

Managing Asthma

for
Patients and families



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The purpose of this educational material is to assist the patient and care givers in understanding the management of asthma. However, this is not a substitute for knowledgeable and skilled medical care. It requires medical decisions to confirm the diagnosis of asthma and formulate a treatment plan appropriate to the individual patient.

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RIGHTS AND RESPONSIBILITIES OF PATIENTS WITH ASTHMA

The management of asthma is most successful when the patient and/or family assumes an active role. To begin to do this, the patient (and/or family) must be effectively assertive in both accessing the medical care system and assuming responsibility for the day-to-day management of the disease. There are both reasonable expectations that patients and their families should have of their medical care providers, and they must also accept responsibilities for the actual administration of the care.

THE ASTHMATIC'S BILL OF RIGHTS

Asthma is the most frequent chronic disease in childhood and remains common throughout life. It is the leading cause of hospitalization in children, a frequent cause in adults, and an exceedingly frequent cause of emergency medical care at all ages. Asthma has been known to the medical profession for over 2000 years. The number of medications effective for asthma has increased considerably since the 1970s, and the sales of those medications have been progressively increasing. There is a major disparity, however, in the effectiveness with which therapeutic measures have been applied. Well-intentioned but misguided practices, occasional indifference, and medical attention focused on the immediate problem, rather than a comprehensive approach, cause frustrations for patients and their families. State-of-the-art care usually results in a high degree of successful control of asthma with acceptably safe and reasonably convenient therapy. Patients should therefore not settle for less. They should insist on:

- **The right to immediate care when needed for respiratory distress;**
- **The right to intensive treatment until respiratory distress is relieved;**
- **The right to measures that prevent the need for future emergency care;**
- **The right to accurate scientific medical knowledge about asthma;**
- **The right to a comprehensive evaluation to assure the diagnosis, characterize the pattern of symptoms, assess the severity, and identify the triggers of asthma;**
- **The right to an organized rational therapeutic plan and instruction to implement that plan;**
- **The right to medication that can safely, rapidly, and effectively relieve symptoms;**
- **The right to measures that can prevent frequent return of troublesome symptoms without side effects of treatment;**
- **The right to be able to take part in the same activities as non-asthmatics, including competitive athletics;**
- **The right to a knowledgeable physician with interest and expertise in managing asthma.**

THE RESPONSIBILITIES OF THE PATIENT AND/OR FAMILY

Asthma is a recurring or chronic problem. Treatment is best when applied by a patient or parent who understands the disease and its treatment. It is the physician's responsibility to determine the safest effective treatment and teach the patient how to apply that treatment. It is the patient's responsibility to:

- **Understand what asthma is and what it does;**
- **Know the names of the medications, both the generic name and brand name.**
(Please don't identify medications just by color! Colors for the same medication can vary with the manufacturer. All of the medications have names and should be clearly labeled! And besides, doctors often don't know what color they are!);
- **Know what each medication does for asthma;**
- **Know when each medication should be taken;**
- **Know possible side effects of each medication;**
- **Keep regularly scheduled appointments;**
- **Keep their asthma controlled;**
- **Know when to call the doctor for advice;**
- **Maintain a healthy active life-style if there are no other limiting medical problems;**
- **Discuss concerns regarding the asthma or its treatment with their physician.**

OVERVIEW OF ASTHMA

- **Common and important questions:**
 - " **What is asthma?**
 - " **Is all asthma the same?**
 - " **Why does someone get it?**
 - " **What can be done about it?**
 - " **Will it ever go away?**

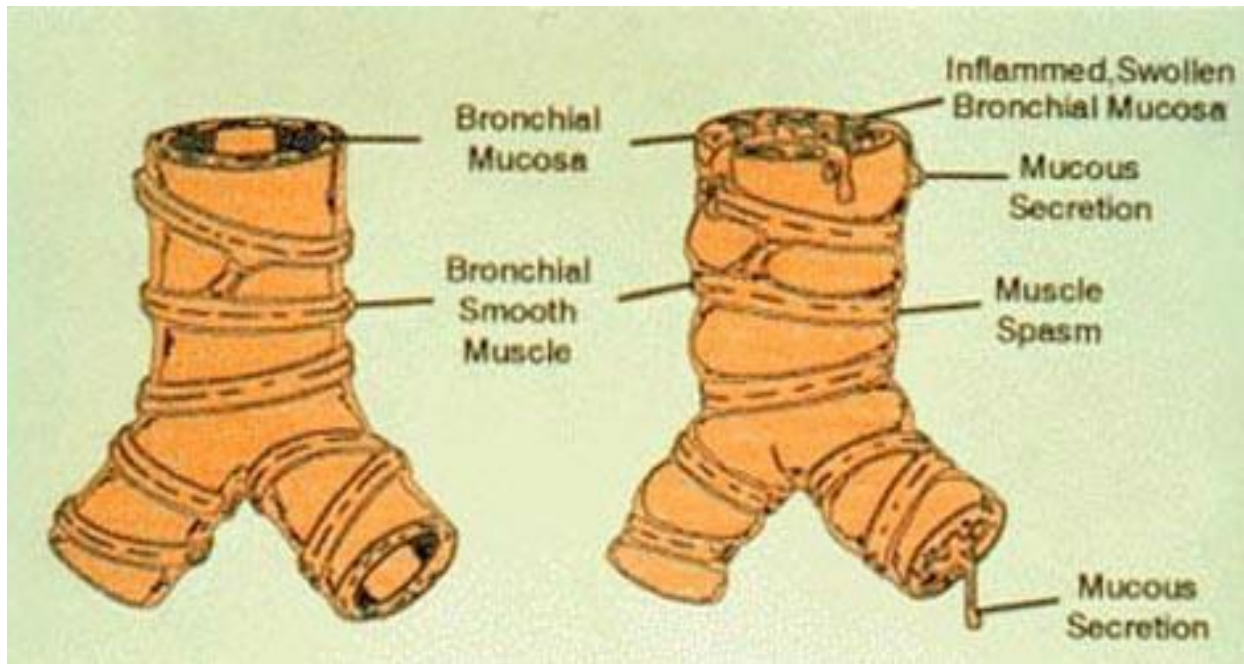
What is asthma?

Asthma occurs because the airways in the lungs overreact to various stimuli, resulting in narrowing with obstruction to air flow. This recurrently results in one or more of the following **symptoms**:

- **Tightness in the chest;**
- **Labored breathing;**
- **Coughing;**
- **Noises in the chest heard particularly during a prolonged forced expiration (wheezing).**

As a result of these symptoms, asthmatics may not tolerate exertion. They may be awakened frequently at night. More severe symptoms may result in requirements for urgent medical care and hospitalization. For a very few with particularly severe asthma, there is a risk of fatality.

Asthma affects the **airways**, which begin just below the throat as a single tube called the trachea. The trachea is situated immediately in front of the esophagus, the passageway that connects the throat with the stomach. The trachea divides into two slightly narrower tubes called the main bronchi (each one is called a bronchus). Each main bronchus then divides into progressively smaller tubes - the smallest are called bronchioles - to carry air to and from microscopic air spaces called alveoli. It is in the alveoli that the important work of the lung occurs, exchanging oxygen in the air for carbon dioxide in the blood. The airways (trachea, bronchi, bronchioles) are surrounded by a type of involuntary muscle known as smooth muscle. The airways are lined with a mucus membrane that secretes a fine layer of mucus and fluid. This mucus washes the airways to remove any bacteria, dirt, or other foreign material that might get into our lungs. The overreaction or hyper-responsiveness of the airways results in bronchospasm, which is excessive contraction or spasm of the bronchial smooth muscle. The airways also become inflamed with swelling of the bronchial mucous membrane (mucosa) and secretion of excessive thick mucus that is difficult to expel (*see illustration in Figure on next page*). It is part of the evaluation process to identify the role of each of these physiologic components in asthma. This is important because bronchospasm (constriction of the muscle surrounding the airways) and inflammation respond to different medications.



The airway hyper-responsiveness leading to obstruction of the airways occurs from one or more of various stimuli that vary with the individual patient. These include:

- Viral (but not bacterial) respiratory infections (i.e., common colds)
- Inhaled irritants (cigarette smoke, wood burning stoves and fireplaces, strong odors, chemical fumes)
- Inhaled allergens (pollens, dusts, molds, animal danders)
- Cold air
- Exercise
- Occasional ingested substances (aspirin, sulfite preservatives, specific foods).

Sometimes these exposures just act as triggers of brief symptoms with rapid relief once exposure ends. However, sensitivity of the airway may be increased following even brief exposure to one of these. This causes a longer period of asthmatic symptoms. More information should be provided to you for each of these that are judged to be important for your asthma.

The obstruction of the airways decreases the rate at which air can flow. This is felt as tightness in the chest and labored breathing (*dyspnea*). The obstruction and inflammation causes coughing. Obstruction to air flow can be measured with pulmonary function tests, which can detect even degrees of airway obstruction not yet causing symptoms. Pulmonary function measurements can be an extremely valuable tool for your physician to make decisions regarding treatment.

The increased mucus in the airways stimulates coughing as the body attempts to clear the airways. The unusually thick (*viscous*) mucus is difficult to expel, however, resulting in continued coughing that fails to adequately expel the mucus. General irritability of the airways also causes coughing. The coughing and mucus production may cause some

physicians to diagnose bronchitis. However, the term "bronchitis" simply means inflammation of the airways, and asthma causes airway inflammation. Consequently, anti-asthmatic medication, and not antibiotics, are the appropriate treatment. (Of course an asthmatic can, on occasion, have an infectious bronchitis that does not respond to anti-asthmatic medication, but this is usually viral and usual antibiotics are still not generally of any value - although there are exceptions to this generality).

Narrowing of the airway causes noises when air passes through them with sufficient speed. This typical high-pitched noise is called wheezing. Mucus in the airway causes a rattling sound. Complete obstruction of some airways can cause absorption of air from the alveoli (air sacks at the end of the airways in the lungs). This causes portions of the lung to appear more dense and cast more of a shadow on a chest x-ray (this is called *atelectasis*). The rattling sounds or increased shadows on the x-ray are often misinterpreted as indicating pneumonia. The inappropriate diagnoses of bronchitis and pneumonia cause much unnecessary use of antibiotics, which are ineffective both for asthma in general and for most of the infections, such as the common cold viruses, that trigger asthma.

Is all asthma the same?

Asthma is quite variable. Symptoms can range from trivial and infrequent in some to severe, unrelenting, and dangerous in others. Even when severe, however, the airway obstruction is usually fully reversible, either spontaneously or as a result of treatment. This means that symptoms can be relieved, airway obstruction can be reversed, and pulmonary function can be made normal.

There are different patterns of asthma. Some people have only an intermittent pattern of disease. They have self-limited episodes of varying severity followed by extended symptom-free periods. The individual episodes are frequently triggered by viral respiratory infections (causes of the common cold). This is particularly common in young children in whom viral respiratory infections are frequent (as many as 8 to 12 per year during the toddler and preschool age group). Others have these intermittent symptomatic periods brought on by vigorous exertion, cold air, or specific environmental exposures. This pattern is **intermittent asthma**.

More prolonged periods of symptoms occur in people who have asthma from seasonal outdoor inhalant allergens. This may be from grass pollen on the West Coast or mold spores from molds that grow on decaying vegetation in the Midwest. Through a knowledge of the aerobiology in your area and allergy skin testing, your physician can attempt to identify whether the symptoms fit into this pattern of disease. This pattern is **seasonal allergic asthma**.

Some patients have daily or very frequently recurring symptoms. Although variable in severity, these patients do not have extended periods free of chest tightness, labored breathing, exertional intolerance, or cough. They may additionally have acute exacerbations triggered by the same factors that cause symptoms with an intermittent or

seasonal allergic pattern of disease. Thus, viral respiratory infections (common colds) and specific environmental exposures may further increase the severity of symptoms in these patients. This pattern is **chronic asthma** (sometimes called persistent asthma).

All patterns of disease are associated with varying degrees of severity ranging from mild to severe. It is your doctor's job, with your help, to identify the pattern and severity of disease and provide effective **intervention measures** to rapidly relieve acute symptoms and determine appropriate **maintenance measures** for those with extended symptomatic periods.

Why does someone get it?

Over 10% of people have some history of asthma. It often runs in families. The heritable nature of asthma is not well understood, however, and geneticists cannot define the precise manner in which it is passed from parents to children. All we can say is that families with asthma are more likely to have children with asthma. Although there appears to be an inherited predisposition to develop asthma, severity varies considerably among asthmatics, even among members in the same family. If asthma is present in both parents, the likelihood of a child having asthma is even greater, but even then not all of the children will have asthma. Even among identical twins, both do not necessarily have asthma, although this is more likely than if they were just siblings or nonidentical twins. This suggests that there is some additional factor that we do not yet fully understand, other than inheritance, that influences the development of asthma.

Asthma commonly begins early in childhood, even in infancy. But it can begin at any time, even among the elderly. In many cases, asthma runs in families; sometimes it does not. Sometimes it goes away with time; sometimes it does not. We do not know what causes asthma to start nor can we predict who will lose it with time. We do know that most people with asthma can be provided with the means to control the disease and prevent symptoms that interfere with daily living. Rather than ask "Why do I have asthma?", it is better to ask "How can I control asthma so as to go about my usual activities without having interference from asthma?".

What can be done about it?

Asthma can be controlled. Moreover, it can be controlled by those who have asthma. The role of the physician is to provide the means for the patient to control asthma and to teach the patient to use provided measures (this is called physician-directed self-management).

Since asthma varies greatly in pattern of symptoms and severity, the treatment plan needs to be individualized. This should be done in a systematic manner. Goals of therapy must be realistically attainable and explicitly defined for you. The plan for attaining the treatment goals must be understood. Once the measures needed for control of asthma are identified, they can be placed in the hands of the patient with appropriate instructions for usage. Parental supervision is needed for young children, but progressive responsibility for self-management is given with advancing maturity.

Treatment may consist of medication, environmental changes, and life-style changes. The more the patient (or family for young children) understands the disease and its treatment, the better the outcome is likely to be. The patient (and family) should therefore be an active partner in making decisions about treatment. Be wary, however, of superstitions and misinformation regarding asthma. More than almost any other medical problem, asthma is associated with a wide diversity of medical and nonmedical opinion. Both the physician and the patient therefore need to exercise judgment. Four common sense measures to remember are:

- Ineffective measures should not be continued.
- Effective measures should be continued as long as they are needed unless risk exceeds benefit.
- Treatment should not be worse than the problem being treated.
- Treatment should be the simplest that is adequate.

Remember that it is not sufficient just to do what is prescribed. You must also understand why measures are used so that you can be an active partner in learning what measures are required and when they should be applied. Learn the names of your medications (both the brand name and the generic name). Be critical in your observations. Report observations and concerns regarding asthma to your physician. Ask questions. Answering your questions is part of the physician's job in providing you with the skills to manage your (or your child's) asthma. The final goal is for you, not the physician, to be treating the asthma. After all, you are there when it occurs. Your physician should try to determine the most appropriate therapeutic measures. However, these measures are not optimally effective until they are implemented by you.

Will it ever go away?

Asthma has a variable course. Many children with asthma see it improve or appear to go away as they get older. This can happen any time in childhood or adolescence. If asthma was only intermittent in nature and triggered by viral respiratory infections (a particularly common form of asthma in young children), there is an excellent likelihood that asthma will be much less of a problem as the child gets older. Sometimes the nature of the asthma changes with age. A young child may have asthma initially only from viral infections. As the child ages, asthma may occur less from viral infections (because older children get fewer viral respiratory infections than younger children), but inhalant allergy may become an important contributor to the asthma. If asthma persists into adult life, or returns later in adult life after a period of remission, persisting asthmatic symptoms may not be readily explainable by any environmental factors.

Approximately half of children with chronic asthma have little or no problem after adolescence. There appears to be no way to predict who will "outgrow" their asthma and who will not. This does not relate to severity, however. Very severe asthma often goes away, and mild asthma may persist. Even when asthmatic symptoms cease to be a problem for a while, this is not an assurance that asthma will not return later in life. We should

therefore not talk about "growing out of asthma" in children but should instead refer to extended periods of remission when asthma becomes quiescent. Asthma that persists into adult life, returns in an adult, or begins later in life, is much less likely to go into remission, although some waxing and waning of severity may occur.

Whatever the course, however, asthma is virtually always controllable with acceptably safe measures. While ongoing medical evaluation of asthma should assess whether the disease is still active and continues to need treatment, it is not wise to withhold treatment in the hope that asthma will go away by itself. That may indeed occur, but it may not, and there can be considerable avoidable suffering and disability in the interim.

Does asthma cause permanent damage?

The airway obstruction of asthma is generally completely reversible and usually does not cause permanent damage to the lungs, heart, or other organs. However, severe acute episodes of asthma can be life threatening and even fatal. Moreover, a severe life threatening episode can cause lack of oxygen to the brain with loss of consciousness and possible brain damage.

Chronic asthma with ongoing airway inflammation may also be associated with what is called "remodeling" of the airways. This describes permanent changes occurring in the tissues surrounding the airways that results in permanent narrowing of airways. The potential for this emphasizes the importance of monitoring pulmonary function in patients with asthma at regular intervals, particularly those with a chronic pattern of asthma.

GOAL OF TREATMENT - CONTROL OF THE DISEASE

The primary goal of treatment is the control of asthma.

What does control of asthma mean?

- Dealing effectively with acute exacerbations of asthma so that the need for urgent medical care is prevented;
- Preventing hospitalization for asthma;
- Tolerating all normal activities up to and including competitive athletics if otherwise able;
- The avoidance of symptoms that interfere with sleep;
- Normal pulmonary physiology (as measured by pulmonary function equipment);
- These goals should be reached safely and with the least interference with a normal life-style. The risks and bother of the treatment must be carefully weighed against the risk and bother of the asthma. The benefit obtained from the treatment must be worth any inconvenience and potential medication risks (and any medication has potential risks) imposed by the treatment.

In other words, it is the goal of treatment to determine the simplest, safest therapeutic measures that minimize disability, normalize lung function, avoid the need for acute medical care of asthma, and permit a normal life.

HOW THE TREATMENT GOALS ARE ATTAINED

Unfortunately, there is no magic bullet for asthma. While treatment can control symptoms safely and effectively for most patients most of the time, it is not a simple matter of the doctor writing a prescription and the patient taking the medication. Successful treatment of asthma is likely to require several steps on the part of physician. These include:

- Confirmation of the diagnosis (make sure it's asthma and not some other problem);
- Characterization of the asthma with regard to:
 - " Chronicity (how frequent are the symptoms and how persistent is the airway obstruction?)
 - " Severity (how bad do the symptoms get?)
 - " Identification of triggers (what makes the asthma worse?)
 - " Identification of the components of airway obstruction (bronchospasm, inflammation, or both?)
- Development of a plan to identify the least treatment that is safe and effective;
- Teach implementation of that plan (what to do and when!).

The diagnosis of asthma is suspected when a patient has a history of recurrent or chronic shortness of breath, labored breathing, or cough in the absence of any other obvious reason. The diagnosis is confirmed by obtaining evidence that there is airway obstruction that reverses either spontaneously or as a result of treatment with anti-asthmatic measures. The procedures used to make the diagnosis include a careful history, measurement of pulmonary function (unless not practical, as in young children), and therapeutic trials of medication.

Chronicity refers to the relative persistence of symptoms and signs of asthma. Some patients have only episodic or **intermittent asthma**; between relatively infrequent episodes of acute symptoms, they are completely asymptomatic. Other patients have extended periods of seasonally recurring symptoms due to seasonal inhalant allergens. This pattern is classified as **seasonal allergic asthma**. Yet others have **chronic asthma**. These patients may also have brief acute exacerbations or recurring seasons of worsened symptoms but differ from intermittent or seasonal allergic asthmatics in that they do not experience extended periods free of symptoms and signs of asthma.

Assessment of severity is independent of chronicity. For any of the classifications, symptoms may range from trivial to life-threatening. Severity of acute symptoms is judged by the degree of medical care needed. Some patients never require an urgent visit to a physician or an emergency room for their asthma while others have required frequent emergency care and hospitalizations. Asthmatic symptoms that have resulted in loss of consciousness or admission to an intensive care unit identifies a particularly dangerous degree of severity.

Severity of chronic symptoms is judged by the degree of disability resulting from the daily or frequently recurring symptoms that occur in the absence of effective medication. Patients may have daily symptoms that cause only minimal discomfort. These patients

tolerate activities and sleep undisturbed by their asthma. Others are literally pulmonary cripples with virtually no tolerance of activity and frequent disturbance of sleep by shortness of breath or cough.

Triggers of asthma, those identifiable factors that commonly worsen symptoms, include:

- Viral respiratory infections (common colds);
- Airborne allergens (such as pollens, mold spores, animal danders, dusts);
- Inhaled irritants (such as cigarette smoke, chemical fumes, strong odors, air pollution);
- Cold air;
- Exertion.

Other factors can also worsen asthma on occasion. Hyperventilation, excessively rapid and deep breathing, can worsen asthma. This occurs from anxiety in some patients, particularly when asthma symptoms have begun for some other reason. A vicious cycle then occurs of asthma causing anxiety, which then worsens asthma, thereby causing more anxiety, etc. Ingested substances, such as aspirin, sulfite preservatives, and specific foods can cause acute attacks of asthma in sensitive patients.

The components of airway obstruction in asthma include bronchospasm (constriction of the muscle surrounding the airways) and inflammation. The distinction is important because the responses of each to medical treatment are different. Bronchospasm (constriction of the muscle surrounding the airways) responds to bronchodilators, medication that relaxes the bronchial smooth muscle that causes narrowing of the airway from bronchospasm. Bronchodilator medications, however, have little or no effect on mucosal edema and mucous secretions caused by inflammation. Anti-inflammatory corticosteroids (no relationship to "steroids" used by athletes to build muscle) dramatically, though slowly, reduce the mucosal swelling and mucous secretions but have no direct ability to relax the bronchial smooth muscle and relieve the bronchospasm.

An organized plan should determine specific treatment needs to control the asthma. These include medication needs, environmental alterations, and indications for allergy shots.

Medication requirements can be divided into two categories:

- *intervention* measures to relieve acute symptoms;
- *maintenance* medication to prevent the rapid return of symptoms once the intervention measures are stopped.

Patients with an intermittent pattern of asthma require only intervention measures.

Patients with sustained periods of asthmatic symptoms or asthma that returns promptly after complete clearing with intervention measures require the use of maintenance medication in addition to intervention measures.

Virtually all patients should be taught to deliver an inhaled bronchodilator to relieve or prevent acute episodes of bronchospasm. This is all that is needed for many patients. The need for corticosteroids as an additional intervention measure should be assessed based on response to bronchodilator and prior history of severity. For those with sustained periods of symptoms, maintenance medication should be selected sequentially until symptoms and signs of asthma are adequately suppressed. The goal is to permit normal sleep and activities without excessively frequent addition of intervention measures (inhaled bronchodilators and short courses of oral corticosteroids) for breakthrough symptoms.

The need for environmental alterations should be individualized as carefully as medication selection. Non-allergic irritants such as cigarette smoke or chemical fumes are usually assumed to be potentially detrimental to asthma. The use of allergy skin testing helps identify potential allergic sensitivity to specific environmental exposures. When environmental alteration is not practical, allergy shots may be useful for treatment of some (but not all) clinically important airborne allergen sensitivities.

The treatment plan can be no more effective than its implementation. Most of the treatment, and certainly the most important aspects of the treatment, are carried out by the patient (or the family for young children). It is the physician's job (with help from other health professionals) to teach, and it is your job to learn how to carry out the treatment plan. This is an interactive and ongoing process. Use each contact, whether in person or by phone, to learn more about managing your (or your child's) asthma.

INFORMATION FOR SCHOOL PERSONNEL REGARDING TREATMENT OF ASTHMA

Asthma is a disease characterized by increased sensitivity of the airways. This results in airway obstruction that is reversible spontaneously or as a result of treatment. Asthma is very common; at least 5% of your students will have some manifestations of asthma. There are many misconceptions about asthma among both the medical and lay community. Specific myths that have been discredited include:

- ***Is asthma a psychosomatic disease?*** Asthma has no greater association with psychological problems than might be expected from any recurrent or chronic illness.
- ***Do asthma medications cause behavior or learning problems?*** No such association has been established. Any suspicion you have of side effects from asthma medication should be discussed with the physician caring for the student's asthma.
- ***Can asthmatics exercise safely?*** When asthma is satisfactorily controlled, asthmatics need not be restricted from any activity up to and including competitive athletics. In fact, exercise is desirable to promote physical conditioning in asthmatics. However, prophylactic inhaled medication may be needed before exercise, and there may be temporary periods when activities will be less well tolerated. School personnel, including physical education instructors, must let the student temporarily stop vigorous activities upon the judgment of the student that asthmatic symptoms are present. Please discuss with the parents and/or the physician responsible for the medical care of the student's asthma if exercise is not tolerated or if you feel the student is inappropriately avoiding activities.

There is a wide range of severity among individuals, so treatment is individualized. School personnel should be cautious in generalizing from their own personal experience with asthma which may reflect greater or lesser severity of asthma than any individual student.

INTERVENTION FOR ACUTE ASTHMATIC SYMPTOMS

- All students with asthma occasionally require intervention measures for acute symptoms, regardless of whether or not their symptoms are sufficiently chronic to justify a preventative maintenance medication. It is critical that use of the initial intervention measure, a bronchodilator inhaler, never be delayed. For this reason, it is essential that all students with sufficient maturity have their bronchodilator inhaler in their possession at all times. This bronchodilator inhaler is used at the discretion of the student for acute symptoms of asthma.
- The bronchodilator inhaler is also commonly used prophylactically before exercise to prevent exercise-induced asthma.

Who keeps the bronchodilator inhaler at school?

School policy restricting possession of medication by students is insufficient grounds for preventing students with sufficient maturity from retaining possession of their bronchodilator inhaler. Such policies, when enforced, delay appropriate treatment, restrict activities unnecessarily, and require that the student be identified among peers as requiring special attention. The decision regarding sufficient maturity of the student to be responsible for appropriate inhaler use is an individual one to be made by the parents in consultation with their physician. The inhalers pose no abuse potential or other danger to classmates. It therefore constitutes unreasonable interference with the student's medical care for school personnel to unilaterally restrict possession of bronchodilator inhalers by students judged by parents and physician to have sufficient maturity to use the device appropriately. While restrictions on bronchodilator inhaler possession may be necessary for the youngest students, the earlier students begin to take responsibility for their own inhaler use, the earlier they will be able to manage their asthma sufficiently to function in a fully peer-appropriate manner and thereby minimize feelings of difference from classmates. This feeling of control and self-confidence is important in the long-term management of asthma. Possession of the bronchodilator inhaler by the student also promotes earlier use that decreases the risk of requiring emergency medical care from rapidly progressive asthma, which on rare occasion can cause hypoxia, brain damage, and death.

Responsibility for care of their medical problem is also enhanced by permitting children with asthma to take their scheduled medication on their own. Discussion among parents, physician, and school personnel can determine whether school-supervised administration would improve or deter compliance.

DEALING WITH ANXIETY, FEAR, AND PANIC DURING AN ACUTE EXACERBATION OF ASTHMA

It is frightening and anxiety-producing to be unable to breathe comfortably. For some, anxiety interferes with treatment of acute asthmatic symptoms. If you (or your child) fail to respond to an inhaled bronchodilator but then rapidly respond to similar medication given by inhalation or injection at a doctor's office or emergency room, a likely explanation is anxiety interfering with the proper technique needed for delivery of the aerosol to the airways. This occurs because anxiety causes more rapid and often shallower breathing that can both aggravate the asthma further and decrease delivery of an inhaled medication. It is therefore medically essential that anxiety be controlled at least sufficiently to permit effective use of the inhaled bronchodilator.

How do I control anxiety?

Just saying "Relax" will not do the job. For children, it is essential that parents (or baby-sitters) keep their cool. It is difficult for visibly panicky parents to deal effectively with anxiety in a child. For children or adults, anxiety is often controlled by focusing on some specific behavior such as rate of breathing.

Two techniques are used to slow respiration increased by anxiety:

- slow drinking of any liquid;
- breathing exercises.

Sitting down with a glass of liquid ranging from water to any flavored beverage imposes a degree of relaxation by distracting patients from their discomfort. Additionally, breathing must slow down in order to drink. Once breathing is slowed, use of the inhaled bronchodilator is likely to be more effective.

Breathing exercises are a method of gaining control of respirations by "overriding" the anxiety-producing ventilatory drive. The technique is as follows:

1. Sit down.
2. Take a long slow deep breath while pushing on your upper abdomen with folded hands.
3. Let the air out slowly through "pursed" lips, i.e. the lips should be kept almost completely closed, sufficient to cause considerable resistance.
4. Repeat the slow inhalation with abdominal compression and "pursed" lip expiration at least 2 more times.
5. Try the prescribed inhaled bronchodilator again concentrating on the proper technique.
6. Repeat procedures 1 through 5 if needed.

If difficulty breathing is so severe and sudden in onset that the above relaxation technique does not permit effective delivery of inhaled medication, a self-injecting adrenalin syringe (e.g., **EpiPen**) provides a useful though rarely needed emergency measure for temporary relief. This can then permit the above procedure to be used. *Discuss this with your doctor if you feel that your situation justifies this measure.*

ASTHMA AND PREGNANCY **(Effects on the mother and baby)**

Asthma need not complicate pregnancy, and pregnancy does not usually influence the course of asthma. There are, however, several relevant questions.

Is asthma a risk to the unborn child?

Asthma that is sufficient to cause decreased ability of the lungs to provide the body with oxygen can cause a risk to the unborn child. That risk is most grave if the asthma is active and not adequately managed during labor and delivery. When asthma is well managed and satisfactorily controlled, there is no risk to the unborn child.

Does any of the treatment for asthma cause a risk to the unborn child?

As with many medications, there is not sufficient information to provide absolute assurance that there is complete absence of risk. Nonetheless, most medications used for asthma have had extensive use, and no harm to the unborn child has been demonstrated from any appropriately used antiasthmatic medications. If used in a manner that is safe for the mother, no apparent harm occurs to the baby with currently available antiasthmatic medications. As a precaution, however, newly marketed antiasthmatic medications should probably be avoided during pregnancy until there have been several years of experience.

Will the medications for asthma be a problem with breast feeding?

As with many medications, some of the antiasthmatic medications may appear in small quantities in the breast milk. If used in dosages that are safe for the mother, the dose received by the infant is unlikely to be of any importance.

Will the baby develop asthma?

The predisposition to have asthma is inherited. The child of an asthmatic mother (or father) is therefore more likely to have asthma than the child of someone without asthma in the family. However, most children of an asthmatic mother will not have asthma. Moreover, asthma, even when present in the child, is more commonly mild than severe, even if the mother's asthma was severe. Since even severe asthma is generally controllable with acceptably safe medication, concern about the baby developing asthma should not be a deterrent to having children.

Medication use for asthma

Medication for asthma should be viewed in two broad functional categories:

- **Intervention measures** - those medications used to stop acute symptoms of asthma
- **Maintenance measures** - those medications used to prevent symptoms from occurring. However, maintenance medication do not prevent urgent medical care or hospitalizations from acute exacerbations of asthma and are therefore of no routine value for those patients whose asthma is limited to intermittent viral respiratory induced exacerbations, as is most common among pre-school age children. Early use of intervention measures is essential for those acute exacerbations.

All patients with asthma require the availability of intervention measures. Only patients with chronic asthma or extended periods of persistent symptoms or airway obstruction require maintenance medication. However, no safe maintenance medication is reliably effective in preventing all acute exacerbations, especially those triggered by viral respiratory infections. Patients who have only intermittent asthma triggered by viral respiratory infections are not likely to benefit from maintenance medication, and patients with chronic asthma who have a viral respiratory infection are likely to require intervention medication at those times.

Which are the most effective intervention measures?

There are two categories of medication that, when used appropriately, provide highly effective intervention:

- **Inhaled bronchodilators** - these rapidly relax the spasm of bronchial smooth muscle that narrows the airway and creates obstruction to air flow
- **Anti-inflammatory corticosteroid medications taken by mouth or, if necessary, by injection** - these decrease the mucosal edema and stop the mucous secretions that obstruct airways

The most effective initial intervention measures are **inhaled bronchodilators** of the drug class known as **beta-2 agonists**. The most common of these is **albuterol** (known as salbutamol outside the United States). It is available generically and as the brand names **Proventil** and **Ventolin**. It can be delivered by various nebulizer devices and metered dose inhalers. **Pirbuterol** is closely related to albuterol and is therapeutically equivalent; it is available as a metered dose device that delivers the medication automatically upon inhalation (the brand name is **Maxair Autohaler**). There are several others available in this family but are less commonly used and have no advantage over albuterol and pirbuterol. *As effective as these agents are for relief of acute symptoms, they provide no value as routinely scheduled medication.*

Albuterol and other beta-2 agonists are also available in tablets and syrups for oral administration. However, they are much less effective by that route and have more side effects. Another inhaled bronchodilator unrelated to the beta-2 agonists is **ipratropium (Atrovent)**. It is available as a nebulizer solution or metered dose inhaler. It has no routine

role in the outpatient management of asthma but may be of value by nebulizer in the emergency care setting when there is severe airway obstruction that responds inadequately to albuterol aerosol.

WARNING: The greatest danger from overuse of inhaled bronchodilators for intervention results from their prompt but often transient effectiveness. This can result in delayed recognition and progression of the inflammatory component of airway obstruction from asthma. The inhaled bronchodilators relieve only the airway narrowing from spasm of the bronchial smooth muscle. A short course of oral corticosteroids may be needed for patients who have progressive or prolonged periods of asthmatic symptoms as a result of airway inflammation. However, corticosteroids are slow to work, so it is important to recognize as early as possible when this inhaler is incompletely effective, suggesting that inflammation in addition to bronchospasm is present and that oral corticosteroids may be needed to prevent emergency care or hospitalization. While repeating the inhaler is appropriate if an initial use is incompletely effective, the need for a third use in a 4-hour period for recurrent symptoms or repeated use with decreasing periods of effectiveness requires a prompt call for further medical advice.

When response to inhaled beta-2 agonist bronchodilators is incomplete, airway inflammation is generally a major contributor to the airway obstruction, and an **anti-inflammatory corticosteroid** medication is needed. The oral route is most effective for reversing the acute inflammatory process causing bronchodilator subresponsiveness. The most common medications in this class used are **prednisone**, **prednisolone**, and **methylprednisolone**. High doses for short periods of time (5-10 days) are safe and highly effective at reversing airway obstruction. If used early enough at adequate doses, this strategy prevents progression of asthmatic symptoms and avoids the need for urgent medical care or hospitalization. While high doses are generally well tolerated for this period of time, some people (about 10%) experience irritability and other minor side effects after the first day or two. Decreasing the dose at that time to once daily in the morning generally eliminates those side effects. **Methylprednisolone** appears to be less likely to cause such side effects. Prednisolone is available as several liquid formulations. **Orapred** at 3 mg/ml is the best tasting and most convenient of these liquid formulations. It is desirable to teach children to swallow solid dosage forms as soon as possible so they don't have to be dependent on liquid medications, which are always more expensive than their comparable solid dosage forms and certainly messier. Children from age 3 on up can often be taught to swallow solid dosage forms without chewing (you don't want to chew a prednisone or methylprednisolone tablet - they are very bitter). After all, they have all swallowed chewing gum or food particles larger than a tablet by that time. One successful technique is to use a non-threatening product like M&Ms or jelly beans and tell them that for each one they swallow whole, they get to chew the next two. Most catch on quite quickly. To assure a young child doesn't get the taste of prednisone while swallowing the tablet (which will be a potential turnoff to future attempts), clear gelatin capsules can be obtained from a pharmacist and the tablet placed in that (breaking the tablet in half if necessary so it will fit). The traditional practice of many physicians of using tapering doses is irrational and

inconsistent with controlled clinical trials in the medical literature. The best practice is to continue a high dose till symptoms are gone and then discontinue. If improvement has not occurred unequivocally by 5 days, or if there is not complete absence of symptoms by 7-10 days, further medical evaluation is needed.

While anti-inflammatory corticosteroid medications are available for inhaled and oral administration, the inhaled route is not optimally effective for treating acute symptoms. The oral or injectable route is therefore preferred for intervention when acute exacerbations of asthmatic symptoms occur. The inhaled route is best reserved for maintenance medication of chronic asthma with persistent symptoms. Injections of corticosteroids are no more effective than oral administration unless oral medication cannot be given or is not retained.

What are the choices for maintenance medication to prevent symptoms in patients identified as having a chronic or extended seasonal pattern of symptoms?

Maintenance medication is indicated as a preventative measure for patients who have continuous or frequently recurring symptoms of asthma. These patients have asthmatic symptoms that promptly return even after being completely cleared with vigorous intervention measures. Since maintenance medication may be needed on a long-term basis, safety and convenience are prime considerations. In general, there are enough alternatives to avoid side effects from the medication, and any suspected side effects should be discussed with your physician. Each alternative has its own advantages and disadvantages. Maintenance medication needs to be systematically determined for each patient. No more should be used than is necessary to control the asthma. A single maintenance medication is often sufficient. Two medications should be used only if the two provide an advantage over one. More than two maintenance medications for asthma are occasionally justified for patients with severe asthma. Intervention measures must still be available for breakthrough symptoms. No maintenance medications reliably prevent all acute exacerbations, especially those triggered by viral respiratory infections.

For patients requiring long-term maintenance medications, careful consideration should be given to treatment measures that do not involve medication. Some patients have their asthmatic symptoms reduced with environmental measures. While some environmental exposures such as cigarette smoke and wood burning stoves are common irritants that can worsen asthma in many patients, others involve allergic reactions to substances that are otherwise harmless to nonallergic people. Identification of allergy as a cause of asthma requires evaluation by a physician knowledgeable about environmental allergens who will review the medical history of symptoms and perform tests to identify allergic antibody to environmental allergens. In some cases, the use of allergy shots may be considered as an effort to decrease sensitivity to inhalant allergens judged important in triggering asthma.

Once maintenance measures that control the asthma are determined, repeated reevaluation at regular intervals helps assure continued safety and effectiveness of treatment in addition to assessing the continued adequacy and/or need for medication.

Inhaled corticosteroids that have a high degree of topical potency at low delivered doses have been available in the U.S. since 1977 with experience elsewhere for several years prior to that. They are the most effective single medications for asthma. These include **beclomethasone dipropionate (Beclovent and Vanceril are older formulations, QVAR 40 and 80 is a newer improved preparation), triamcinolone acetonide (Azmacort), flunisolide (Aerobid), fluticasone (Flovent 44, 110, & 220), and budesonide (Pulmicort Turbuhaler and Nebules)**. The inhaled corticosteroids have acquired a sufficient safety record that their use as an initial maintenance medication for chronic asthma is justified. However, there are some potential side effects that appear to be dose related. Small decreases in growth have been shown, predominantly at higher doses (but uncontrolled asthma also has the potential to suppress growth). A very small increased risk of cataracts has been reported in adults; that risk appears to be related to the dose and duration of administration. Potential effects on bone metabolism have been suggested from sensitive biochemical studies, but development of osteoporosis seen with long-term daily oral corticosteroids has not been seen with inhaled corticosteroids. However, the potential for side effects, even if very low risk, justifies determining the lowest dose that provides good control of asthma. Other medications such as **salmeterol (Serevent) and slow-release theophylline (Theodur, Slobid, or generically equivalent formulations)** when added to inhaled corticosteroids provide greater benefit than increasing the dose of inhaled corticosteroids. A combination product containing an inhaled corticosteroid (fluticasone) and salmeterol is marketed with three alternative concentrations of fluticasone, each with the standard dose of salmeterol (**Advair 100, 250, and 500**). **Montelukast (Singulair)** also provides some degree of added benefit when added to an inhaled corticosteroid.

Alternate-morning oral corticosteroids have been used for over 30 years as maintenance medication for asthma and other corticosteroid responsive diseases. The alternate-morning schedule is a strategy to obtain the effectiveness of oral corticosteroids in suppressing the disease while avoiding the well-recognized and potentially serious side effects of long-term daily oral corticosteroids. Most patients do not experience recognizable side effects from alternate morning oral corticosteroids. They have generally been used for asthma in combination with theophylline to obtain maximal clinical effect at doses of 20 to 40 mg every other morning. They are easier to use and less expensive than inhaled corticosteroids, but some patients gain weight with their usage because of appetite stimulation. The inhaled corticosteroids rarely cause weight gain. However, they do require more frequent administration, cost more, sometimes cause hoarseness and thrush, a minor fungal infection in the mouth, and are more frequently not taken as regularly as prescribed.

Theophylline is administered as an oral slow release capsule or tablet such as **Slo-bid Gyrocaps, Theo-Dur Tablets, or their generic equivalents**, which require only twice daily administration. This medication had been the most commonly used maintenance medication for asthma in the U.S. for many years, and it still has a high degree of efficacy as an initial agent or when added to inhaled or alternate-morning oral corticosteroids. The combination of theophylline and low dose inhaled corticosteroid is more effective than a higher dose of inhaled corticosteroid alone. For young children, the Slo-bid Gyrocaps or generic equivalent capsule can be opened and the contents sprinkled on a spoonful of soft

food. Many patients appear to take an oral medication like theophylline more regularly than an inhaled maintenance medication. Only a morning and evening dose are needed. However, dosage needs to be individually adjusted based on a blood test to assure effectiveness and safety.

Long acting inhaled beta-2 agonist bronchodilators such as **salmeterol (Serevent)** and **formoterol** are chemically related to intervention bronchodilators such as albuterol and pirbuterol but can last 12 hours. They are intended as daily maintenance treatment rather than as intervention for acute symptoms. Not generally recommended as initial therapy, their primary role is as additive therapy to inhaled corticosteroids. Adding a long acting inhaled beta-2 agonist bronchodilator or theophylline to low doses of inhaled corticosteroid is more effective than higher doses of inhaled corticosteroid alone. Because of the long duration of action, it is important that these long acting beta-2 agonist bronchodilators are not used additionally as intervention measures to treat acute symptoms. However, there is no contraindication to continuing use of albuterol or pirbuterol as an intervention measure.

Leukotriene modifiers include a medication, **zileutin (Zyflo)** that decreases the production of a leukotriene, a substance that is one of the mediators of inflammation in asthma, and two medications that antagonize the activity of that leukotriene, **zafirlukast (Accolate)** and **montelukast (Singulair)**. **Zileutin** requires 4 times daily administration and has been associated with liver abnormalities; it therefore has little general appeal. **Zafirlukast** is a twice daily medication that is generally quite free of side effects but does have some potential for certain drug interactions and, although not proven to be a cause, has been associated with a rare but serious disorder called the Churg Strauss syndrome, but only in adults. **Montelukast** is a once daily medication, available also in a chewable tablet for young children, which has no identified adverse effects or drug interactions. While there have also been a few cases of Churg Strauss syndrome seen in adults taking montelukast, the weight of medical opinion is that neither of the leukotriene antagonists actually cause this clinical problem. The most common theory about the appearance of Churg Strauss syndrome in patients taking leukotriene antagonists is that this is simply being unmasked as patients are withdrawn from their previous dose of oral corticosteroids used for what was believed to be asthma but was in fact suppressing the symptoms and signs of Churg Strauss syndrome.

Cromolyn (Intal) and a newer medication with similar effect, **nedocromil (Tilade)** are inhaled medications that are relatively weakly potent, require multiple daily administration, and have little or no additive effect with other medications. They act by preventing the release of some mediators of the asthmatic response. Their primary merit is an almost complete lack of any serious side effects, even with overdose. Unlike the inhaled bronchodilators, cromolyn and nedocromil have no immediate effect and do not relieve acute symptoms. Although potentially effective for many patients with mild chronic asthma, they appear to be no more effective than montelukast, a once daily oral medication, and less effective than theophylline or inhaled corticosteroids.

Ketotifen is an oral medication with antihistaminic effects that also is reported to have some of the effects of cromolyn or nedocromil. While popular elsewhere, studies regarding its efficacy for asthma have been unimpressive, and it has not become available in the U.S.

Omalizumab (Xolair) is a humanized monoclonal antibody against immunoglobulin E (IgE), the allergic antibody that can cause allergen-induced asthma from airborne substances such as pollen, molds, dust mite, and animal dander. Given as an injection every 2-4 weeks (depending on the dose determined by body weight and the total IgE level measured in a blood test), this new (and very expensive) medication has the potential to almost completely eliminate the allergic antibody and thereby prevent that allergic antibody from causing asthma. The degree of benefit from Xolair is likely to relate to the extent to which allergy contributes to the individual's asthma. Since asthma is a multifactorial disease, the extent to which allergy contributes to asthma ranges from none in some to a major component of the disease in others.

DELIVERY OF INHALED MEDICATION

Use of an inhaled medication by a metered-dose inhaler

Inhaled medications are available in various types of metered-dose inhalers containing various types of medications.

The types of inhalers include pressurized metered dose inhalers and dry powder inhalers. While most metered dose inhalers require that actuation of the inhaler be carefully coordinated with inspiration, at least one type of pressurized metered dose inhaler, the **Maxair Autohaler**, is self actuated by the inspiratory effort. The dry powder inhalers are becoming increasingly available as an alternative. These have the advantage of delivering the medication with the inspiratory effort. However, all inhalers require careful attention to proper technique to ensure drug delivery. You should receive instruction when these are prescribed, and technique should be demonstrated at each regular physician visit.

The types of medication in inhalers includes bronchodilators for **intervention** (albuterol, pirbuterol) to treat acute symptoms, anti-inflammatory corticosteroid medications for **maintenance** treatment of asthma, and long acting bronchodilators (salmeterol, formoterol) as adjunctive maintenance medication to be added to inhaled corticosteroids when low doses of the inhaled corticosteroid are inadequate for control of asthma.

Use of an inhaled medication by a metered-dose inhaler with an aerosol holding chamber as an assist device

Two types of assist devices can be used with pressurized metered dose inhalers in an attempt to improve delivery of medication. While simple spacers are simply extender tubes that result in reducing the amount of drug that settles out in the mouth and throat by having the larger particles settle in the extender tube, holding chambers are tubes or chambers with one way valves (the **AeroChamber Plus** and the **Pari Vortex** are two that are best studied) that enable the drug to be delivered into the tube and then inhaled from the tube without having to precisely coordinate inspiration with actuation of the inhaler. They are available with 3 different sizes of a soft flexible face mask that when pressed firmly against the face of an infant or young child permit drug to be delivered when they inhale without active cooperation on the part of the patient. When prescribed on of these devices, specific instructions and demonstration should be provided and reviewed at regular intervals.



Example of inadequate delivery of medication from a metered dose inhaler. This child had placed the inhaler in her mouth and actuated it, but little or no medication reached her lungs - it stayed in her mouth as is apparent after she removed the inhaler from her mouth.



This 5 y.o. child, the same age as the child to the left, was able to actuate the inhaler and then breath through the valved chamber, AeroChamber Plus or Pari Vortex) taking several breaths to evacuate the medication from the chamber.



Proper hand position for an infant or young toddler to maintain seal of face mask for a child who wiggles (*the hand and mask will move with the face*). This is the Pari Vortex. The mask has a duck face that seems to entertain this age group.



This 2 year old child is using a valved holding chamber with a soft flexible face mask (Aerochamber Plus with ComfortSeal Mask). Up to six inhalations of albuterol (one at a time with 3-4 breaths to ensure evacuation of the medication from the chamber) is simpler and quicker than administration of albuterol by nebulizer and has been shown to be as effective.

Use of an inhaled medication by a nebulizer system

Since inhaled medication can be delivered just as effectively for most children using a metered dose inhaler with an assist device when needed, the traditional use of nebulizers to deliver aerosol medication should rarely be needed. They are more cumbersome, more expensive, and more time consuming to use than a metered dose inhaler with an assist device if needed. Even for infants, a device such as the AeroChamber Plus with soft flexible face mask delivers medication as effectively and much more rapidly than a nebulizer. Since the usual dose of albuterol by nebulizer is 2.5 mg and each actuation of a metered dose inhaler delivers 0.1 mg, studies demonstrating similar effect of albuterol in emergency rooms have used 6 actuations of the albuterol metered dose inhaler (one at a time with several breaths after each actuation into the chamber to evacuate the medication).

When a nebulizer is used, a face mask is preferred for infants and toddlers, while a mouthpiece is preferred if the child will use it. Effective delivery to the lungs is best served by mouth-breathing. Nose breathing filters out the medication thereby decreasing delivery to the lungs. A screaming child gets less medication than during quiet breathing. Holding the mask or the end of the tube away from the face greatly decreases the amount of delivered medication.

ADMINISTRATION OF ORAL MEDICATION TO YOUNG CHILDREN

Children vary in how well they are willing to take medication. The problem can be compounded when the medication is foul tasting. One solution is to teach children to swallow tablets or capsules whole as early as possible. This can be done at a much earlier age than is generally presumed (after all, toddlers often swallow chewing gum whole in addition to many other things they shouldn't swallow). Using m&m candies or jelly beans, the child can be offered the reward of being permitted to chew the next two for each one swallowed whole. They tend to learn fast when thus motivated. Once that is done, prednisone tablets (which are bitter if tasted) can be placed in empty gelatin capsules (available from a pharmacist) to avoid even the transient taste if the prednisone tablets are not swallowed quickly enough.

PREVENTING EXERCISE-INDUCED ASTHMA

Exercise limitation is one of the more common results of asthma. This can result in part from persisting obstruction to airways at the time exercise is attempted. More commonly, however, the involuntary muscle surrounding the airway is triggered to contract by the deep breathing occurring during the exercise. This is commonly termed exercise-induced asthma or exercise-induced bronchospasm.

If asthma is otherwise not troublesome or is well-controlled with maintenance medication and pulmonary function is normal or near-normal before exercise, the airway

obstruction triggered by exercise is reliably and easily prevented with an inhaled bronchodilator. At least two inhalations of one of the modern generation of inhaled bronchodilators used with proper technique should effectively block this asthmatic airway response to exercise for at least 2 hours.

With prophylactic use of the inhaled bronchodilator, asthmatics can generally take part in all physical activity, including competitive athletics, without limitations imposed by the asthma. In fact, physical exercise is encouraged for asthmatics because physical conditioning itself decreases the patient's susceptibility to exercise-induced asthma.

ENVIRONMENTAL ASPECTS OF ASTHMA MANAGEMENT

Asthma and smoking

Asthmatics are at double risk from smoking:

- Smoking increases asthmatic symptoms.
- Asthmatics are at greater risk of developing irreversible airway damage from smoking.

When smoking increases asthmatic symptoms, medication requirements increase. Smokers are then exposed to additional risks of medication that otherwise may not be needed. Even with the additional medication, control of asthma may be difficult to attain while smoking. Therefore, asthmatics should not smoke. If they do, they should not expect the degree of success from medical management attainable for nonsmokers, and they must personally accept the possible risks of medication that might otherwise be needed.

Second-hand or passive smoke refers to the smoke contaminating indoor air from the presence of smokers. This smoke is inhaled by smokers and nonsmokers alike and increases the asthmatic symptoms of many patients. Children with asthma in the homes of smoking parents have more asthmatic symptoms and more emergency care requirements for asthma than similar children in homes where there are no smokers. Smoking in the presence of an asthmatic child with a history of significant illness is therefore considered a form of child abuse.

In addition, parents who smoke set an example that teaches their children to smoke. If that child has asthma, then not only is the child's asthma likely to be worse from the passive smoking, but that child is also more likely to begin a lifelong habit of smoking during adolescence and be at substantial risk for developing irreversible lung-damage in midlife from smoking.

Asthma and allergies

Many people with asthma have allergy to inhalants as triggers to their asthma. The extent to which allergic factors bothers asthma varies widely among individuals. Assessment of allergic factors requires careful medical evaluation including a detailed history and a measure of the degree of allergic antibody. Determination of allergic antibody requires either allergy skin testing or specific types of laboratory tests on blood. Neither a history of symptoms or the skin testing alone can define the extent to which allergy contributes to problems. Medical assessment requires careful consideration of both the allergy testing and the history obtained by someone familiar with both asthma management and the aerobiology of inhalant allergens.

USE OF ASTHMA DIARIES

An asthma diary can provide your physician with invaluable firsthand information regarding your asthma. As you well know, symptoms of asthma fluctuate and may not be present at all when you see your doctor. Your physician, however, must make decisions regarding the medical indications for adding, continuing, or withdrawing medication. The diary provides information that is more accurate than trying to remember what happened over weeks or months when you are seen for a scheduled medical appointment. This, in turn, results in better medical decisions.

The question regarding asthmatic symptoms "last night" should be completed upon awakening in the morning. The second question line asks for a "morning peak flow" measurement. Not all patients are asked to keep track of peak flow measurements. This procedure is discussed separately. The subsequent questions are completed at bedtime and ask about symptoms during the day. Keeping the diary and a pencil beside the bed and completing it at bedtime and on arising is probably the easiest way of not forgetting. Always bring the diary with you to appointments with your physician.

Two sample diaries are illustrated in the following pages (standard for older children and adults, simplified for children and adults with lesser language skills).

ASTHMA DIARY FOR _____

Complete diary by checking the correct box or filling in the requested value

	Month _____ Day _____							
Last night	Good night							
	Slept well but some wheeze or cough							
	Awake briefly with wheeze or cough							
	Bad night, awake repeatedly							
Morning Peak Flow*	(best of 3 efforts)							
Activity	Vigorous activity OK							
	Can run only briefly							
	OK for walking only							
	Must rest at home							
Wheeze	None							
	Briefly, not troublesome							
	Several times							
	Continuous							
Cough	None							
	Present but not troublesome							
	Interrupted activities once							
	Interrupted activities more than once							
Evening Peak Flow*	(best of 3 efforts)							
Intervention	Inhaled bronchodilators (no. of treatments)							
	Oral corticosteroid (dose)							

*Use only if clinically indicated – see following section on Peak Flow Meters

ASTHMA DIARY FOR _____

Complete diary by checking the correct box or filling in the requested value

	Month _____ Day _____							
Last night	Good night							
	Slept well but a little wheeze or cough							
	Woke once or twice							
	Bad night, awake a lot							
Morning Peak Flow*	(best of 3 efforts)							
Activity	No problem							
	Can run a little bit							
	Can't run at all							
	Had to rest all day							
Wheeze	No							
	Yes, 2 times or less							
	Yes, more than 2 times							
	Yes, all the time							
Cough	No							
	Yes, a little							
	Yes, keeps me from doing some things							
	Yes, bothers me a lot							
Evening Peak Flow*	(best of 3 efforts)							
Intervention	Inhaled bronchodilator (no. of treatments)							
	Oral corticosteroid (dose)							

*Use only if clinically indicated – see following section on Peak Flow Meters

USE OF THE HOME PEAK FLOW METER

The home peak flow meter is a simple portable device for measuring a component of lung function. It is generally no more useful than careful symptom monitoring for most patients. It is also not a substitute for more sophisticated pulmonary function equipment that provides more accurate and complete evaluation of lung function. However, the peak flow meter, by providing the ability to monitor lung function at home, provides potentially valuable information for those few individuals who do not recognize airway obstruction until it becomes severe.

While some recommend routine use of the peak flow meter, most people with asthma gain little additional information since they readily perceive symptoms of chest tightness, shortness of breath, wheeze, or cough when their asthma is active. However, others do not perceive symptoms early in the course of active asthma. This is especially true for patients with severe chronic asthma. Those with longstanding severe chronic asthma frequently are quite tolerant to living with airway obstruction that would be uncomfortable for others with only occasional or less severe asthma. The peak flow meter can provide potentially valuable information for such individuals. Use of the peak flow meter can also assist a patient who confuses anxiety symptoms with asthma. Anxiety is sometimes associated with a feeling of being unable to get enough air. However, the peak flow will be normal in such cases in contrast to the decreased values associated with acute symptoms from asthma.

The peak flow meter measures the fastest flow of expired air that can be produced with maximal effort. Since narrowed airways from asthma will decrease the maximal rate of air flow, this is a measure of active asthma. Therefore, the home peak flow meter, when used properly by people with severe chronic asthma who perceive asthma poorly, may tell you and your physician when airways are narrowing from asthma. Progressively falling peak flow measurements also can provide you and your physician with early warning signs of worsening asthma and permit earlier and therefore more effective intervention for acute exacerbations.

The instructions that come with the peak flow measuring device should be read to understand the operation and care of the instrument. Perform the peak flow by:

- First relaxing while taking a few slow moderately deep breaths.
- Then breathe in as far as you can.
- Hold your breath while placing the mouthpiece in your mouth beyond your teeth.
- Seal your lips tightly around the mouthpiece; keep your tongue away from the mouthpiece.
- Blow out as hard and fast as you can.
- Repeat at least 2 more times.
- Record the best of 3 trials on your diary form unless that value was so different from the values of the other 2 efforts that you suspect something may have gone wrong. In that case, repeat one more time and record the best effort that is reasonably reproducible

Sometimes it is also useful to measure the peak flow before and after you use your inhaled bronchodilator. In that case, repeat 3 measurements about 3 to 5 minutes after using your inhaler. Record both the best of 3 measurements before and after the inhaled bronchodilator.

Measurement of the peak flow before and after use of the bronchodilator may be particularly useful in determining the completeness of response to that treatment. Early identification of incomplete response to the bronchodilator is important in knowing when other measures are needed to prevent progression of asthma to more severe or prolonged symptoms.

INTERPRETING THE ALLERGY EVALUATION AND UNDERSTANDING THE ROLE OF ENVIRONMENTAL FACTORS IN ASTHMA

Asthma is not caused primarily by allergy. Neither are nasal symptoms necessarily caused by allergy. There first has to be a predisposition or sensitivity of the nose or lungs. However, inhaled allergens often aggravate the bronchospasm and airway inflammation of asthma and the stuffiness, congestion, and drainage from the nose. Allergens include such substances as pollens, mold spores, animal danders, substances in dusts (dust mite dung), and sometimes specific types of exposures in the workplace. Allergens cause symptoms when they react with specific types of antibodies (of the IgE immunoglobulin class) that reside in the mucous membranes of the respiratory tract. This reaction results in the release of substances that cause constriction of muscle around the airway (bronchospasm) and inflammation of the mucous membrane of the airways which causes swelling of the tissues lining the airways and secretion of mucous into the airway (see Figure 1). In the nose, this can result in sneezing, itchy nose, and runny nose. In the lungs, this results in tightness of the chest, coughing, wheezing, and labored breathing. It is important in managing asthma to identify the extent to which allergic factors contribute to the disease. And if allergic factors do contribute substantially to the disease, it is important to identify the specific allergic substances.

The evaluation for allergy involves a careful history of the environment and its relationship to your symptoms. Allergy testing identifies the type of antibody that causes allergic reactions in the airways. Both components of this evaluation, the medical history and allergy testing, are important in making clinical judgments regarding the importance of allergy in causing symptoms and in identifying what environmental factors, if any, may be causing problems with the nose or lungs.

There are two types of tests used to identify antibodies that cause allergic respiratory reaction. Allergy skin testing is most common. This involves exposing the tissues immediately below the outer surface of the skin to an extract of allergen (pollen, animal dander, dust mite, etc.) either by a superficial puncture, prick, or scratch or by injection of material just under the skin with a small needle. The size of local swelling and redness is then measured in 15 minutes. There are also blood tests for measuring the same type of antibody in a laboratory test. The blood tests are usually less sensitive, are no more accurate, and are usually more expensive than skin testing. They may be useful, however, when there is difficulty in interpreting skin tests.

The presence of positive skin tests or laboratory tests for the allergic antibodies do not, by themselves, indicate that usual natural exposure to those allergens will cause an allergic reaction. This depends on the degree of sensitivity of the airways, the degree of exposure, and perhaps other variables that we do not fully understand. The presence of the antibodies only indicates the *potential* for exposure to cause symptoms. The final decision as to whether exposure actually does cause symptoms is a clinical judgment based on evidence accumulated from the history and the allergy testing combined.

Not all environmental factors that aggravate respiratory problems are allergic. Cigarette smoking, whether by the patient or those around the patient, can cause respiratory symptoms through a direct irritant effect. Similar irritation may occur from open fires such as those in fireplaces and wood stoves. Strong odors and chemical irritants may also trigger the sensitive airways of the asthmatic patient. Skin testing will not be useful in identifying the potential for these irritant substances to cause symptoms.

ENVIRONMENTAL CONTROL MEASURES FOR ASTHMA

Environmental controls for allergic factors requires identification of allergic substances in the household that are judged to contribute to the clinical problem. This judgement should be based on a careful and detailed clinical history combined with appropriate allergy testing. Since some of the measures are expensive and disruptive, the severity of the problem and the risk of the medications are also factors that require consideration. There are also non-allergic factors that potentially contribute to asthma such as exposure to cigarette smoke, wood burning stoves, unvented gas heaters and gas stoves, and even strong odors such as perfumes, fresh paint, etc. Sometimes a trial of a changed environment, such as at least a week or so where exposure to a suspected substance may not occur, may be a useful diagnostic test to assess the degree to which a potentially expensive or disruptive measure to change the environment may improve symptoms.

Pollens are the male sex cells that grow on the stamens of flowers. Plants that have readily recognizable attractive flowers usually contain heavy sticky pollen that is transmitted by insects. This kind of pollen causes little respiratory allergy. It is wind-borne pollen from plants that have inconspicuous flowers like wild grasses or ragweed that are the major causes of respiratory allergy. They are microscopic in size, invisible singly to the naked eye. These pollens, produced in vast quantities, are designed to carry far distances. Your exposure is therefore not dependent on what is growing in your yard or even your next door neighbor's yard. The vegetation for many miles upwind provides you with exposure to pollens from plants that you never see. Pollens are regional, however, and your exposure will be different in different geographical areas. There is no practical means to limit exposure to pollens outdoors. However, at least half of a 24-hour day is spent indoors, and air conditioning with high-efficiency air filtration can markedly decrease indoor exposure. For these to be optimally effective, the building must be reasonably well sealed and have a continuous central air circulation system so that air is continuously filtered, not just when the air conditioner condenser (or heater) turns on. Most forced air home furnace/air conditioners have continuous fan operation as an option. There are various types of high-efficiency air filters. Discuss with a heating contractor which would be most suitable for your home.

Outdoor molds (*Alternaria*, *Horodendrum*, *Epicoccum*, *Cladisporum*, and others) grow predominantly on decaying vegetation. They give off microscopic spores that are the "seeds" from which new molds grow. The type and extent of outdoor molds vary with the climate. In temperate climates, they are seasonal with variable concentrations in the air during the growing season. They may not be as much of a problem in dry climates such as

the Southwest U.S. While exposure is likely to be influenced by the mold growth for miles upwind, increased exposure can occur from local conditions such as extensive decaying vegetation (as in forests) or when the ground vegetation is disturbed (as when mowing a lawn). There is no practical means to limit outdoor exposure to molds. However, at least half of a 24-hour day is spent indoors, and air conditioning with high-efficiency air filtration can markedly decrease indoor exposure. For these to be optimally effective, the building must be reasonably well sealed and have a continuous central air circulation system so that air is continuously filtered, not just when the air conditioner condenser (or heater) turns on. Most home furnace/air conditioners have continuous fan operation as an option. There are various types of high-efficiency air filters. Discuss with a heating contractor which would be most suitable for your home.

Household pet dander frequently contributes to symptoms from inhalant allergy. The dander is microscopic particles of dead skin (not the hair itself). The saliva of the animals also appears to have the allergenic substance. The microscopic particles of dander and dried saliva become airborne from circulating air in the home. Short-haired animals are therefore not necessarily less of a problem than long-haired animals, and even hairless breeds are not immune from causing allergic problems. There are suggestions of some species differences so that individuals sometimes report sensitivity to one breed of cat or dog but not another. Since there is no testing material specific for all of the different breeds, this question cannot always be critically examined. The animal itself need not be present for allergic symptoms to occur since the microscopic particles of dander and dried salivary material may still be present in the animal's absence. In fact, it may take months or years for the animal dander to be eliminated from the furniture, carpeting, and forced air circulation system of a home. Exposure to animal dander outside of the home is often less of a problem because the exposure is not as continuous and intense as when the animal lives in the house. Animal dander can be brought into a home from an outside animal by contact with clothing. If the patient is sufficiently sensitive, control measures may be necessary to prevent animal dander on the clothing from contaminating the house.

Horse dander is not commonly seen anymore as a household allergen. The extensive use of synthetics has largely replaced horse hair for upholstery and manufacturing of carpet pads. Quality furniture formerly used horsehair stuffing, and this may still be present in some antiques. Felt pads for use under carpeting were made from horsehair and are still used by some oriental carpet buffs. If sensitivity to horsehair is judged clinically important and horsehair is present in these forms, reupholstering with synthetic stuffing material and replacement of felt with foam pads eliminates this source of problems.

Housedust is a mixture of material that varies somewhat from house to house and perhaps even from climate to climate. A major component of allergic housedust has been identified as coming from a microscopic insect called *Dermatophygoides*, known more commonly as the **dust mite** or **human mite**. These mites or their feces (mite dung) permeate upholstered material (mattresses and furniture) and carpeting in homes. The microscopic insect and dung particles then become airborne from normal household activities (such as sitting or lying on a mattress or upholstered furniture), and are recirculated by a forced air furnace. High humidity enhances their growth (they appear not to survive under

conditions of low humidity. Home humidifiers should therefore be avoided, or used only at a low setting if felt to be essential for comfort, for those with house dust mite sensitivity. Completely eliminating exposure to housedust is difficult. Since the most intimate exposure to dust mite occurs in bedrooms, especially from mattresses and pillows, it is sensible to begin control efforts there. Airtight zippered encasings are available from various sources. Avoid plastic because of discomfort and their tendency to tear quickly, thus decreasing their usefulness. There are excellent special cloth encasings that are impervious to the microscopic particles that can cause allergy and yet still “breathe” sufficiently to provide comfort. Pillows (if not encased) and stuffed toys should be machine washable synthetic and should be washed in hot water at least monthly. Other measures for decreasing dust mite exposure include the simple elimination of obvious dust catchers such as long-term storage in the actively used portion of the house, particularly the bedroom. Synthetic material for drapes, bedding, and carpeting are easier to clean and accumulate less dust than wool. Removing carpeting will further decrease dust mite exposure, but this is more disruptive and the potential value should be discussed with your physician. Cleaning forced-air furnace ducts may also help decrease airborne recirculation of dust, as may high-efficiency air filtration. There are various types of high-efficiency air filters for central furnaces including low cost electrostatic replacements for the usual disposable filters on most forced air furnaces. Discuss with a heating contractor which would be most suitable for your home. Room air filters have generally not been found to be clinically useful.

Indoor molds (Penicillium - the common bread mold, Aspergillus, and others) are almost universal to some extent. Their growth is encouraged by high humidity (home humidifiers are best avoided for mold sensitive patients; if used, they should be kept on low settings) Damp basements with water leakage or condensation become particular breeding grounds for the indoor molds. Their growth is further stimulated by high humidity and indoor plants. Live Christmas trees appear frequently to trigger symptoms in mold-sensitive patients. The molds cause respiratory allergy from the release of microscopic spores which are the seeds for new molds. These can be recirculated by forced air furnaces. Vigorous cleaning, special moisture control measures, and dehumidification, along with minimizing indoor plants, can decrease mold exposure. However, it is sometimes difficult to eliminate intense mold exposure in old musty homes without extensive renovation.

Smoking and second-hand smoke exposure can contribute substantially to asthmatic symptoms. Smoking for an asthmatic is particularly self-destructive. Not only is the asthma more likely to be difficult to control, but also there is evidence that asthmatics are more prone to the airway destructive effects of smoking that lead to COPD (chronic obstructive pulmonary disease with chronic bronchitis and emphysema). The smoking patient is therefore multiply exposed to risk: the risk of the asthma, the increased risk of the medications used because more are likely to be needed, and the increased risk of developing a second obstructive lung disease in addition to the asthma. This is in addition to the routine risks of lung cancer, cardiovascular disease (heart attacks and strokes), and effects on unborn children during pregnancy associated with smoking. **Second-hand or passive smoke exposure** occurs when nonsmokers breathe the sidestream smoke created in

indoor environments from the presence of smokers. Children of smoking parents have more respiratory illness than children of nonsmokers, and children of asthmatics have more asthmatic symptoms and more emergency room visits for asthma than otherwise similar asthmatic children of nonsmoking parents. Smoking in front of a child with severe asthma (even if asymptomatic at the time) can, with current knowledge, be considered a form of child abuse. Giving up smoking is difficult but not impossible. Not smoking in front of someone who has asthma may be inconvenient, but it is minimal humane behavior if living with an asthmatic. Patients and parents of patients with asthma should be politely assertive in requesting smokers to refrain from that practice in the presence of someone with asthma.

Fireplaces or wood burning stoves appear to aggravate asthmatic symptoms through direct irritation of the airways from particulate matter released into the air.

Other types of environmental exposure that can cause airway symptoms range from specific types of allergic factors such as **wood dusts** to nonspecific irritants such as **paint fumes**. The examples of each are many and varied. Report any unusual types of exposures that you suspect may cause symptoms to your doctor for further assessment.

Moving to escape exposure to inhalant allergens is a strategy often considered but only occasionally carried out because of the economic and social disruption entailed. Before even being considered, however, you should have reason to believe that the benefit will be worth the cost. The potential for benefit can be judged to some extent by the nature and extent of the environmental factors affecting the asthma. Someone with severe asthma and indoor mold sensitivity living in an old musty home with a damp moldy basement heated with open fireplaces and a wood stove is likely to benefit simply from a move to a newer dryer home with baseboard (rather than forced-air) heating. A patient with severe grass pollen sensitivity causing seasonal asthma in Northern California is likely to have far fewer symptoms in parts of the country where grass pollen is less of a problem. On the other hand, there is virtually no ragweed pollen in Northern California, and patients with that sensitivity from other parts of the country are likely not to have that problem in California. Similarly, those who suffer from seasonal outdoor mold sensitivity that causes severe seasonal asthma in much of the Midwestern farm belt will be likely not to have those symptoms in the desert areas of the Southwest. Unfortunately, many who move to Arizona or other areas in the Southwest continue to have much the same symptoms. Before considering a move, discuss with your physician the likelihood of improvement from the change in environment.

ALLERGY SHOTS FOR ASTHMA

The purpose of allergy shots is to decrease sensitivity to inhalant allergens. It is hoped that the decreased sensitivity will result in decreased respiratory symptoms. However, respiratory symptoms from asthma and rhinitis (nasal symptoms) will only improve to the extent that: 1) they are actually caused by the specific inhalant allergen for which injections are given, and 2) the allergic sensitivity is actually decreased by the series of

injections. In actual fact, respiratory symptoms may not all be on an allergic basis, and the allergy shots are not always effective in decreasing sensitivity. The ability of allergy shots to reduce allergic sensitivity appears to be greater for some allergens than for others. For example, there is less evidence that allergy shots are beneficial for mold sensitivity than there is for pollens. Your physician must weigh the evidence that allergy shots to the allergen suspected of causing a clinical problems can reduce sensitivity. Additionally, the judgment must also be made that there will be substantial clinical benefit if allergic sensitivity were reduced (remember, not all asthma is due to allergy) since allergy shots are an extensive and prolonged undertaking and are not completely without risk (allergic reactions can occur from the injections).

The procedure for allergy shots involves beginning with weekly injections of small amounts of dilute antigen and increasing the dose and concentration slowly over several months. Once a maximum dose is reached, a monthly maintenance schedule is established. This takes at least 4 months and often longer. Missed doses slow the procedure by preventing safe increases. Extended periods without injections require that the dose be reduced to assure safety.

Side effects of allergy shots relate to the possibility of an allergic reaction to the allergy shots. This happens in approximately 1% of injections. As long as this is treated promptly with an injection of epinephrine, the danger from the reaction is small. However, it is important that you wait in the doctor's office for 15 to 30 minutes after receiving each injection.

Assessment of benefit from allergy shots for inhalant allergens generally requires at least a 1 to 2-year trial. Failure to be convinced of substantial benefit indicates the allergy shots should be considered a treatment failure and be discontinued. If convincing benefit is apparent, then the allergy shots are continued until there is a 2-year period without any symptoms. Consideration is then given to discontinuing the allergy shots to see if the problem is in remission. However, there is always the possibility that symptoms suppressed by the allergy shots will return once they are stopped.