
POCKET GUIDE FOR ASTHMA MANAGEMENT AND PREVENTION IN CHILDREN



A Pocket Guide for Physicians and Nurses
(Updated 2005)

**BASED ON THE WORKSHOP REPORT:
GLOBAL STRATEGY FOR ASTHMA MANAGEMENT AND PREVENTION
UPDATED (2005)**



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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 adoption of the reports, and promotes international collaboration on asthma research.

While childhood and adult asthma share the same underlying pathophysiological mechanisms, because of the processes of growth and development, the effects, and adverse effects of asthma and asthma treatments in children differ from those in adults. 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 2005). Scientific information and recommendations for asthma programs.
- *Pocket Guide for Asthma Management and Prevention*. Summary of patient care information for primary health care professionals. (updated 2005).
- *Pocket Guide for Asthma Management and Prevention in Children*. Summary of patient care information for pediatricians and other health care professionals. (updated 2004).
- *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 *Workshop Report: Global Strategy for Asthma Management and Prevention* (updated 2005).

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. The prevalence of asthma symptoms in children varies from 0 to 30 percent in different populations with the highest prevalence occurring in Australia, New Zealand and England.

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

- Avoid troublesome symptoms night and day.
- Avoid serious attacks.
- Use 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.

■ **Risk factors** for asthma include **host factors** that predispose individuals to or protect them from developing asthma (genetic predisposition, gender, and race) and **environmental factors** that influence the susceptibility to the development of asthma in predisposed individuals, precipitate asthma exacerbations and/or cause symptoms to persist. Exposure to allergens, viral and bacterial infections, diet, tobacco smoke, socioeconomic status and family size are the main environmental factors that influence the susceptibility to the development of asthma in predisposed individuals. Exposure to allergens and viral infections are the main environmental factors causing exacerbations of asthma and/or the persistence of symptoms in children.

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- Asthma **severity** can be intermittent, or it can be persistently mild, moderate, or severe. Children with intermittent asthma, but severe exacerbations, should be considered as having mild or moderate persistent asthma. 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.
 - 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, as well as 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 child/parent and the health care professional. The aim is to provide children and families 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.

DIAGNOSING ASTHMA

Do all children who wheeze have asthma?

The younger the child, the greater the likelihood that an alternative diagnosis may explain recurrent wheeze.

There are two general patterns of wheezing in infancy:

- Infants who have recurrent episodes of wheeze associated with acute viral respiratory infections, come from nonatopic families and have no atopy themselves. These infants usually outgrow their symptoms in the preschool years and have no evidence of subsequent asthma.
- Other infants with asthma have an atopic background often associated with eczema. Symptoms in these children often persist through childhood and into adult life. In these children characteristics of airway inflammation can be found even in infancy.

In young children with frequent wheezing, a parental history of asthma along with the presence of other atopic manifestations in the child are significantly associated with the presence of asthma at age 6.

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

Health care professionals are encouraged to use the word "asthma" rather than other terminology to describe recurrent viral-associated wheezing in early childhood.

Alternative but very rare causes of recurrent wheezing, particularly in early infancy, include cystic fibrosis, recurrent milk aspiration, primary ciliary dyskinesia syndrome, primary immune deficiency, congenital heart disease, congenital malformations causing narrowing of intrathoracic airways and foreign body aspiration. Chest radiography is an important diagnostic test to exclude such alternative causes of wheezing.

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 difficulty 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 in children over 5 years of age. 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.

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 in children 5 years and older.

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. It is important to use a “low flow” peak flow meter for younger children. Appropriate ages for use are usually indicated by the manufacturer. 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 child cannot achieve 80 percent of predicted PEF (predicted values are provided with all peak flow meters), it may be necessary to determine the child’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 child’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.org.

Other diagnostic considerations in children include the following:

- The presence of recurrent nocturnal cough in an otherwise healthy child should raise asthma as a probable diagnosis.
- A trial of asthma medication is probably the most confident way to make a diagnosis of asthma in children.
- The use of diary cards to record symptoms and PEF (in children over 5 years of age) readings are important tools in childhood asthma management.
- Some children with asthma present only with wheezing or coughing with exercise. If there is doubt in the diagnosis, a 6-minute running protocol followed by measurement of PEF showing a 15 percent drop or symptoms of wheezing or coughing following exercise can help establish a diagnosis of asthma.
- 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.
- Asthma should be considered if the child's colds repeatedly "go to the chest" or take more than 10 days to clear up, or if the child improves when asthma medication is given.

CLASSIFY ASTHMA SEVERITY

Classify asthma as intermittent, mild persistent, moderate persistent, or severe persistent based on the combined assessments of symptoms and lung function in children over 5 years of age. **Severity of asthma will determine the type of treatment required.**

When the child 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 child 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 child in that category.
- Children with intermittent asthma but severe exacerbations should be treated as having moderate persistent asthma.
- Children 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 children prevent most attacks, stay free of troublesome night and day symptoms, and keep physically active.

A six-part management program includes:

- Part 1. Educate children/families 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 infants and preschool children, school children, and adolescents with asthma.**
- 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 Children/Families To Develop a Partnership in Asthma Care.

- With your help, and the help of others on the health care team, children and their families 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 in children over 5 years of age.
 - Recognize signs that asthma is worsening and take action.
 - Seek medical help as appropriate.

-
- Working together, you and the child and their family 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, increasing use of reliever medication, 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 the child's age. 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 child's 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 in children over 5 years of age.
 - PEF monitoring at every physician visit, (spirometry is preferred but not always available), along with review of symptoms, helps in evaluating the child's response to therapy and adjusting treatment accordingly. PEF consistently greater than 80 percent of the child's personal best suggests good control.
 - Long-term PEF monitoring at home can help children and their families recognize early signs of worsening asthma (PEF less than 80 percent of personal best) before symptoms occur. Children and/or their parents can act promptly according to their personal asthma management plan to avoid serious attacks. Home PEF monitoring is not always practical, but for children 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 children and their parents 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 child/family:**

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 CHILD USING INHALERS, SPACERS, OR PEAK FLOW METERS CORRECTLY?**Ask the child/family:**

Please show me how you take your medicine.

Action to consider:

Demonstrate correct technique. Have patient demonstrate back.

IS THE CHILD TAKING THE MEDICATIONS AND AVOIDING RISK FACTORS ACCORDING TO THE ASTHMA MANAGEMENT PLAN?**Ask the child/family, 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 child to overcome barriers to following the plan.

DOES THE CHILD/FAMILY HAVE ANY CONCERNS?**Ask the child/family:**

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, children 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 cleaners with filters. |
| Tobacco smoke (whether the patient smokes or breathes in the smoke from others) | Stay away from tobacco smoke. Children and their families 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 child 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. Exercise symptoms can be prevented or diminished by taking a rapid-acting inhaled β_2 -agonist, or cromone, before strenuous exercise. Furthermore, continuous treatment with inhaled glucocorticosteroids markedly reduces the occurrence of exercise induced asthma. |
| Drugs | Do not take beta blockers or aspirin or NSAIDs if these medicines cause asthma symptoms. |

- **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 Infants and Preschool Children (Younger than 5 years), School Children (5-12 years), and Adolescents (12 years and older) With Asthma.

- 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 child'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 child 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 low doses 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 (DPIs), and nebulizers. Spacer (or holding chamber) devices make inhalers easier to use. Spacers also reduce systemic absorption and side effects of inhaled glucocorticosteroids. As CFCs in MDIs are being replaced by hydrofluoroalkanes (HFAs), the medication insert for dosage of the HFA preparations should be carefully reviewed by the clinician.
 - 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.
 - 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.

Additional information about available inhaler devices can be found on www.ginasthma.org.

| 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 Mometasone furoate 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 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. Medium and high doses have produced minor growth delay or suppression (avg.) 1 cm 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 Fig 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 children unable to tolerate the taste.</p> |
| <p>Long-acting β_2-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: Adolescents S: 4 mg q12 h Children: 3-6 mg/kg/day w/max 8 mg/day T: Adolescents; 10 mg 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> |

Table continued...

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

| Name and Also Known As | Usual Doses | Side Effects | Comments |
|---|---|---|--|
| Sustained-release Theophylline Aminophylline Methylxanthine | 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 10 mg qhs P 450 mg bid Z 20 mg bid; Zi 600 mg qid. Children: M 5 mg qhs (6-14 y) M 4 mg qhs (2-5 y) Z 10 mg 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) 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 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 Glucocorticosteroids for Children by Age

| Drug | Low Daily Dose (μg) | | Medium Daily Dose (μg) | | High Daily Dose (μg) | |
|--------------------------------------|----------------------------------|-----------|-------------------------------------|-----------|-----------------------------------|-----------|
| | >12yr | Age <12yr | >12yr | Age <12yr | >12yr | Age <12yr |
| Beclomethasone-CFC | 200-500 | 100-250 | 500-1000 | 250-500 | >1000 | >500 |
| Beclomethasone-HFA | 100-250 | 50-200 | 250-500 | 200-400 | >500 | >400 |
| Budesonide-DPI | 200-600 | 100-200 | 600-1000 | 200-600 | >1000 | >600 |
| Budesonide-Neb Inhalation suspension | 500-1000 | 250-500 | 1000-2000 | 500-1000 | >2000 | >1000 |
| Flunisolide | 500-1000 | 500-750 | 1000-2000 | 750-1250 | >2000 | >1250 |
| Fluticasone | 100-250 | 100-200 | 250-500 | 200-400 | >500 | >400 |
| Mometasone furoate | 200-400 | | 400-800 | | >800 | |
| Triamcinolone acetonide | 400-1000 | 400-800 | 1000-2000 | 800-1200 | >2000 | >1200 |

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 several clinical parameters and adjust the dose accordingly. The stepwise approach to therapy emphasizes that once control of asthma is achieved, the dose of medication should be carefully titrated to the minimum dose required to maintain control, thus reducing the potential for adverse effects.
- As CFC preparations are taken from the market, medication inserts for HFA preparations should be carefully reviewed by the clinician for the correct dosage level.

Stepwise Approach to Long-Term Management of Asthma in Children

Figure 8 presents the stepwise approach to therapy to achieve and maintain control of asthma in children older than age 5. **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 for 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: 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 for Children Younger than 5 Years of Age¹ | | |
|--|--|---|
| 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 Medications³ | Other Treatment Options⁴ |
| STEP 1 Intermittent⁵ | <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"> • Medium-dose inhaled glucocorticosteroid | <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 inhaled β_2-agonist, <i>or</i> • High-dose inhaled glucocorticosteroid <i>or</i> • 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 17 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 attacks may be life threatening. (Figure 10)
- Children/adolescents 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 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.**

■ 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 child/family is prepared and there is 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 | Talking Infant - softer, shorter cry; difficulty feeding | At rest Infant stops feeding | | | | | | | | | | | |
| Talks in | Sentences | Phrases | Words | Drowsy or confused | | | | | | | | | | |
| Alertness | May be agitated | Usually agitated | Usually agitated | Paradoxical | | | | | | | | | | |
| Respiratory rate | Increased | Increased | Often > 30/min | Paradoxical | | | | | | | | | | |
| Guide to rates of breathing associated with respiratory distress in awake children <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;"><i>Age</i></td> <td style="text-align: center;"><i>Normal rate</i></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> | | | | | <i>Age</i> | <i>Normal rate</i> | < 2 months | < 60/min | 2-12 months | < 50/min | 1-5 years | < 40/min | 6-8 years | < 30/min |
| <i>Age</i> | <i>Normal rate</i> | | | | | | | | | | | | | |
| < 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 | thoraco-abdominal movement | | | | | | | | | | |
| Wheeze | Moderate, often only end 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 | | | | | | | | | | | | |
| Preschool | 1-2 years | -Normal rate <120/min | | | | | | | | | | | | |
| School age | 2-8 years | -Normal rate <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 Possible cyanosis > 45 mmHg: Possible respiratory failure | | | | | | | | | | | |
| 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. Families should contact the physician promptly after initial treatment, especially if the child has had a recent hospitalization for asthma.

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 every 60 minutes
- Consider inhaled anticholinergic
- Systemic 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 every 60 minutes 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 methylxanthines
- Monitor PEF, O₂ saturation, pulse, theophylline

Admit to Intensive Care

- Inhaled β_2 -agonist hourly or continuously + 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

Children with asthma and their families 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.

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