <i>plus</i> long-acting inhaled β_2-agonist, or • High-dose inhaled glucocorticosteroid or • Medium-dose glucocorticosteroid <i>plus</i> leukotriene modifier
STEP 4 Severe Persistent	<ul style="list-style-type: none"> • High-dose inhaled glucocorticosteroid <i>plus</i> one or more of the following, if needed: <ul style="list-style-type: none"> • Sustained-release theophylline • Long-acting inhaled β_2-agonist • Leukotriene modifier • Oral glucocorticosteroid 	
All steps: Once control of asthma is achieved and maintained for at least 3 months, a gradual reduction of the maintenance therapy should be tried to identify the minimum therapy required to maintain control.		

¹See page 16 for use of delivery systems.

²Other options for reliever medications are (in increasing order of cost): short-acting theophylline, inhaled anticholinergic and short-acting oral β_2 -agonist.

³See Figure 7: Estimated Equipotent Doses of Inhaled Glucocorticosteroids

⁴Other treatment options listed in order of increasing cost. Relative medication costs may vary from country to country.

⁵Patients with intermittent asthma but severe exacerbations should be treated as having moderate persistent asthma.

Part 5: Establish Individual Plans To Manage Asthma Attacks

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 attack may be life threatening. (Figure 10)
- Patients at high risk for asthma-related death include those with:
 - History of near-fatal asthma.
 - Hospitalization or emergency visit for asthma within the past year, or prior intubation for asthma.
 - Current use of, or recent withdrawal from, oral glucocorticosteroids.
 - Over-dependence on rapid-acting inhaled β_2 -agonists.
 - History of psychosocial problems or denial of asthma or its severity.
 - History of noncompliance with asthma medication plan.
- **Patients should immediately seek medical care if...**
 - **The attack is severe:**
 - 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 120/min (greater than 160/min for infants).
 - PEF is less than 60 percent of predicted or personal best even after initial treatment.
 - The patient 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.**
- **Asthma attacks require prompt treatment:**
 - Inhaled rapid-acting β_2 -agonists in adequate doses are essential. If inhaled medications are not available, oral bronchodilators may be considered.

-
- Oral glucocorticosteroids introduced early in the course of a moderate or severe attack help to reverse the inflammation and speed recovery.
 - Oxygen is given at health centers or hospitals if the patient is hypoxemic.
 - Methylxanthines are not recommended if used in addition to high doses of inhaled β_2 -agonist. 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.
 - Epinephrine (adrenaline) may be indicated for acute treatment of anaphylaxis and angioedema.

■ 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).

■ Mild attacks can be treated at home if the patient is prepared and has a personal asthma management plan that includes action steps (Figure 11).

■ Moderate attacks may require, and severe attacks usually require, care in a clinic or hospital (Figure 12).

■ **Monitor Response to Treatment**

Evaluate symptoms and, as much as possible, peak flow. In 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.

Figure 10. Severity of Asthma Attacks

Parameter ¹	Mild	Moderate	Severe	Respiratory arrest imminent										
Breathless	Walking Can lie down													
Talks in Alertness	Sentences May Be agitated	Phrases Usually agitated	Words Usually agitated	Drowsy or confused										
Respiratory rate	Increased	Increased	Often > 30/min	Paradoxical										
<p>Guide to rates of breathing associated with respiratory distress in awake children</p> <table> <thead> <tr> <th>Age</th> <th>Normal rate</th> </tr> </thead> <tbody> <tr> <td>< 2 months</td> <td>< 60/min</td> </tr> <tr> <td>2-12 months</td> <td>< 50/min</td> </tr> <tr> <td>1-5 years</td> <td>< 40/min</td> </tr> <tr> <td>6-8 years</td> <td>< 30/min</td> </tr> </tbody> </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 end expiratory	Loud	Usually Loud	Absence of wheeze										
Pulse/min.	< 100	100-120	> 120	Bradycardia										
<p>Guide to limits of normal pulse rate in children:</p> <table> <thead> <tr> <th>Age</th> <th>Normal rate</th> </tr> </thead> <tbody> <tr> <td>Infants</td> <td>< 160/min</td> </tr> <tr> <td>Preschool</td> <td>< 120/min</td> </tr> <tr> <td>School age</td> <td>< 110/min</td> </tr> </tbody> </table>					Age	Normal rate	Infants	< 160/min	Preschool	< 120/min	School age	< 110/min		
Age	Normal rate													
Infants	< 160/min													
Preschool	< 120/min													
School age	< 110/min													
PEF after initial bronchodilator % predicted or % personal best	Over 80%	Approximately 60-80%	< 60% predicted or personal best (100 L/min adults) or response lasts < 2 hours											
PaO ₂ (on air)* and/or PaCO ₂ *	Normal Test not usually necessary < 45 mmHg	> 60 mmHg < 45 mmHg	< 60 mmHg > 45 mmHg: Possible respiratory failure	Possible cyanosis										
SaO ₂ % (on air)*	> 95%	91-95%	< 90%											
Hypercapnia (hypoventilation) develops more readily in young children than in adults and adolescents.														

¹ The presence of several parameters, but not necessarily all, indicate the general classification of the attack.

* Kilopascals are also used internationally; conversion would be appropriate in this regard.

Figure 11. Management of an Asthma Attack: Home Treatment

Assess Severity

Cough, breathlessness, wheeze, chest tightness, use of accessory muscles, suprasternal retractions, and sleep disturbance. PEF less than 80 percent of personal best or predicted.

Initial Treatment

Inhaled rapid-acting β_2 -agonist up to three treatments in 1 hour. (Patients at high risk of asthma-related death should contact physician promptly after initial treatment.)

Response to Initial Treatment Is...

Good if...	Incomplete if...	Poor if...
<p>Symptoms subside after initial β_2-agonist and relief is sustained for 4 hours.</p> <p>PEF is greater than 80% predicted or personal best.</p> <p>ACTIONS:</p> <ul style="list-style-type: none"> • May continue β_2-agonist every 3-4 hours for 1-2 days. • Contact physician or nurse for followup instructions. 	<p>Symptoms decrease but return in less than 3 hours after initial β_2-agonist treatment.</p> <p>PEF is 60-80% predicted or personal best.</p> <p>ACTIONS:</p> <ul style="list-style-type: none"> • Add oral glucocorticosteroid. • Add inhaled anticholinergic. • Continue β_2-agonist. • Consult clinician urgently for instructions. 	<p>Symptoms persist or worsen despite initial β_2-agonist treatment.</p> <p>PEF is less than 60% predicted or personal best.</p> <p>ACTIONS:</p> <ul style="list-style-type: none"> • Add oral glucocorticosteroid. • Repeat β_2-agonist immediately. • Add inhaled anticholinergic. • Immediately transport to hospital emergency department.

Figure 12. Management of Asthma Attacks: Hospital-Based Care

Initial Assessment

- History, physical examination (auscultation, use of accessory muscles, heart rate, respiratory rate, PEF or FEV₁, oxygen saturation, arterial blood gas of patient in extremis, and other tests as indicated)

Initial Treatment

- Inhaled rapid-acting β_2 -agonist, usually by nebulization, one dose every 20 minutes for 1 hour
- Oxygen to achieve O₂ saturation \geq 90% (95% children)
- Systemic glucocorticosteroids if no immediate response, or if patient recently took oral glucocorticosteroids, or if episode is severe
- Sedation is contraindicated in the treatment of attacks

Repeat Assessment

Physical Exam, PEF or FEV₁, O₂ saturation, other tests as needed

Moderate Episode

- PEF 60-80% predicted/personal best
- Physical exam: moderate symptoms, accessory muscle use
- Inhaled β_2 -agonist and inhaled anticholinergic every 60 minutes
- Consider glucocorticosteroids
- Continue treatment 1-3 hours, provided there is improvement

Severe Episode

- PEF < 60% predicted/personal best
- Physical exam: severe symptoms at rest, chest retraction
- History: high-risk patient
- No improvement after initial treatment
- Inhaled β_2 -agonist and inhaled anticholinergic
- Oxygen
- Systemic glucocorticosteroid
- Consider subcutaneous, intramuscular, or intravenous β_2 -agonist
- Consider intravenous methylxanthines
- Consider intravenous magnesium

Good Response

- Response sustained 60 minutes after last treatment
- Physical exam: normal
- PEF > 70%
- No distress
- O₂ saturation > 90% (95% children)

Incomplete Response Within 1-2 Hours

- History: high-risk patient
- Physical exam: mild to moderate symptoms
- PEF < 70%
- O₂ saturation not improving

Poor Response Within 1 Hour

- History: high-risk patient
- Physical exam: symptoms severe, drowsiness, confusion
- PEF < 30%
- PCO₂ > 45 mmHg
- PO₂ < 60 mmHg

Discharge Home

- Continue treatment with inhaled β_2 -agonist
- Consider, in most cases, oral glucocorticosteroid
- Patient education:
Take medicine correctly
Review action plan
Close medical followup

Admit to Hospital

- Inhaled β_2 -agonist \pm inhaled anticholinergic
- Systemic glucocorticosteroid
- Oxygen
- Consider intravenous ethylxanthines
- Monitor PEF, O₂ saturation, pulse, theophylline

Admit to Intensive Care

- Inhaled β_2 -agonist + anticholinergic
- Intravenous glucocorticosteroid
- Consider subcutaneous, intramuscular, or intravenous β_2 -agonists
- Oxygen
- Consider intravenous methylxanthines
- Possible intubation and mechanical ventilation

Improve

Not Improved

Discharge Home

- If PEF > 60% predicted/personal best and sustained on oral/inhaled medications

Admit to Intensive Care

- If no improvement within 6-12 hours

Note: Preferred treatments are inhaled β_2 -agonists in high doses and glucocorticosteroids. If inhaled β_2 -agonists are not available, methylxanthines may be considered.

Part 6: Provide Regular Followup Care

Patients with asthma need regular supervision and support by a health care professional who is knowledgeable about the condition. Continual monitoring is essential to assure that therapeutic goals are met.

Once asthma control is established, regular followup visits, at 1- to 6-month intervals as appropriate, continue to be essential. During these visits, monitor and review treatment plans, medications, and level of asthma control.

SPECIAL CONSIDERATIONS ARE REQUIRED IN MANAGING ASTHMA IN RELATION TO:

- Pregnancy
- Surgery
- Physical activity
- Rhinitis
- Sinusitis and nasal polyps
- Occupational asthma
- Respiratory infections
- Gastroesophageal reflux
- Aspirin-induced asthma

Discrimination Prohibited: Under provisions of applicable public laws enacted by Congress since 1964, no person in the United States shall, on the grounds of race, color, national origin, handicap, or age, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity (or, on the basis of sex, with respect to any education program or activity) receiving Federal financial assistance. In addition, Executive Order 11141 prohibits discrimination on the basis of age by contractors and subcontractors in the performance of Federal contracts and Executive Order 11246 states that no federally funded contractor may discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. Therefore, the National Heart, Lung, and Blood Institute must be operated in compliance with these laws and Executive Orders.

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