ASTHMA

INTRODUCTION

Asthma is one of the most common diseases of the lung, and more than 22 million Americans have asthma. Asthma is also the most common chronic disease among children, and it is the number one reason for hospitalization in the pediatric population. Each year in the United States there are approximately 2 million patient visits to emergency rooms because of asthma attacks, and over 500,000 patients are admitted to hospitals for the treatment of asthma.

The word asthma comes from an ancient Greek word that means “noisy breathing” and this is an accurate description of the disease. Asthma causes difficulty breathing and very often as asthmatic episode (often called an asthmatic attack) is characterized by audible wheezing. Unlike other lung diseases such as emphysema, people with asthma do not have difficulty breathing all the time. They have asthma attacks - sudden episodes of wheezing, coughing, difficulty breathing and other signs and symptoms. Asthma attacks happen suddenly, they are sporadic in nature, and in between attacks the person with asthma feels fine.

In the great majority of people who have asthma the disease is not dangerous. However, although asthma does not have a high mortality rate it is a very serious disease in many other ways. There are millions of emergency room visits and hundreds of thousands of hospital admissions every year that are directly related to asthma. People with asthma miss many days of work and children with asthma
miss many days of school. And everyone with asthma has to live with fact that at any time they may suddenly and often without warning be barely able to breathe.

There is quite a lot that is known about why asthmatic attacks happen, what goes on in the lungs during an asthma attack, and how to treat and prevent the disease. For some people asthma will be a temporary disease but for most asthma sufferers it is a chronic disease and there is no cure. However, asthma can be managed and there are very effective treatments and methods of prevention that can help people with asthma lead normal lives.

**OBJECTIVES**

After completing the module the learner will be able to:

1. Identify the basic cause of asthma attacks.
2. Identify the three processes that contribute to an asthma attack.
3. Identify three triggers for an asthma attack.
4. Identify common signs and symptoms of an asthma attack.
5. Identify the two general classes of asthma medications.

**REVIEW OF THE RESPIRATORY SYSTEM**

The respiratory system, also called the pulmonary system, begins with the nose and the mouth. Attached to the back of the mouth is a stiff but somewhat flexible tube that is called the trachea (often referred to as the windpipe) The trachea ends at about the level of the shoulders and is attached to two other stiff but flexible tubes, one going left, the other going right, that are called the main stem bronchi. At the end of the bronchi are the two lungs.
The lungs are large flexible organs that contain many small hollow passages that branch off from the two main stem bronchi, the bronchial tubes. (Note: Collectively these are called the bronchial tree). The bronchial tubes extend to the outer parts of the lungs and they end in the alveoli. The alveoli are small clusters of air sacs that look very much like clusters of grapes.

The anatomy of the pulmonary system is fairly complex but the structures that comprise this organ system can be divided into two categories: gas transporting and gas exchanging. The nose, mouth, main stem bronchi and the bronchial tree are gas transporting structures, and the alveoli are the gas exchanging structures.

Our bodies use food to produce the energy we need to survive. However, the nutrients in food, the carbohydrates, proteins and fats, can’t be utilized for energy unless oxygen is present. One of the primary jobs of the respiratory system is to deliver oxygen to the body so we can process nutrients for energy. Oxygen is delivered to the body when we inhale.

Our bodies also produce waste products when nutrients are used for energy and from the normal metabolic processes. These waste products are much like the exhaust gases of a car that result from burning gasoline and the body cannot survive if they accumulate. Carbon dioxide is one of the by-products of metabolism and nutrient utilization, and it is eliminated by both the kidneys and the lungs.

Oxygen is delivered to the body when we inhale, and carbon dioxide is eliminated from the body when exhale. The process of breathing, of inhaling and
exhaling and moving air through the lungs is called **ventilation**. The process of moving oxygen from the air to the blood and carbon dioxide from the blood to the air is called **respiration**.

When we inhale, air moves through the nose and mouth, down the trachea to the bronchi and then to the alveoli. Immediately next to the alveoli are an enormous number of tiny blood vessels called the pulmonary capillaries. The walls of the alveoli have extremely small pores and the inhaled air with oxygen moves through these pores and combines with the blood that is passing by in the pulmonary capillaries. Oxygen combines with a special protein in the blood called hemoglobin and it is carried by hemoglobin to the tissues and organs where it can be used to process nutrients for energy. When we exhale carbon dioxide leaves the pulmonary capillaries, passes into the alveoli, and is eliminated out through the lungs.

**WHO IS AFFECTED BY ASTHMA?**

Asthma is one of the most common diseases worldwide, and it is the most common chronic disease in children. However, despite the typical perception that asthma is more common in children asthma is almost as prevalent in adults as it is in the pediatric population. Asthma develops in most children by the age of 3 and in this age group, many more boys are affected than girls but by adulthood this difference has disappeared and men and women are equally affected. Adult onset asthma affects more women than men and in adults asthma is more severe in women than in men.
In many patients asthma resolves once adolescence or early adulthood is reached is reached, but if the disease is carried over to the later years it is rare that the person with asthma will ever be permanently asymptomatic. The pattern of asthma and the character of someone’s individual disease appear to be fixed: people who have mild asthma will always have mild asthma and those with a severe form of the disease will always have severe asthma.

The numbers of cases of asthma and the death rate from the disease have been rising in the past several decades, but there is evidence that these increases have started to decline or at least stabilize. But asthma is still a very serious public health problem, especially among children. Asthma is the number one diagnosis in children admitted to hospitals, and asthma is responsible for more school absences and hospitalizations than any other childhood disease. The prevalence and seriousness of asthma is particularly high in African American and Hispanic children; approximately 15% of all Hispanic children have asthma and African American children are twice as likely to die from asthma as are white children.

**Learning Break:** The evidence is clear that in recent decades the prevalence of asthma, especially in children, has been rising. This increase has been explained by changes in living patterns that have led to greater exposure to air pollution, indoor air pollution, and allergic material such as mold, house dust, and plant pollens. However, there is evidence that in the past few years this increase in the number of childhood asthmatic cases has been leveling off.
THE CAUSES OF ASThma

There are many different causes of asthma and in most cases the disease is caused, as are many chronic diseases, by exposure to a causative factor in a susceptible person - in simpler terms, a combination of bad luck and bad timing.

The topic of the causes of asthma can be a bit confusing as well, because many people mistake the so-called asthma triggers with asthma causes and the two are not the same.

The causes of asthma are typically considered to be:

- Atopy: Atopy is defined as a “predisposition to developing allergic reactions” and asthma is in many important ways an allergic reaction. An allergic reaction, which is also called a hypersensitivity reaction, is an abnormal response by the body’s immune system to a foreign substance that normally would not cause a problem. In asthma these foreign substances are called allergens (this term will be explained later) and common allergens associated with asthma are air pollutants, dust, cigarette smoke, or pet dander. When someone who has asthma is exposed to these allergens the exaggerated and intense immune response - the allergic reaction - produces many of the signs and symptoms of an asthmatic. The hypersensitivity to allergens is also the basis for several of the pathologic changes that occur in the lungs of people who have asthma. Almost everyone who has asthma has atopy.
and people who do not have atopy have a very, very low risk for developing asthma.

- Genetics: It is clear that the tendency to develop asthma is inherited and the level of severity of the disease may be partially inherited, as well. The genetic predisposition toward asthma may explain why some people who have atopy do not suffer from asthma. The atopic person may have a predisposition to developing allergic reactions but this predisposition cannot be fully expressed if the genetic susceptibility to the disease is absent.

- Occupational exposure: Asthma can definitely be caused by occupational exposure to a wide variety of allergens such as chemicals and fumes.

- Obesity: Asthma is more common in people who are overweight.

- Gender: As mentioned previously, depending on age asthma is more common in one gender compared to the other.

- Pre-natal factors: The term pre-natal refers to the period before birth. Maternal cigarette smoking, increased age of the mother at birth, and a mother who smokes have all been implicated as causes of asthma.

There has been extensive research investigating the connection between viral infections and asthma, especially the rhinovirus that causes the common cold, but at this time there is no evidence that viral infections cause asthma. These infections may trigger an asthma episode or worsen the disease but it does not appear that they cause asthma.
Air pollution has been considered to be a possible cause of asthma and it makes intuitive sense that high levels of air pollution might cause asthma. But asthma is as common in rural areas as it is in large urban areas with lots of traffic, and there is no evidence that proves air pollution causes asthma.

Exposure to allergens can definitely trigger an asthmatic episode, but exposure to common allergens such as air pollutants, dust, cigarette smoke, or pet dander has not be proven to cause asthma. There is no evidence that a specific diet or exposure to common food allergens can cause asthma.

**PATHOPHYSIOLOGY OF ASTHMA: WHAT HAPPENS IN THE LUNGS**

**DURING AN ASTHMATIC EPISODE?**

Asthma is characterized by three, complex pathologic processes in the lungs:

1. Hypersensitivity of the bronchial passages,
2. Airway inflammation and,
3. Airway obstruction.

These processes combine to produce reversible airway obstruction, and reversible airway obstruction is the primary cause of the signs and symptoms of an asthmatic attack. If you understand hypersensitivity of the bronchial passages, airway inflammation, and airway obstruction you will understand asthma.
Learning Break: The term asthmatic episode is more formal and is typically used in the medical literature, but the term asthma attack is more commonly used. In this module the two terms will be used interchangeably.

**Hypersensitivity of the Bronchial Passages**

As mentioned earlier, asthma is an allergic reaction, and an allergic reaction is an abnormal reaction by the body’s immune system to a foreign substance that in people without asthma would not cause a problem. These foreign substances are called allergens and we are all exposed to them every day. However, when someone who has asthma is exposed to these allergens, she/he has an exaggerated and intense immune response that is driven by substances such as histamine and cytokines. Histamine and the cytokines are released and/or produced during the hypersensitivity reaction and they have many harmful effects on the lungs; they constrict the bronchial passages; they dilate the blood vessels, which in turn narrow the bronchial passages; they cause excess mucous production, which causes bronchial obstruction, and; they initiate the process of inflammation in the lungs.

**Airway Inflammation**

Inflammation is one of the defense mechanisms the body uses to respond to infection, injury, or trauma. When there is harm or damage to tissues or organs, the body initiates inflammation and the process of inflammation increases blood flow, causes the blood vessels to “leak,” fluid into the affected area, and increases the local production of mucous: the last two help brings antibodies and
other healing components to where they are needed and help remove injured cells, bacteria, and viruses (if there is an infection) from the inflamed area. Increased blood flow and the leaky blood vessels are an invaluable part of inflammation and the healing process. They also cause the inflamed area to become hot, painful, red, and swollen, the classic signs and symptoms of inflammation.

Inflammation is a natural process and an essential way by which the body protects itself and repairs itself. However in asthma the inflammation is not caused by tissue damage or infection; it is not temporary but it is chronic; it can be very intense, and; it occurs in a vulnerable area of the body. The result is bronchial passages that are always swollen, leaking fluid, and producing excess mucous. Inflammation in asthma, instead of being a healing process, interferes with normal ventilation.

**Airway Obstruction**

Airway obstruction is one of the basic pathologic processes in the asthmatic lung, but it primarily results from inflammation and hypersensitivity of the bronchial passage. Inflammation causes the bronchial passages to become swollen and it causes excess mucous production, and bronchial hypersensitivity causes the airway to narrow. However, over time asthma does cause the respiratory passages to become narrow and stiff, an effect that happens apart from inflammation and bronchial passage hypersensitivity.

In summary, an asthma attack occurs when there is a sudden obstruction of the bronchial tubes. This happens because the person with asthma has been
exposed to some kind of "trigger." The asthma trigger starts the processes of a hypersensitivity response, airway inflammation, and airway obstruction. These three processes induce various changes in the bronchial tubes that cause them to become very constricted, narrowed and at times, completely obstructed. These processes are discussed here individually, but in a practical sense they are really impossible to separate because they are so closely linked

**ASTHMA TRIGGERS**

There are many causes of an asthma attack; these are the triggers that were mentioned previously. However, everyone is exposed to some level of these asthma triggers but obviously not everyone has asthma. There is a lot of evidence that people with asthma inherit hypersensitivity to the asthma triggers and there is a large amount of evidence that environmental exposure is an important part of why people develop asthma. Someone may be sensitive to an asthma trigger, but if that trigger is not a persistent part of the environment then asthma will not happen. Asthma then is an issue of genetics and the environment. The triggers of asthma do not cause asthma; they simply set the disease in motion.

The most common triggers that can cause an asthma attack are:

- Emotional stress
- Temperature, especially cold
- Dust
- Air pollution
- Exercise
- Weather changes
- Humidity
• Respiratory infections
• Pollen
• Mold
• Gastro-esophageal reflux disease (GERD)
• Sinus infections
• Cigarette smoke
• Animal dander
• Exposure to cockroaches, rodents, and dust mites

SIGNS AND SYMPTOMS OF AN ASTHMA ATTACK

Common signs and symptoms of an asthma attack are dyspnea, wheezing, cough, chest tightness, and a rapid respiratory rate. Each one may be more or less prominent.

From the patient's point of view, an asthma attack is very simple. Very suddenly and at times without a lot of warning, he/she cannot breathe. The chest feels very tight, there is a lot of wheezing that can be heard and seen and no matter how hard someone tries to inhale, he/she just cannot get enough air. An asthma attack can be very, very frightening for the person with asthma and also for anyone witnessing it and with good reason. For the person who is having an asthma attack, trying to breathe is like trying to inhale through respiratory passages that are the size of a tiny straw.

Asthma attacks are typically classified as mild, moderate, severe, and imminent respiratory arrest.

When a patient is having a mild asthmatic episode, wheezing usually happens during expiration but not inhalation. The pulse rate is less than 100 and the
respiratory rate is increased. The patient can speak in complete sentences and can tolerate lying flat. The oxygen saturation is usually normal.

In a **moderate** asthmatic episode the heart rate is typically greater than 100 and the respiratory rate is increased. The nasal passages are flared and the patient is obviously using all of his/her chest muscles to inhale. The wheezing can be clearly heard, but it is still usually on expiration only. The patient does not tolerate lying down and although he/she can speak the patient appears “breathless” while talking. The oxygen saturation is typically at the low end of the normal range.

A **severe** asthmatic episode is characterized by difficulty breathing while at rest. The patient can only speak in very short sentences or perhaps only in words. Wheezes are happening during inhalation and exhalation, and the heart rate is greater than 120. Lying down cannot be tolerated and the patient usually sits leaning forward; this allows the chest to expand with less effort. The oxygen saturation is abnormally low.

**Imminent respiratory arrest** is very dramatic. This type of asthmatic attack occurs when the bronchial passages are almost completely closed and the flow of oxygen and carbon dioxide through the lungs is severely restricted. In this type of asthmatic episode the patient may be drowsy and confused (this is more likely in children), he/she be will very diaphoretic, and the airways are constricted and obstructed to the point that wheezes are very slight or even absent. Death from asthma is very unusual. Millions of children have asthma but far less than 1% each year will die from the disease, and only 5000 people in the United States will
die each year from asthma. However, at times the bronchial tubes become obstructed to the point that almost no oxygen can pass through. Despite aggressive treatment, there are times when the condition can't be reversed and the patient expires.

**Learning Break:** Oxygen saturation measures how much oxygen is in the blood and it is a way of determining how obstructed the bronchial passages are during an asthma attack. Oxygen saturation can be measured at the bedside with a pulse oximeter. A pulse oximeter uses a sensor that is placed on the finger and the pulse oximeter detects how well the blood is being saturated with oxygen. The pulse oximeter is a useful tool but it has limitations and using it correctly requires training.

Asthma can also be classified according to how often the attacks occur and when and what medications are needed to control them. For example, **intermittent asthma** is characterized by asthma attacks that happen two or fewer days a week; the patient is woken up by an attack two or fewer nights a month, and; the asthma doesn't interfere with normal activities of daily living between attacks. People who have **severe persistent asthma** need to use bronchodilators several times a day; they are woken up by asthma attacks every night, and; the asthma interferes considerably with normal activities of daily living.

**Other Characteristics of Asthma**
Someone who has asthma and is experiencing an asthmatic episode will typically have dyspnea, wheezing, cough, and an increased respiratory rate, but these signs and symptoms are common to many respiratory and cardiac conditions such as chronic obstructive pulmonary disease (COPD) and congestive heart failure (CHF). However, asthma has several distinct characteristics that clearly distinguish it from other respiratory and cardiac conditions.

- Onset: When compared to other causes of dyspnea, wheezing, cough, etc like COPD and CHF, an asthmatic episode usually (but not always) has a rapid onset. Asthmatic episodes also usually have a definite beginning and an end - they are episodes.

- Warnings signs: Many patients who have asthma will have what are called prodromal signs and symptoms before an asthma episode begins. Prodromal signs and symptoms are “warning signs” that an asthma episode is going to occur. These prodromal signs and symptoms vary for each patient.

- Wheezing: Wheezing is a very prominent part of asthmatic episodes, less so for COPD and CHF.

- Reversible: Dyspnea and wheezing from COPD, CHF, or other cardio-pulmonary diseases will respond to treatment, but an asthmatic episode will usually respond more quickly and dramatically.

- Asymptomatic periods: Many people who have COPD, CHF or other cardio-respiratory diseases that interfere with breathing have some level
of signs and symptoms during the day. However, people with asthma are asymptomatic in the periods between asthmatic episodes.

- **Frequency:** Asthma attacks are intermittent and sporadic. Other types of cardio-pulmonary diseases produce signs and symptoms that are more chronic and continuous.

**EXERCISE-INDUCED ASTHMA**

Exercise-induced asthma is a form of asthma that occurs during exercise. Exercise-induced asthma can occur by itself or in people who have asthma, and it is a relatively common condition. Approximately 10% of the general population has exercise-induced asthma and 90% of people who have asthma have the exercise-induced form of the disease as well. Exercise-induced asthma happens most often when people exercise in cold weather. It also occurs more often if there is a high pollen count or a high level of pollution in the air; if someone has poorly controlled asthma, or; if an upper respiratory tract infection is present.

The cause or causes of exercise-induced asthma is not known, but there are two theories as to how it happens. It may be that air movement through the bronchial passages dries out the airway, and this acts as an asthma trigger. Air movement in the bronchial passages can also cool the airway and the change in temperature can be an asthma trigger.

Exercise-induced asthma is a relatively benign form of the disease. Most attacks last for only a few minutes and respond well to exercise cessation and drug therapy. Exercise-induced asthma can be prevented by warming up before exercising; using bronchodilators before beginning to exercise, and; avoiding
exercise in cold, dry air. If the proper preventive techniques and medications are used, exercise-induced asthma can be prevented and there should be no limits for how often and how strenuously someone exercises.

**TREATING ASTHMA: PREVENTION AND SYMPTOMATIC CARE**

There are two ways to treat asthma attacks. The first step is to understand why they happen and to take preventive steps to make sure the attacks don’t happen and to decrease the frequency of the attacks. The second step is to treat the asthmatic episodes as they happen.

**Asthma Prevention**

Asthma is a chronic disease and it cannot be cured but as with many chronic diseases it can be managed, and asthmatic episodes can be prevented. The following are methods that people with asthma can use to manage their disease.

- Identify and manage asthma triggers: Asthma triggers differ for each person every individual will need to identify his/her asthma triggers. In general people who have asthma should avoid going outside during days and during the times of day when air pollution and pollen counts are high. The home should be kept as clean as possible; dust, mold, mildew, and insect allergens can all trigger an asthma attack. Wash bedding on a regular basis. If possible, use an air conditioner and a dehumidifier. Pay attention to changes in weather that have in the past precipitated asthma attacks and plan the day accordingly. Before starting an exercise program
consult with a physician to determine which exercises and how much exercise is appropriate.

- Use a peak flow meter: A peak flow meter is simple, hand-held devices that can help someone with asthma determine how well air is moving out of the lungs during exhalation. Using a peak flow meter can be valuable way to for someone to confirm that an asthma attack may be starting, and it can help them identify the triggers that may be present at that time. By using the peak flow meter regularly someone who has asthma can determine what his/her normal peak flow is and what the peak flow is during an asthmatic attack, and this information can be used to determine how bad an attack is. The peak flow meter can also let someone know when his/her breathing is being dangerously compromised.

- Make an asthma action plan: An asthma action plan is an organized plan designed to help someone prevent and manage their asthmatic episodes. The asthma action plan should be formulated with the help of a health care professional. There are many examples of asthma actions plans that are freely available on the internet. They are simple to fill out and use and the information can be formatted to fit one page. The asthma action plan should have a section that identifies the allergens. After that they are typically divided into three sections: Asymptomatic, symptomatic, and severe symptoms. Each section will have information about the signs and symptoms that characterize that particular “stage” of the asthma, what and what to do when you are asymptomatic, symptomatic, or severely
symptomatic, eg, what medications to use and when, when to call a physician or go to the hospital

**Example:** Patient A is sensitive to pet dander and cold weather. Patient A is symptomatic when she has a peak flow that is 80% of her best, when she wheezes during exhalation, and has a cough. The plan for this stage is to rest, use a bronchodilator and wait one hour. If after an hour the peak flow has gotten worse and/or the symptoms have not improved, she should use another medication and call her physician. Obviously each person will have a different plan. A typical asthma action plan is provided here in Figure 1.

- Know when to seek help: Asthma action plans are tailored for each individual and should include specific signs and symptoms that would indicate the need seek help, whether it is in a physician’s office or an emergency room. However, anyone who has asthma and has any of the following signs and symptoms should not try and manage the asthmatic episode at home: cyanosis, inability speak, drowsiness, absence of wheeze during inhalation and exhalation, serious decreases in the peak flow measurement, chest pain, or any sign or symptoms that are not typical for that person’s asthma attacks.

**Learning Break:** Some people will downplay the serious of an asthma attack and although it is not scientific and can’t be measured, one of the signs that indicates the need for someone to seek help during an asthmatic episode is a
discrepancy in how that person looks and sounds and what they say. If someone looks and sounds as if they are having as severe asthma attack and but he/she insists that “it’s not that bad,” then it is time to go to the hospital.

**Asthma Medications**

Asthma medications are divided into several categories: medications that are used to for immediate relief; medications used for long-term control of asthma; medications used to treat inflammation, and; medications that are used to dilate the bronchial passages. The two primary categories of medications used to treat asthma and asthma attacks are bronchodilators and anti-inflammatories.

Immediate relief medications: These medications are used to relieve the symptoms of an asthma attack. Some of the more common ones in use are Xopenex®, Proventil®, and Ventolin®, all of which contain albuterol. Many of these come in the form of a small, pressurized canister. The nozzle of the canister is placed in the mouth and as the patient inhales, a trigger is pressed and a puff of the medication is released. Some of these medications can also be placed into hand-held nebulizers or nebulizer masks. These drugs work by dilating the bronchial passages. Some of the anti-inflammatory medications such as methylprednisolone and prednisone can be used for acute asthma attacks and for short-term use (3-10 days) to control asthma.

Long-acting medications: There are many long-acting medications that can be used to treat asthma. There are long-acting bronchodilators such as Serevent®, Foradil,® and Brovana® that have a similar mechanism of action to the short-
acting bronchodilators; long-acting anti-inflammatory medications such as Pulmicort®, Beclovent, and Singulair®; long-acting bronchodilators such as Atrovent® that have a unique mechanism of action, and; cromolyn sodium, a medication that prevents the release of histamine.

It is important to stress to patients that the medications that are used to treat asthma must be used as prescribed. No one wants to go to a hospital, but it is important to remember that with asthma medications more is not better. Drugs that are used to prevent and treat asthmatic episodes are designed to work within a certain period of time - the onset of action - and they are designed to be effective for specific amount of time - the duration of action. Taking extra doses, taking larger doses, or taking doses too close together will not change how quickly the medications work or how effective they will be.

**SUMMARY**

Asthma is a very common chronic respiratory disease that causes intermittent episodes of reversible airway obstruction, typically called asthma attacks. Asthma affects millions of people and despite being often perceived as a childhood disease there are many adults who have asthma. In most people asthma is caused by a combination of hypersensitivity to common allergens and a genetic susceptibility to the disease.

Asthma attacks are caused by exposure to triggers such as cold, animal dander, and dust. These triggers initiate several pathologic processes that are the cause of the signs and symptoms of an asthma attack, hypersensitivity of the bronchial passages, airway inflammation, and airway obstruction, all of which
combine to narrow and block the respiratory passages. The common signs and symptoms of an asthma attack are cough, dyspnea, chest tightness, wheezing, and an increased respiratory rate.

There is no cure for asthma. Some people develop asthma during when they are children and the disease will stop by itself in early adulthood, but if asthma becomes chronic the patient will always have the disease. Some people have asthma that is intermittent and mild and some patients have asthma that is a severe and constant presence in their lives: the presentation of the disease is on a continuum. Asthma rarely causes death, but it can have a very negative effect on personal life, school life, and professional life. Treatment is focused on avoiding asthma triggers and treating acute asthma attacks with bronchodilators and anti-inflammatories.