

**Medical Education  
Systems, Inc.**



**Course 607**

**ASTHMA:  
PHARMACOLOGICAL THERAPY**

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# Asthma: Pharmacological Therapy

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# Learning Objectives

Upon successful completion of this course, you should be able to:

- Define Asthma
- Review pathophysiology
- Identify and discuss the long-term and short-acting medications used in the management of asthma
- Explain the various routes of administration used with medications for asthma
- Discuss special issues regarding asthma-patient medications
- Identify the key factors regarding asthma—patient education
- Identify and discuss the key factors associated with long-term management of asthma
- Explain what is meant by the “step” approach to gaining control of asthma

# Introduction

## Definition of Asthma

Asthma is a chronic, inflammatory disorder of the airways. It is a chronic lung disease that makes it harder to move air in and out of the lungs, and it can start at any age. When exposed to environmental triggers, airways can become inflamed and swollen, and the muscles around them may become tight. Airways narrow and swell, and produce extra mucus. This can make breathing difficult and trigger coughing, wheezing and shortness of breath. If asthma is not controlled, it may have long-term effects on breathing, leading to permanent damage to the lining of a person's airways. While there is no cure for asthma, it can be managed and treated for a normal, healthy life.

## Overview

Worldwide, asthma is a major non-communicable disease. About 235 million people currently suffer from asthma, and it is a common disease among children. Most asthma-related deaths occur in low- and lower-middle income countries. According to the latest World Health Organization (WHO) estimates released in December 2016, there were 383,000 deaths around the globe due to asthma in 2015.

Nearly 26 million Americans have asthma, including more than 7 million children. According to the Center for Disease Control (CDC), there were 3,651 deaths in the U.S. attributed to asthma in 2015. Of these, 219 were children under the age of 18.

## Asthma Glossary of Terms

**Allergen:** a substance (such as a food or pollen) that your body perceives as dangerous and can cause an [allergic reaction](#).

**Allergy:** an exaggerated response to a substance or condition produced by the release of histamine or histamine-like substances in affected cells.

**Alveoli:** thin-walled, small sacs located at the ends of the smallest airways in the lungs where the exchange of oxygen and carbon dioxide takes place.

**Antibiotic:** medication used to treat infection caused by bacteria. Antibiotics do not protect against viruses and do not prevent the common cold.

**Anticholinergics:** (also called cholinergic blockers or "maintenance" bronchodilators). This type of medicine relaxes the muscle bands that tighten around the airways. This action opens the airways, letting more air out of the lungs to improve breathing. Anticholinergics also help clear mucus from the lungs.

**Antihistamine:** medication that stops the action of histamine, which causes symptoms of allergy such as itching and swelling.

**Anti-inflammatory:** medication that reduces inflammation (swelling in the airway and mucus production).

**Asthma:** a disease of the airways or branches of the lung (bronchial tubes) that carry air in and out of the lungs. Asthma causes the airways to narrow, the lining of the airways to swell and the cells that line the airways to produce more mucus. These changes make breathing difficult and cause a feeling of not getting enough air into

the lungs. Common symptoms include cough, shortness of breath, wheezing, chest tightness, and excess mucus production.

**Bacteria:** infectious organisms that may cause sinusitis, bronchitis, or pneumonia.

**Beta2-agonists:** a bronchodilator medication that opens the airways of the lung by relaxing the muscles around the airways that have tightened (bronchospasm). These medications may be short acting (quick relief) or long acting (control) medications. Short acting beta2 agonists are the drugs used to relieve asthma symptoms when they occur.

**Breath sounds:** lung sounds heard through a stethoscope.

**Breathing rate:** the number of breaths per minute.

**Bronchial tubes:** airways in the lung that branch from the trachea (windpipe).

**Bronchioles:** the smallest branches of the airways in the lungs. They connect to the alveoli (air sacs).

**Bronchodilator:** a drug that relaxes the muscle bands that tighten around the airways. Bronchodilators also help clear mucus from the lungs.

**Bronchospasm:** the tightening of the muscle bands that surround the airways, causing the airways to narrow.

**Carbon dioxide:** a colorless, odorless gas that is formed in the tissues and is delivered to the lungs to be exhaled.

**Chronic disease:** a disease that can be controlled, but not cured.

**Cilia:** hair-like structures that line the airways in the lungs and help to clean out the airways.

**Clinical trials:** research programs conducted with patients to evaluate a new medical treatment, drug, or device. The purpose of clinical trials is to find new and improved methods of treating different diseases and special conditions.

**Contraindication:** a reason not to use a course of treatment or medication.

**Dander, animal:** tiny scales shed from animal skin or hair. Dander floats in the air, settles on surfaces and is a major part of household dust. Cat dander is a classic cause of allergic reactions.

**Decongestant:** medication that shrinks swollen nasal tissues to relieve symptoms of nasal swelling, congestion, and mucus secretion.

**Dehydration:** excessive loss of water.

**Diaphragm:** the major muscle of breathing, located at the base of the lungs.

**Dry powder inhaler (DPI):** a device for inhaling respiratory medications that come in powder form.

**Dust mites:** a common trigger for allergies.

**Dyspnea:** shortness of breath.

**Exacerbation:** worsening.

**Exercise induced asthma:** asthma that is made worse when exercising

**Exhalation:** breathing air out of the lungs

**(HEPA) high-efficiency particulate air filter:** a filter that removes particles in the air by forcing it through screens containing microscopic pores.

**Histamine:** a naturally occurring substance that is released by the immune system after being exposed to an allergen. When you inhale an allergen, mast cells located in the nose and lungs release histamine. Histamine then attaches to receptors on nearby blood vessels, causing them to enlarge (dilate). Histamine also binds to other receptors located in nasal tissues, causing redness, swelling, itching, and changes in the secretions.

**Holding chamber:** see spacer.

**Humidification:** the act of moisturizing the air with molecules of water.

**Hyperventilation:** excessive rate and depth of breathing.

**Immune system:** the body's defense system that protects us against infections and foreign substances.

**Indication:** reason to use.

**Inflammation:** a response in the body includes swelling and redness.

**Inhaler:** See metered dose inhaler (MDI).

**Inhalation:** breathing air into the lungs.

**Irritants:** things that bother the nose, throat, or airways when they are inhaled (not an allergen).

**Leukotriene modifier:** drug that blocks chemicals called leukotrienes in the airways. Leukotrienes occur naturally in the body and cause tightening of airway muscles and production of excess mucus and fluid. Leukotriene modifiers work by blocking leukotrienes and decreasing these reactions. These medications are also helpful in improving airflow and reducing some symptoms chronic obstructive pulmonary disease (COPD).

**Medical history:** a list of a person's previous illnesses, present conditions, symptoms, medications, and health risk factors.

**Metered dose inhaler (MDI):** small aerosol canister in a plastic container that releases a mist of medication when pressed down from the top. This drug can be breathed into the airways. Many [asthma medications](#) are taken using an MDI.

**Mold:** parasitic, microscopic fungi (like Penicillin) with spores that float in the air like pollen. Mold is a common trigger for allergies and can be found in damp areas, such as the basement or bathroom, as well as in the outdoor environment in grass, leaf piles, hay, mulch, or under mushrooms.

**Monitoring:** keeping track of.

**Mucus:** a material produced by glands in the airways, nose, and sinuses. Mucus cleans and protects certain parts of the body such as the lungs.

**Nasal spray:** medication used to prevent and treat nasal allergy symptoms. Available by prescription or over-the-counter in decongestant, corticosteroid, or salt-water solution form.

**Nebulizer:** a machine that changes liquid medicine into fine droplets (in aerosol or mist form) that are inhaled through a mouthpiece or mask. Nebulizers can be used to deliver bronchodilator (airway-opening) drugs such as albuterol and Atrovent, as well as anti-inflammatory medicines (Pulmicort Respules). A nebulizer may be used instead of a metered dose inhaler (MDI). It is powered by a compressed air machine and plugs into an electrical outlet.

**Non-steroidal:** anti-inflammatory medication that is not a steroid. Also see steroid.

**Oxygen:** the essential element in the respiration process to sustain life. This colorless, odorless gas makes up about 21% of the air.

**Peak Expiratory flow rate:** a test used to measure how fast air can be exhaled from the lungs.

**Peak flow meter:** a small hand-held device that measures how fast air comes out of the lungs when a person exhales forcefully. This measurement is called a peak expiratory flow (PEF) and is measured in liters per minute (lpm). A person's PEF may drop hours or even days before asthma symptoms are noticeable. Readings from the meter can help the patient recognize early changes that may be signs of worsening asthma. A peak flow meter can also help the patient learn what triggers his or her symptoms and understand what symptoms

indicate that emergency care is needed. Peak flow readings also help the doctor decide when to stop or add medications.

**Personal best peak expiratory flow (PEF):** the highest peak flow number a person can achieve when symptoms are under good control. The personal best PEF is the number to which all other peak flow readings will be compared. In children, peak expiratory flow rates are based on how tall the child is. Therefore, the personal best peak expiratory flow will change as growth occurs. A child's personal best peak expiratory flow should be redetermined approximately every 6 months or when a growth spurt has occurred.

**Pneumonia:** an infection of the lung, which may be located in only one area.

**Pollen:** a fine, powdery substance released by plants and trees; an allergen.

**Pollen and mold counts:** a measure of the amount of allergens in the air. The counts are usually reported for mold spores and three types of pollen: grasses, trees, and weeds. The count is reported as grains per cubic meter of air and is translated into a corresponding level: absent, low, medium, or high.

**Productive cough:** a "wet" cough that may involve coughing up mucus.

**Puffer:** another term for inhaler or metered dose inhaler.

**Pulmonary function tests (PFTS):** a test or series of tests that measure many aspects of lung function and capacity; also referred to as lung function tests.

**Pulse oximetry:** a test in which a device that clips on the finger measures the oxygen level in the blood.

**Respiration:** the process of breathing which includes the exchange of gases in the blood (oxygen and carbon dioxide), the taking in and processing of oxygen, and the delivery of carbon dioxide to the lungs for removal. See inhalation and exhalation.

**Sinuses:** air pockets inside the head.

**Spacer:** a chamber that is used with a metered dose inhaler to help the medication get into the airways better. Spacers also make metered dose inhalers easier to use; spacers are sometimes called "holding chambers."

**Spirometry:** a basic [pulmonary function test](#) that measures how much and how fast air moves out of the lungs.

**Sputum:** mucus or phlegm.

**Steroid:** medication that reduces swelling and inflammation. Comes in pill, injected, and inhaled forms. Also called corticosteroid.

**Symptom:** what someone will experience as a result of a disease or illness, like pain, cough, or shortness of breath, for example.

**Theophylline:** a long-term control medication that opens the airways, which prevents and relieves bronchospasm.

**Trachea:** the main airway (windpipe) supplying both lungs.

**Triggers:** things that cause asthma symptoms to begin or make them worse.

**Vaccine:** a shot that protects the body from a specific disease by stimulating the body's own immune system.

**Wheezing:** the high-pitched whistling sound of air moving through narrowed airways.

# Review of Pathophysiology

Basically, asthma is the result of an immune response in the bronchial airways. Asthma patients are hypersensitive to certain triggers, and in response the bronchi spasm, creating an asthma attack. This is followed by inflammation, leading to a further narrowing of the airways and excessive mucus production. This in turn leads to coughing and other breathing difficulties. The bronchospasm might resolve spontaneously in 1–2 hours, or in about ½ of asthma patients, might progress into a 'late' response, where this initial event is followed 3–12 hours later with further bronchoconstriction and inflammation.

According to the National Heart, Lung, and Blood Institute, the immunohistopathologic features of asthma include inflammatory cell infiltration:

- Neutrophils
- Eosinophils
- Lymphocytes
- Mast cell activation
- Epithelial cell injury

All sources agree that viral respiratory infections are a leading cause of the exacerbation of asthma, and may contribute to the development of this disease.

Factors that put people at risk for developing asthma and causing asthma attacks include:

- A family history of asthma, making the risk of developing asthma three to six times more likely than a person without a parent with asthma
- Childhood viral respiratory infections
- Allergies such as hay fever or eczema
- Exposure to occupational elements such as fumes, gases, dust or other potentially harmful substances while on the job.
- Smoking, including those whose mothers smoked while pregnant or who were exposed to second hand smoke
- Air pollution
- Obesity, possibly because the extra weight creates a low-grade inflammation in the body
- Cockroaches (droppings and remains) and dust mites
- Pollen, indoor and outdoor mold
- Pet dander
- Irritants such as:
  - Strong odors, sprays, wood smoke
  - Tobacco smoke
  - Respiratory infections
  - Food sensitivities
  - Exercise
  - Weather
  - Stress

With so many potential causes and triggers, it is plain that diagnosis, long term treatment, and education are the keys to controlling asthma in children and adults. Medications play a vital role in the control and treatment of asthma.

According to Clinical Medicine and Research, 2004 Aug:2(3), asthma attacks are classified into four levels of severity.

FEV1 : forced expiratory volume in one second; PEF: peak expiratory flow

<b>Severity</b>	<b>Symptoms</b>	<b>Night time Symptoms</b>	<b>Lung Function</b>
Severe persistent	Continual symptoms Limited physical activity Frequent exacerbations	Frequent	FEV1/PEF $\leq$ 60% PEF variability >30%
Moderate persistent	Daily symptoms Daily use of short-acting beta-agonist Exacerbations affect activity Exacerbations $\geq$ 2/week	>1/week	FEV1/PEF >60% but <80% PEF variability >30%
Mild persistent	Symptoms >2/week but <1/day Exacerbations may affect activity	>2/month	FEV1/PEF $\geq$ 80% PEF variability 20% to 30%
Mild intermittent	Symptoms $\leq$ 2/week Asymptomatic between exacerbations Exacerbations brief	$\leq$ 2/month	FEV1/PEF $\geq$ 80% PEF variability <20%

# Pharmacology and Complementary Therapies

With medications playing such a vital part in the treatment and control of asthma, it is important to understand what types of medication are available, and how and when they should be administered.

## Medication Overview

### Long-term-control medications

The "Expert Panel Report 3 Summary Report 2007: Guidelines for the Diagnosis and Management of Asthma" gave the following goals for the long term asthma control:

#### Reduce Impairment

- Prevent chronic and troublesome symptoms (e.g., coughing or breathlessness in the daytime, in the night, or after exertion).
- Require infrequent use ( $\leq 2$  days a week) of inhaled SABA for quick relief of symptoms (not including prevention of exercise-induced bronchospasm [EIB]).
- Maintain (near) normal pulmonary function.
- Maintain normal activity levels (including exercise and other physical activity and attendance at school or work).
- Meet patients' and families' expectations of and satisfaction with asthma care.

#### Reduce Risk

- Prevent recurrent exacerbations of asthma and minimize the need for emergency room visits or hospitalizations.
- Prevent loss of lung function; for children, prevent reduced lung growth.
- Provide optimal pharmacotherapy with minimal or no adverse effects of therapy.

Long-term-control medications are taken daily on a long-term basis to achieve and maintain control of persistent asthma. They include anti-inflammatory agents, long-acting bronchodilators, and leukotriene modifiers. Each of the long-term control medications works in a different way. Some reduce inflammation, others help to open up the airways, and some reduce allergy symptoms. Because many factors contribute to the inflammatory response in asthma, many drugs may be considered anti-inflammatory. The goal of long term medications is to stop and/or control symptoms.

**Corticosteroids:** They are the most potent and effective anti-inflammatory medication currently available. Corticosteroids are variants of the natural hormone cortisol. They reduce airway hyperresponsiveness, and inhibit inflammatory cell migration and activation.

- **Inhaled Corticosteroids:** This form is used in the long-term control of asthma. There are many products, including fluticasone propionate (Flonase, Flovent HFA, Arnuity Ellipta), budesonide (Pulmicort Flexhaler, Rhinocort), Flunisolide (Aerospan HFA), beclomethasone dipropionate (Qvar, Qnasl), mometasone (Asmanex), ciclesonide (Alvlesco, Omnaris, Zetonna), and triamcinolone acetonide (Azmacort).

- **Systemic corticosteroids:** These are often used to gain prompt control of the disease when initiating long-term therapy. Medications include injectable methylprednisolone (A-Methapred, Solu-Medrol), injectable triamcinolone (Kenalog). See more information regarding oral corticosteroids, under “Short term control medications”

**Long-acting beta<sub>2</sub> –agonists (LABA):** Long-acting bronchodilator used concomitantly with corticosteroid medications for long-term control of symptoms, especially nocturnal symptoms. Also prevents exercise-induced bronchospasm (EIB). It works to open airways by relaxing the smooth muscles around the airways.

Drugs that contain LABAs and corticosteroids include formoterol and budesonide (Symbicort), formoterol and mometasone (Dulera), salmeterol and fluticasone (Advair, Advair HFA), and fluticasone futoate and vilanterol (Breo Ellipta), and albuterol-sustained release (VoSpire ER).

**Methylxanthines:** The medications in this class can be given as tablets, in liquid form, as sprinkles to be placed on food or the tongue, and intravenously. They work by relaxing smooth muscles and suppressing of the response of the airways to stimuli. They are second or third line therapies, and not used as often now as in past years.

Medications in this category are theophylline (Theo-24) and aminophylline (Elixophyllin)

**Leukotriene modifiers:** These reduces swelling inside the airways and relaxes the smooth muscles around them. They seem to work best in patients with mild to moderate persistent asthma. Asthma symptoms are relieved for up to 24 hours. These are given in oral form only. Common names include montelukast (Singulair), zafirlukast (Accolate), and zileuton (Zyflo).

**Immunomodulators:** There is only one drug in this category available at this time.

Omalizumab prevents the binding of IgE to the receptors on basophils and mast cells.

This in turn reduces the release of inflammatory molecules such as prostaglandins, histamine, and leukotrienes. It should be used as an adjunct therapy for patients over 12 years of age for severe, persistent asthma. It is only available as a subcutaneous injection, and can result in anaphylaxis, so it must be given with caution in a clinical setting only. This medication is omalizumab (Xolair).

**Mast cell stabilizers:** When inhaled, the release of histamine and other inflammatory substances is prevented, keeping airways from swelling. It prevents asthma symptoms, and is especially useful for children and those with exercise induced asthma. The only form available is as nebulizer solution. These include cromolyn sodium (Intal) and nedocromil (Tilade).

### **Quick-relief medications**

**Short-acting beta<sub>2</sub> –agonists (SABs):** Therapy of choice for relief of acute symptoms and prevention of EIB. They are inhaled and relax smooth muscles of the bronchioles (small airways) while decreasing swelling that impedes airflow. They begin acting in less than five minutes, and last for three to six hours.

Medications include albuterol (Proventil HFA, Ventolin HFA, AccuNeb, Proair HFA, Vospire ER), levalbuterol (Xopenex), and terbutaline.

**Anticholinergics:** These drugs are bronchodilators, relaxing the muscles around the bronchi. They also reduce excess mucus, which is produced during an asthma attack. Medications include ipratropium bromide (Atrovent HFA), long-acting tiotropium (Spiriva), and ipratropium and albuteral

**Oral Corticosteroids:** May be used on a short term basis to relieve airway inflammation caused by severe asthma. Used for moderate to severe exacerbations, in conjunction with SABAs. Due to serious side effects, they are not suitable on a long term basis. These include prednisone (Prednisone Intensol, Rayos), prednisolone (Orapred, Pediapred, Prelone), methylprednisolone (Medrol).

Pharmacologic therapy is used to prevent and control asthma symptoms, reduce the frequency and severity of asthma exacerbations, and reverse airflow obstruction. Recommendations in this unit reflect the scientific concept that asthma is a chronic disorder with recurrent episodes of airflow limitation, mucus production, and cough. Asthma medications are thus categorized into two general classes: *long-term-control* medications taken daily on a long-term basis to achieve and maintain control of persistent asthma (these medications are also known as long-term preventive, controller, or maintenance medications) and *quick-relief* medications taken to provide prompt reversal of acute airflow obstruction and relief of accompanying bronchoconstriction (these medications are also known as reliever or acute rescue medications). Patients with persistent asthma require both classes of medication. Figures 3-1 and 3-2 present summaries of the indications, mechanisms, potential adverse effects, and therapeutic issues for currently available long-term-control and quick-relief medications.

**Figure 3-1 Long-Term-Control Medications** ↓

Corticosteroids

Mast Cell Stabilizers

Long-acting beta<sub>2</sub>-agonists

Methylxanthines

Leukotriene modifiers

Immunomodulators

Long acting anticholinergics

Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient Teaching
<p><b>Corticosteroids (Glucocorticoids)</b></p> <p><i>Inhaled:</i></p> <p>Beclomethasone dipropionate Budesonide Flunisolide Fluticasone propionate Triamcinolone acetanide</p> <p>Mometasone</p> <p>Ciclesonide</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>• Long-term prevention of symptoms; suppression, control, and reversal of inflammation.</li> <li>• Reduce need for oral corticosteroid.</li> </ul> <p><i>Precautions:</i></p> <p>Not for use during asthma attack, or if history of cataracts or glaucoma.</p>	<ul style="list-style-type: none"> <li>• Cough, dysphonia, oral thrush (candidiasis).</li> <li>• Body aches, depressions, headaches</li> </ul>	<ul style="list-style-type: none"> <li>• Instruct on proper inhaler/nasal spray technique</li> <li>• Be sure patient knows this is not for an acute attack</li> <li>• Have patient rinse and spit after use</li> <li>• Inform patient to use on a regular schedule, and that therapeutic results may take several weeks</li> <li>• Tell patient to allow one minute between inhalations, and to hold breath for a few seconds after each inhalation</li> </ul>
<p><i>Systemic:</i></p> <p>Methylprednisolone</p> <p>Triamcinolone I.M.</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>• For long-term prevention of symptoms in severe persistent asthma: suppression, control, and reversal of inflammation.</li> </ul> <p><i>Mechanisms</i></p> <ul style="list-style-type: none"> <li>• Same as inhaled.</li> </ul>	<p><i>Adverse Effects:</i></p> <ul style="list-style-type: none"> <li>• Short-term use: reversible abnormalities in glucose metabolism, increased appetite, fluid retention, weight gain, mood alteration, hypertension, peptic ulcer, and rarely aseptic necrosis of femur.</li> <li>• Long-term use: adrenal axis suppression, growth suppression, dermal thinning, hypertension, diabetes, Cushing's syndrome, cataracts, muscle weakness, and-in rare instances--impaired immune function.</li> <li>• Consideration should be given to coexisting conditions that could be worsened by systemic corticosteroids, such as herpes virus infections, <i>Varicella</i>, tuberculosis, hypertension, peptic ulcer, and <i>Strongyloides</i></li> </ul>	<p><i>Patient teaching:</i></p> <ul style="list-style-type: none"> <li>• When giving IM, give it deeply into the gluteal muscle.</li> <li>• Oral med should not be stopped suddenly, and should be then with milk or food</li> <li>• Teach signs of adrenal insufficiency: nausea, joint pain, fever, fatigue, muscle weakness</li> <li>• Teach signs of Cushing's disease, as symptoms must be reported to physician</li> <li>• Encourage exercise and vitamin D supplement to avoid bone loss</li> </ul>
<b>Name/Products</b>	<b>Indications/Mechanisms</b>	<b>Potential Adverse Effects</b>	<b>Patient teaching</b>

<p><b>Mast Cell Stabilizers</b></p> <p>Cromolyn Nedocromil</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>• Long-term prevention of symptoms; may modify inflammation.</li> <li>• Preventive treatment prior to exposure to exercise or known allergen.</li> </ul> <p><i>Mechanisms</i></p> <ul style="list-style-type: none"> <li>• <b>Anti-inflammatory.</b> Block early and late reaction to allergen. Interfere with chloride channel function. Stabilize mast cell membranes and inhibit activation and release of mediators from eosinophils and epithelial cells.</li> <li>• Inhibit acute response to exercise, cold dry air, and SO<sub>2</sub></li> </ul>	<p>15 to 20 percent of patients complain of an unpleasant taste from nedocromil</p>	<ul style="list-style-type: none"> <li>• Therapeutic response to cromolyn and nedocromil often occurs within 2 weeks, but a 4- to 6-week trial may be needed to determine maximum benefit.</li> <li>• Dose of cromolyn MDI (1 mg/puff) may be inadequate to affect airway hyperresponsiveness. Nebulizer delivery (20 mg/ampule) may be preferred for some patients.</li> <li>• Safety is the primary advantage of these agents</li> </ul>
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Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<p><b>Long-Acting Beta<sub>2</sub> – Agonists</b></p> <p><i>Inhaled:</i></p> <p>Salmeterol and fluticasone</p> <p>Formoterol and budesonide</p> <p>Formoterol and mometasone</p> <p>Fluticasone futoate and vilanterol</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>• Long-term prevention of symptoms, especially nocturnal symptoms, <i>added to anti-inflammatory therapy</i></li> <li>• Prevention of exercise-induced bronchospasm.</li> <li>• <b><i>Not to be used to treat acute symptoms or exacerbations.</i></b></li> </ul> <p><i>Mechanisms</i></p> <ul style="list-style-type: none"> <li>• <b>Bronchodilation.</b> Smooth muscle relaxation following adenylate cyclase activation and increase in cyclic AMP producing functional antagonism of bronchoconstriction.</li> <li>• Compared to short-acting inhaled beta<sub>2</sub>-agonist, salmeterol (but not formoterol) has slower onset of action (15 to 30</li> </ul>	<ul style="list-style-type: none"> <li>• Tachycardia, skeletal muscle tremor, hypokalemia, prolongation of QT interval in overdose.</li> <li>• A diminished broncho-protective effect may occur within 1 week of chronic therapy.</li> </ul>	<ul style="list-style-type: none"> <li>• Be sure patient knows these are not to be used for an asthma attack</li> <li>• Should not be used in place of anti-inflammatory therapy.</li> <li>• May provide more effective symptom control when added to standard doses of inhaled corticosteroid compared to increasing the corticosteroid dosage</li> <li>• Don't exceed recommended dosage</li> <li>• Rinse mouth after inhalation to avoid oral infections</li> </ul>

	minutes) but longer duration (>12 hours).		
<p><b>Oral:</b></p> <p>Albuterol, sustained-release</p> <p><i>Inhaled long-acting beta<sub>2</sub> - agonists are preferred because they are longer acting and have fewer side effects than oral sustained-release agents.</i></p>	<ul style="list-style-type: none"> <li>To prevent bronchospasm</li> </ul>	<ul style="list-style-type: none"> <li>Tremor, nervousness, tachycardia</li> <li>Nausea, vomiting</li> <li>Cough, wheezing</li> <li>Increased appetite</li> </ul>	<ul style="list-style-type: none"> <li>Advise patients not to increase dose</li> <li>Do not chew or crush extend-release tablets</li> <li>Warn of risk of paradoxical bronchospasm—stop drug immediately if this occurs</li> </ul>

Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<p><b>Methylxanthines</b></p> <p>Theophylline, sustained-release tablets and capsules</p> <p>Aminophylline tablets</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>Long-term control and prevention of symptoms, especially nocturnal symptoms.</li> </ul> <p><i>Mechanisms</i></p> <ul style="list-style-type: none"> <li><b>Bronchodilation.</b> Smooth muscle relaxation from phosphodiesterase inhibition and possibly adenosine antagonism.</li> </ul>	<ul style="list-style-type: none"> <li>Dose-related acute toxicities include tachycardia, nausea and vomiting, tachy-arrhythmias (SVT), central nervous system stimulation, headache, seizure, hematemesis, hyperglycemia, and hypokalemia</li> <li>Adverse effects at usual therapeutic doses may include nausea, stomach pain, irritability, sleeplessness,</li> </ul>	<ul style="list-style-type: none"> <li>Take the tablets or oral liquid with a full glass of water on an empty stomach, at least 1 hour before or 2 hours after a meal. Do not chew or crush the long-acting tablets; swallow them whole.</li> </ul>

Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<b>Leukotriene Modifiers</b>  Zafirlukast tablets  Montelukar	<i>Indications</i>  <ul style="list-style-type: none"> <li>• Long-term control and prevention of symptoms in mild persistent asthma for patients over 12 years of age.</li> </ul>	<ul style="list-style-type: none"> <li>• Headache, dizziness, fever</li> <li>• Abdominal pain, gastritis, vomiting</li> <li>• Back pain</li> <li>• Mood changes, including agitation, depression, insomnia, and suicidal thinking</li> </ul>	<ul style="list-style-type: none"> <li>• Administration with meals decreases bioavailability; take at least 1 hour before or 2 hours after meals.</li> <li>• Aspirin may increase Zafirlukast level</li> <li>• Taken along with warfarin, it may prolong PT</li> <li>• Patient must report any changes in mood as outlined under potential adverse effects</li> <li>• Do not open Montelukar packet until ready to use</li> </ul>
Zileuton tablets	<i>Indications</i>  <ul style="list-style-type: none"> <li>• Control chronic asthma and decrease the number of attacks</li> </ul>	<ul style="list-style-type: none"> <li>• Nausea, drowsiness, constipation, headaches, dizziness, insomnia, gas, joint pain, eye redness, or vomiting</li> </ul>	<ul style="list-style-type: none"> <li>• Zileuton can inhibit the effect of warfarin, and theophylline. Doses of these drugs should be monitored accordingly.</li> <li>• Monitor hepatic enzymes (ALT).</li> <li>• Use to prevent attacks, but never to treat one</li> </ul>
Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<b>Immunomodulators</b>  Omalizumab	<ul style="list-style-type: none"> <li>• Moderate to severe asthma, not controlled by inhaled corticosteroids</li> <li>• Given subcutaneously, reconstitute with sterile water—swirl gently</li> <li>• Solution is viscous, give over 5-10 seconds</li> </ul>	<ul style="list-style-type: none"> <li>• Headache, dizziness, fatigue, pharyngitis, arm pain, injection-site reaction</li> </ul>	<ul style="list-style-type: none"> <li>• To be given in a health care setting only due to risk of anaphylaxis</li> <li>• Observe for at least two hours after injection</li> <li>• Teach patient signs of anaphylaxis, as it may occur up to 24 hours after injection</li> </ul>
Name/Products	Indications/Mechanisms	Potential Adverse Effects	Therapeutic Issues
<b>Long acting anticholinergics</b>  Tiotropium  Ipratropium and albuterol	<ul style="list-style-type: none"> <li>• To treat asthma poorly controlled by standard combination therapy</li> <li>• Relax muscles of the airways</li> </ul>	<ul style="list-style-type: none"> <li>• Depression, paresthesia, angina, glaucoma,</li> <li>• GI problems, hypercholesterolemia, hyperglycemia</li> <li>• Skeletal pain, cough</li> </ul>	<ul style="list-style-type: none"> <li>• Drug is for maintenance, and not for acute attacks</li> <li>• Demonstrate proper use of inhaler</li> <li>• Capsules should stay in sealed blister pack until ready for use</li> <li>• Inhalers should be stored at room temperature</li> </ul>

**Figure 3-2 Quick Relief Medications** ↓

- Short-acting inhaled beta<sub>2</sub>-agonists
- Anticholinergics
- Corticosteroids

Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<p><b>Short-Acting Inhaled Beta<sub>2</sub> -Agonists</b></p> <p>Albuterol</p> <p>Levalbuterol</p> <p>Terbutaline</p>	<p><i>Indications:</i></p> <ul style="list-style-type: none"> <li>• Relief of acute symptoms; quick-relief medication.</li> <li>• Preventive treatment prior to exercise for exercise-induced bronchospasm.</li> </ul> <p><i>Mechanisms</i></p> <ul style="list-style-type: none"> <li>• <b>Bronchodilation.</b> Smooth muscle relaxation of airways</li> </ul>	<ul style="list-style-type: none"> <li>• Tachycardia, arrhythmias, skeletal muscle tremor, dizziness, migraine, anxiety</li> <li>• Dyspepsia, diarrhea</li> <li>• Increased cough</li> <li>• Flulike syndrome</li> </ul>	<ul style="list-style-type: none"> <li>• If breathing worsens, stop drug and contact doctor</li> <li>• Do not use more or less often than prescribed</li> <li>• Effects may last up to 8 hours</li> <li>• Keep unopened vial in their foil pouches until ready to use</li> <li>• The first time the inhaler is used, or if it has not been used in four days, have patient release four test sprays into the air to make sure it is spraying out an adequate dose</li> <li>• For terbutaline, take six hours apart, and report any heart irregularities (racing heart or palpitations)</li> </ul>

Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<p><b>Anticholinergics</b></p> <p>Ipratropium bromide</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>• Relief of acute bronchospasm</li> </ul> <p><i>Mechanisms</i></p> <ul style="list-style-type: none"> <li>• <b>Bronchodilation.</b></li> <li>• Reduces bronchoconstriction secondary to irritants or to reflux esophagitis.</li> <li>• May decrease mucus gland secretion.</li> </ul>	<ul style="list-style-type: none"> <li>• Drying of mouth and respiratory secretions, increased wheezing in some individuals, blurred vision if sprayed in eyes.</li> <li>• GI distress, flulike symptoms, back pain</li> </ul>	<ul style="list-style-type: none"> <li>• Teach proper technique for inhalers</li> <li>• Is an alternative for patients with intolerance to beta<sub>2</sub> -agonists.</li> <li>• Use face mask for nebulizer— prevent leaks as they may cause eye pain or blurred vision</li> </ul>

Name/Products	Indications/Mechanisms	Potential Adverse Effects	Patient teaching
<p><b>Corticosteroids</b></p> <p><i>Systemic:</i> Methylprednisolone Prednisolone Prednisone</p>	<p><i>Indications</i></p> <ul style="list-style-type: none"> <li>• For moderate-to-severe exacerbations to prevent progression of exacerbation, reverse inflammation, speed recovery, and reduce rate of relapse.</li> </ul>	<ul style="list-style-type: none"> <li>• Short-term use: reversible abnormalities in glucose metabolism, increased appetite, fluid retention, weight gain, mood alteration, hypertension, peptic ulcer</li> <li>• Consideration should be given to coexisting conditions that could be worsened by systemic corticosteroids, such as herpes virus infections, <i>Varicella</i>, tuberculosis, hypertension, peptic ulcer, and <i>Strongyloides</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• Short-term therapy should continue until patient achieves 80% PEF personal best or symptoms resolve. This usually requires 3 to 10 days but may require longer.</li> <li>• Tell patient not to abruptly stop taking</li> </ul>

It is interesting to note that chlorofluorocarbon (CFC) inhalers were banned in the United States as of the end of 2008. They were banned because CFC's cause air pollution that contributes to the thinning of our earth's ozone layer. All inhalers all had to be converted to hydrofluoroalkane (HEA) propelled inhalers. There are mixed reactions to this ban, with some patients feeling their medications work even better now, and others claiming just the opposite. The ban is part of a global treaty to ban CFC's, so there is no going back.

## Complications Related to Asthma Medication Use

With prolonged exposure to elevated levels of exogenous corticosteroids, the person may develop **Cushing's syndrome**, sometimes called hypercortisolism. Signs and symptoms of this condition include:

- Fatty deposits under the skin, especially of the face, upper back, torso, and supraclavicular region
  - Skin changes, including pink or purple stretch marks, easy bruising, thinning, and fragility
  - Progressive proximal muscle weakness
  - Menstrual irregularities/amenorrhea
  - Hirsutism in women
  - Infertility, decreased libido, and impotence in men
  - Psychological problems, including depression, emotional lability, and cognitive problems
  - Osteopenia, osteoporotic fractures
  - Cataracts
  - Immunosuppression with slow wound healing and increased infections
  - New-onset or worsening of hypertension or diabetes mellitus
  - Growth retardation in children
- (Adler, 2014)

## Complementary Alternative Medicine

Alternative healing methods are not substitutes for recommended pharmacologic therapy. According to the Mayo Clinic, the lack of well-designed clinical trials makes it difficult to determine the safety and effectiveness of these therapies. Complementary and alternative medicine (CAM) asthma treatments range from breathing exercises to herbal remedies. Also included on the list are acupuncture, homeopathy, and Ayurvedic medicine (which includes transcendental meditation (TM), herbs, and yoga).

Chiropractic manipulation might reduce the number of asthma attacks and the need for medication, particularly in children, but there are not enough studies to endorse its use as an effective asthma treatment. There are no controlled studies that show any improvement after acupuncture treatments.

Breathing exercises used for asthma include the Buteyko technique, Papworth method and yoga breathing (pranayama). Breathing retraining exercises are among the most frequently used adjunct treatments for asthma. Patients are taught that sighs, yawns, and gasps should be eliminated, as these are considered over-breathing. Patients using breathing techniques are instructed to use the method for 5 to 10 minutes before using a bronchodilator for symptom relief (O'Connor et al., 2012; Hassan et al., 2012).

With all these techniques, you take slow, deep, even breaths to change breathing pattern and prevent rapid breathing (hyperventilation). While they may help a patient relax and feel better, they have no effect on an allergic reaction which can lead to an asthma attack. TM and yoga will definitely relax a person and put them more in touch with their breathing, but again it cannot fight off an asthma attack.

**Probiotics.** Probiotics are beneficial bacteria that may help protect against allergies and asthma. Antibiotic over-use and modern hygiene may specifically be reducing these helpful organisms. Probiotics can be obtained in active yogurt cultures and in supplements, which are being studied for protection.

**Herbal Remedies.** Herbal remedies have been used with apparent success in Eastern nations, but few have been studied rigorously in the United States. Butterbur (also known as *Petasites hybridus*, butter dock, bladderdock,

bog rhubarb, and exwort), a traditional herbal remedy, is used for seasonal allergies and asthma. In a 2002 study, it was as effective and less sedating than a commonly prescribed antihistamine for treating seasonal allergies over a 2-week period. More research is needed. Even when natural remedies appear to be effective in trials, there are no standards or regulations in the U.S. to guarantee their quality, effectiveness, or safety. Of great concern are their growing use and the possibilities of serious drug interactions. Patients who try alternative treatments should be sure to inform their doctor.

## Inspiratory Muscle Training

Physical therapists may use techniques such as inspiratory muscle training that strengthen both inspiratory and/or expiratory muscles in an effort to reduce the patient's perception of dyspnea, aid in overcoming airway resistance, and avoid hyperinflation due to insufficient expiratory strength (O'Connor et al., 2012).

## Relaxation Techniques

Relaxation and anxiety reduction techniques are also taught by physical therapists, such as yoga-based approaches that involve slow and regular breathing and prolongation of expiration, which is meant to promote mental and physical relaxation. These techniques improve abdominal/diaphragmatic breathing and force resistance to both inspiration and exhalation (O'Connor et al., 2012).

## Diet

We can all agree that a nutritious diet helps you stay healthy. According to the Mayo Clinic, some studies show that certain vitamins and nutrients found in foods may help relieve asthma symptoms in some people. Three that seem promising include:

- **Antioxidants.** People with severe asthma appear to have lower levels of these protective nutrients found in fruits and vegetables. Hospitals commonly give the antioxidant magnesium intravenously for severe asthma attacks.
- **Omega-3 fatty acids.** Inflammation leads to asthma symptoms, and these healthy oils found in several types of fish may reduce inflammation. Some small studies suggest fish oil supplements also offer a modest benefit. Omega-3s appear to have a number of other health benefits.
- **Vitamin D.** Along with many Americans, some people with severe asthma have low levels of vitamin D. Researchers are exploring whether there is any connection between vitamin D and asthma symptoms. A doctor should advise on how much vitamin D is best, as too much can cause kidney damage.

Multivitamins or supplement may help you get nutrients, but the best way to get proper nutrition is to eat a varied diet rich in fresh, unprocessed foods. There's no downside to increasing the intake of fruits and vegetables, and foods rich in omega-3 fatty acids, such as cold-water fish, nuts, greens and ground flaxseed.

Fruits, vegetables, and whole grains are important for lung function. Specific foods that may be important for healthy lungs contain antioxidants (deep green and yellow-orange fruits and vegetables), selenium (fish, red meat, grains, eggs, chicken, liver, garlic), plant chemicals called flavonoids (apples, onions), and magnesium (green leafy vegetables, nuts, whole grains, milk, and meats).

Caffeine has properties that are similar to theophylline, a drug used to treat asthma. A major analysis of studies reported that caffeine improved lung function modestly for up to 4 hours after consumption. (People who are

going to have their lung function tested should avoid drinking coffee, tea, or other caffeinated beverages for at least 4 hours beforehand.)

Herbal remedies are tricky because there are no federal standards, meaning there is no quality control. There is no way to know what is actually being sold, what strength it is, or if it is contaminated. There can be serious side effects, especially with an herbal containing ephedra. Also of note, some herbals can interact with prescription medications.

People who have asthma and who are overweight may help reduce asthma symptoms with weight loss.

Although 67% of people with asthma believe their symptoms are aggravated by food allergies, studies indicate that this belief may be true in only 5% of cases. The primary suspects are monosodium glutamate, or MSG (found in some canned soups, cheese, and certain vegetables), and sulfites (preservatives in wine and foods that include processed frozen potatoes and tuna). Contrary to what many people believe, dairy products do not appear to worsen asthma symptoms in people who are not already allergic to them.

It is very important that health professionals ask patients about all the medications and treatments they are using for their asthma, stressing that every pill or tonic they may take is important to their overall health.

### **Bronchial thermoplasty**

This is a relatively new treatment for those with severe asthma that doesn't improve with traditional long-term asthma medications. It takes three different outpatient hospital treatments during which the inside of the lung's airways are treated with mild heat via an electrode. The goal is to shrink the smooth muscle inside those airways, limiting the ability of the airways to tighten. When airways cannot tighten, air is free to flow.

### **Immunotherapy**

Since allergies are the most common trigger for an asthma attack, allergy shots can be given to relieve allergy symptoms and sometimes cure the allergy. After careful allergy testing, small amounts of the allergen is given over time, to build up the body's own immunity to the allergy. There is a relatively new treatment called Sublingual immunotherapy, using a sublingual tablet instead of the more traditional injection. Currently, the only forms approved by the FDA are tablets for ragweed and grass pollen, but it certainly holds promise for the future.

# Routes of Administration

Medications for asthma can be administered either by inhaled or systemic routes. Systemic routes are oral (ingested) or parenteral (subcutaneous, intramuscular, or intravenous). The major advantages of delivering drugs directly into the lungs via inhalation are that higher concentrations can be delivered more effectively to the airways and that systemic side effects are avoided or minimized. Furthermore, the onset of action of inhaled bronchodilators is substantially shorter than that of oral bronchodilators.

Inhaled medications, or aerosols, are available in a variety of devices that differ in technique required and quantity of drug delivered to the lung. Whatever device is selected, patients should be instructed in its use and their technique checked regularly.

There are several devices available for delivering drugs directly into the lungs. The common aerosol devices include:

- **Nebulizer:** An electric machine used to change medication from a liquid to a mist so that it can be more easily inhaled into the lungs through a mouthpiece or mask worn over the nose and mouth. It is often referred to as a “breathing treatment”. A nebulizer is the most common device used to deliver medications to infants, small children, and patients requiring hospitalization, and anyone who has difficulty using a hand held device.
- **Metered-dose inhaler (MDI):** An asthma inhaler is a hand held device that delivers medication straight into the lungs. This pressurized canister contains medication, and is activated by compressing it to deliver a metered dose of the drug to be inhaled. This is the most common device used to deliver medications in an ambulatory setting.
- **Spacers, or valved holding chambers (VHCs):** A spacer is a simple tube added to the mouthpiece of an MDI to move the inhaler farther from the patient’s mouth. Metered-dose inhalers can spray medicine as fast as 60 miles per hour, causing the medicine to hit the back of the throat or roof of the mouth. Since the drug needs to reach the lungs, the VHC helps achieve this by moving the medication past the mouth, allowing it to go deep into the lungs. VHC spacers have a one-way valve that keeps the patient from exhaling into the MDI.
- **Dry powder inhaler (DPI):** A device that does not use a chemical propellant to push the medication out of the inhaler. Instead, the medication is released through the mouthpiece by deep and fast inspiration. This device is not indicated for use in children younger than 12 years because of the requirement of a high inspiratory flow.

## Adverse Effects of Corticosteroid use

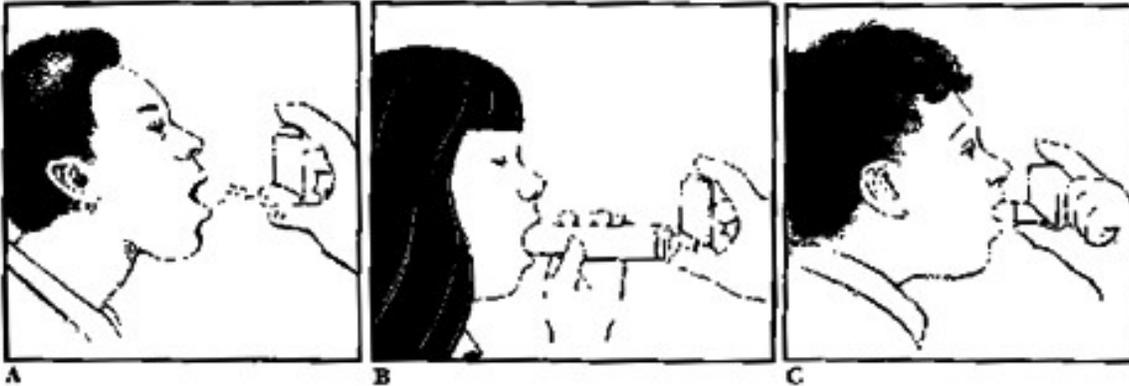
There are very few side effects associated with corticosteroid MDI use. Thrush or hoarseness can occur, but is not common. Ways to avoid these problems are rinsing or gargling after using an inhaler, or using a spacer device. The spacer helps the medication bypass the mouth and go right to the lungs,

as intended. If thrush does occur, it can easily be treated with an antifungal medication. The advantages of long-term inhalers far outweigh the possible side effects. They reduce the frequency of asthma attacks, decrease the use of beta-agonist bronchodilators (quick relief or rescue inhalers), improve lung function, and reduce emergency room visits and hospitalizations for life-threatening attacks.

According to the Mayo Clinic, oral corticosteroid medications may cause side effects such as increased blood pressure, fluid retention, weight gain, mood swings and glaucoma. Patients can reduce their risk of side effects by taking the lowest doses of corticosteroids needed to achieve their desired affect. If these steroids must be taken on a long-term basis, adding calcium and vitamin D supplements is recommended to reduce the loss of bone density that can occur.

# Patient Education

## Guidelines for the Health Care Professionals to Instruct Patients Using Inhaled Medications



### Step 1: Correct Use of a Metered Dose Inhaler (MDI) to discuss and then demonstrate the correct use of inhaled medicines.

- Describe the advantages and disadvantages of using inhaled medicines.
- Demonstrate to the patient how to use each inhaled medicine prescribed.
- Ask the patient to demonstrate to you the correct use of each inhaled medicine prescribed.
- Explain that if the patient is taking both bronchodilator and anti-inflammatory medicines, the inhaled bronchodilators are usually taken first.
- If more than one inhaler is prescribed, label each in order of intended use.

### Step 2: Assess the patient's need for a spacer or holding chamber.

The following criteria indicate who may benefit from using a spacer or holding chamber:

- The young patient
- The patient with coordination problems
- The patient with particularly irritable airways

### Step 3: Spacers: describe and then demonstrate the correct use of an inhaler with a spacer or holding chamber attached.

- Explain the purpose and advantages of using a spacer.
- Demonstrate to the patient the correct use of the metered dose inhaler with spacer or holding chamber attached.
- Ask the patient to demonstrate to you the correct use of the metered dose inhaler with the spacer attached.
- Emphasize the importance of closing the mouth around the mouthpiece when using a spacer or holding chamber to allow for maximum effectiveness of the medicine.

## PROPER USE OF INHALERS

Most asthma patients use MDIs for their quick-relief medications. It is easiest to learn the proper use of an MDI through an in-person demonstration. These are the essential steps whether or not a spacer or VHC is used:

### Preparation

1. Take off the cap and shake the inhaler for 5 seconds.
2. Breathe out all the way.
3. Hold the inhaler as instructed.

### Administer the Medicine

1. Close your lips around the mouthpiece (closed-mouth technique) or hold the mouthpiece 1 to 2 inches in front of your open mouth (optimal technique when not using a spacer or VHC).
2. As you start to slowly inhale, press down on the inhaler one time. **(If the inhaler has a spacer or holding chamber, press down on the inhaler 5 seconds before beginning to inhale.)**
3. Keep inhaling slowly and as deeply as possible.
4. Hold your breath and slowly count to 10 (if possible).
5. Let your breath out.

When inhaling quick-relief medicine, wait 30 to 60 seconds between puffs. For other medicines it is not necessary to wait before taking the prescribed number of puffs. Always make certain to shake an inhaler before taking another puff (Buddiga, 2013b; Bonds et al, 2015).

When using a dry powder inhaler, the steps are the same, however, the inhaler is activated when the person inhales, not by pressing down on a tube.

It is important to keep the inhaler clean. Look at the hole where the medicine sprays out of the inhaler. If there is powder in or around the hole, it should be cleaned.

1. Remove the metal canister from the L-shaped plastic mouthpiece.
2. Rinse only the mouthpiece and cap in warm water.
3. Let them air dry overnight.
4. In the morning, put the canister back inside. Put the cap on.
5. Do not rinse any other parts.
6. Follow the manufacturer's instructions for cleaning a dry powder inhaler.

## INHALER MISUSE

Unfortunately, the improper use of inhalers is far too common. A 2011 study published in the Journal of General medicine revealed that out of 100 hospitalized patients who routinely used an inhaler, 86% used their MDI incorrectly. So it is vitally important that as nurses we understand the proper techniques, and take the time to teach and reinforce these steps with all MDI users.

## Correct Use of Spacer

A spacer or holding chamber is a device that attaches to a metered dose inhaler. It holds the medicine in its chamber long enough for you to inhale it in one or two slow deep breaths. The spacer makes it easy for you to use the medicines the right way (especially if your child is young or you have a hard time using just an inhaler). It helps you not cough when using an inhaler. A spacer will also help prevent you from getting a yeast infection in your mouth (thrush) when taking inhaled steroid medicines.

There are many models of spacers or holding chambers that you can purchase through your pharmacist or a medical supply company. Ask your doctor about the different models.

### How To Use a Spacer

1. Attach the inhaler to the spacer or holding chamber as explained by your doctor or by using the directions that come with the product.
2. Shake well.
3. Press the button on the inhaler. This will put one puff of the medicine in the holding chamber.
4. Place the mouthpiece of the spacer in your mouth and inhale slowly. (A face mask may be helpful for a young child.)
5. Hold your breath for a few seconds and then exhale. Repeat steps 4 and 5 two more times.
6. If your doctor has prescribed two puffs, wait between puffs for the amount of time he or she has directed and repeat steps 2-5.

## Correct Use of a Nebulizer



### Step 1: Assess the patient's need for a nebulizer.

The following criteria indicate who may benefit from using a nebulizer:

- The young patient (under age 5)
- The patient with coordination problems
- The patient with severe asthma

**Step 2: Supervise the use of nebulizers closely in order to avoid inappropriate doses and too frequent use.**

- Describe the advantages and disadvantages of using a nebulizer.
- Emphasize the importance of correctly measuring the medicine and saline solution.
- Demonstrate to the patient how to use the nebulizer. Use an empty sample medicine bottle filled with water to show the patient how much medicine and saline solution to use.
- Ask the patient to demonstrate to you the correct use of the nebulizer.
- Explain the importance of proper cleaning of the nebulizer to prevent infection.
- Supervise the use of nebulizers closely in order to avoid inappropriate doses and too frequent use.

Most nebulizers are small, so they are easy to transport. Also, most nebulizers also work by using air compressors. A different kind, called an ultrasonic nebulizer, uses sound vibrations. This kind of nebulizer is quieter, but costs more.

Stress the importance of keeping the nebulizer clean so that it continues to work properly.

The basic steps to set up and use a nebulizer are as follows:

1. Wash your hands well.
2. Connect the hose to an air compressor.
3. Fill the medicine cup with medication. To avoid spills, close the medicine cup tightly and always hold the mouthpiece straight up and down.
4. Attach the hose and mouthpiece to the medicine cup.
5. Place the mouthpiece in mouth. Keep lips firm around the mouthpiece so that all of the medicine goes into the lungs.
6. Patient should breathe through the mouth until all the medicine is used. This takes 10 to 15 minutes. Small children usually do better if they wear a mask.
7. Turn off the machine when done.
8. Wash the medicine cup and mouthpiece with water and air dry until the next treatment.

# Managing Asthma Long Term

## Key Recommendations for Managing Asthma Long Term

Persistent asthma is most effectively controlled with daily long-term-control medication, specifically, anti-inflammatory therapy.

A stepwise approach to pharmacologic therapy is recommended to gain and maintain control of asthma.

The amount and frequency of medication is dictated by asthma severity and directed toward suppression of airway inflammation.

Therapy should be initiated at a higher level than the patient's step of severity at the onset to establish prompt control and then stepped down.

Continual monitoring is essential to ensure that asthma control is achieved.

Step-down therapy is essential to identify the minimum medication necessary to maintain control. In general, the last medication added to the medical regimen should be the first medication reduced.

Regular follow-up visits (at 1- to 6-month intervals) are essential to ensure that control is maintained and the appropriate step down in therapy is considered. Therapeutic strategies should be considered in concert with clinician-patient partnership strategies; education of patients is essential for achieving optimal pharmacologic therapy.

At each step, patients should be advised to avoid or control allergens, irritants, or other factors that make the patient's asthma worse.

## STEPWISE APPROACH FOR MANAGING ASTHMA IN ADULTS AND CHILDREN OLDER THAN 5 YEARS OF AGE

The aim of asthma therapy is to maintain control of asthma with the least amount of medication and hence minimal risk for adverse effects. Control of asthma is defined as:

Preventing chronic and troublesome symptoms (e.g., coughing or breathlessness in the night, in the early morning, or after exertion).

- Maintaining (near) "normal" pulmonary function.
- Maintaining normal activity levels (including exercise and other physical activity).
- Preventing recurrent exacerbations of asthma and minimizing the need for emergency department visits or hospitalizations.
- Providing optimal pharmacotherapy with minimal or no adverse effects.
- Meeting patients' and families' expectations of and satisfaction with asthma care.

The stepwise approach to therapy, in which the dose and number of medications and frequency of administration are increased as necessary and decreased when possible, is used to achieve this control. Because asthma is a chronic inflammatory disorder of the airways with recurrent exacerbations, therapy for persistent asthma must emphasize efforts to suppress inflammation over the long term and prevent exacerbations. Recommendations in the stepwise approach to therapy are based on the Expert Panel's review of the literature and the Expert Panel's experience and opinion.

## Asthma Treatment

- Prevent chronic and troublesome symptoms (e.g., coughing or breathlessness in the night, in the early morning, or after exertion)
- Maintain (near) "normal" pulmonary function
- Maintain normal activity levels (including exercise and other physical activity)
- Prevent recurrent exacerbations of asthma and minimize the need for emergency department visits or hospitalizations
- Provide optimal pharmacotherapy with minimal or no adverse effects
- Meet patients' and families' expectations of and satisfaction with asthma care

	Symptoms	Nighttime Symptoms	Lung Function
STEP 4 Severe Persistent	<ul style="list-style-type: none"> <li>• Continual symptoms</li> <li>• Limited physical activity</li> <li>• Frequent exacerbations</li> </ul>	<ul style="list-style-type: none"> <li>• Frequent</li> </ul>	<ul style="list-style-type: none"> <li>• FEV<sub>1</sub> /PEF &lt; 60% predicted</li> <li>• PEF variability &gt;30%</li> </ul>
STEP 3 Moderate Persistent	<ul style="list-style-type: none"> <li>• Daily symptoms</li> <li>• Daily use of short-acting inhaled beta<sub>2</sub>-agonists</li> <li>• Exacerbations affect activity</li> <li>• Exacerbations □ twice weekly; may last days</li> </ul>	<ul style="list-style-type: none"> <li>• &gt;once weekly</li> </ul>	<ul style="list-style-type: none"> <li>• 60%&lt;FEV<sub>1</sub>/PEF&lt;80%</li> <li>• PEF variability &gt;30%</li> </ul>
STEP 2 Mild Persistent	<ul style="list-style-type: none"> <li>• Symptoms &gt;2 times a week but &lt;1 time a day</li> <li>• Exacerbations may affect activity</li> </ul>	>2 times a month	FEV <sub>1</sub> /PEF > 80% predicted  PEF variability 20-30%
STEP 1 Mild Intermittent	Symptoms < 2 times a week  Asymptomatic and normal PEF between exacerbations  Exacerbations brief (from a few hours to a few days); intensity may vary	<2 times a month	FEV <sub>1</sub> /PEF > 80% predicted  PEF variability <20%

## NOTE:

- **The stepwise approach presents general guidelines to assist clinical decision-making; it is not intended to be a specific prescription. Asthma is highly variable; clinicians should tailor specific medication plans to the needs and circumstances of individual patients.**
- Gain control as quickly as possible; then decrease treatment to the least medication necessary to maintain control. Gaining control may be accomplished by either starting treatment at the step most appropriate to the initial severity of the condition or starting at a higher level of therapy (e.g., a course of systemic corticosteroids or higher dose of inhaled corticosteroids).
- A rescue course of systemic corticosteroids may be needed at any time and at any step.
- Some patients with intermittent asthma experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms. This may be especially common with exacerbations provoked by respiratory infections. A short course of systemic corticosteroids is recommended.
- At each step, patients should control their environment to avoid or control factors that make their asthma worse (e.g., allergens, irritants); this requires specific diagnosis and education.

## Asthma Progression by Age Groups

Asthma symptoms can vary over the lifetime of each person. Nonetheless, there are some generalities and commonalities that characterize the progression of the disease in various age groups.

### CHILDREN

Asthma progression in childhood can go in many different directions. Some children with asthma continue to have the disease for their entire lives. Other children find that their symptoms decrease or even disappear during adolescence. Of those patients whose disease is in remission, some will remain symptom-free for the rest of their lives, while others will develop symptomatic asthma again later in life (Eberle et al., 2015).

As for general trends, clinicians often discuss asthma in three age ranges: infants, preschoolers, and school-age children.

#### Infants: Years 0 to 2

Many infants wheeze with respiratory diseases, and half of them have at least one episode of wheezing before the age of 3 years. However, infants who repeatedly develop wheezing should be evaluated.

Infants with intermittent wheezing are more likely to have or to develop asthma if:

- They wheeze when they have no respiratory illness
- They develop wheezing with allergies or after inhaling common triggers, such as dust or smoke
- They are prone to developing nasal, conjunctival, or skin signs of allergy, food allergies, or eczema
- A parent has a history of asthma
- Blood tests of the infant show eosinophilia (i.e., higher than usual concentrations of eosinophils). (Tran et al., 2014)
- Some infants can have persistent wheezing or cough. When these infants have atopy (tendency to have allergic reactions) or a family history of atopic diseases, asthma is likely, although it is important for them to have an open-minded medical evaluation (Eberle, 2015).

### **Preschool: Years 3 to 5**

In the preschool years, asthma phenotypes become distinct, and children with wheezing often fall into one of three categories:

- Asthma symptoms that come episodically with colds and other respiratory infections
- Asthma symptoms that are brought on by exercise
- Asthma symptoms that persist throughout the year

An important caveat for clinicians and parents is that episodes of wheezing in early childhood does not necessarily mean that the child will have a lifetime of asthma. Fifty-five percent of all children who have episodes of wheezing before the age of 7 will be symptom-free by the time they are 21 years old.

### **School-Age Children: Years 6 to 12**

In the pre-adolescent school years, allergen-induced asthma is more common than before, and viral-induced asthma remains a prevalent phenotype in school-age children (Guilbert et al., 2014).

Asthma is a progressive disease that gradually diminishes lung function. All people lose lung function as they age, but people with asthma lose lung function faster. In children, there is an additional risk. The lungs of young children are growing, and childhood asthma can interfere with this growth. A study has shown that children who develop asthma by age 7 had a lung function deficit and increased airway responsiveness as newborns. This lung function deficit progressed to age 7. The study raised an important question as to whether the loss of function associated with asthma is a cause or a consequence of the disease (Bisgaard et al., 2012).

## **ADOLESCENTS**

Asthma can first appear in a person at any age, and new cases of asthma develop throughout the adolescent years. Asthma symptoms can also become less frequent or even disappear altogether at any age, and overall about 50% of asthmatic children go into remission during their first 18 years of life (Javed et al., 2013).

Children with infrequent wheezing or with wheezing only during viral infections are most likely to lose their symptoms in adolescence.

Adolescents have more remissions of symptomatic asthma than any other age group. During their teen years, between a quarter and a half of all children with asthma symptoms go into remission, which may be explained by the increased growth of the airways during and after puberty. The more severe the asthma past the age of 5, however, the more likely symptoms will continue (Edgar, 2015).

Adolescence also brings new difficulties in asthma management. Adolescent cigarette smoking is one of the factors, involving taking health risks, being pressured by peers, and parental role modeling. In a recent study, asthmatic adolescents had greater odds of smoking than non-asthmatics, with 79% having tried cigarette smoking. The study found that those adolescents with asthma reported experiencing feelings of moderate or intense physical relaxation when they smoke. As a result, they were less likely to try to quit smoking (Dowdell et al., 2011).

## ADULTS

When people are diagnosed with asthma when they are older than age 20, it is known as **adult-onset asthma**. The thirties is the typical decade for symptoms to appear. Adult-onset asthma is most common in females during the childbearing years, when body and hormonal changes are occurring. Asthma may develop during or immediately after pregnancy.

Adult-onset asthma is different than childhood asthma because adults have a lower lung capacity and changes in muscles and stiffening of chest walls after middle age. Asthma is common among persons over age 65, and most deaths caused by asthma occur in this age group.

When asthma develops in advanced age, symptoms are much like those in young adults. Unlike asthma in younger persons, though, asthma in older adults rarely goes into remission. It is likely to remain a severe and disabling disorder, and daily medications may be required to keep the disease under control (UMMC, 2013).

About half of adults who have asthma also have allergies. Many persons with adult-onset asthma have had a history of long-standing nasal allergies or frequent sinus infections. Allergies often begin with nasal symptoms and progress to breathing symptoms over a period of years. Adult-onset asthma also may be the result of commonplace irritants in the workplace or home, and the asthma symptoms come on suddenly (Buddiga, 2013).

### **Asthma in the Elderly**

Asthma is not uncommon in the elderly patients. Prevalence of asthma is similar in older and younger adults. Asthma in the elderly patient is underdiagnosed because of false perceptions by both patient and physician. The high incidence of comorbid conditions in the elderly patient makes the diagnosis and management more difficult. Correct diagnosis is demonstrated with spirometry. The goals of asthma treatment are to achieve and maintain control of symptoms and to prevent development of irreversible airflow limitation. Asthma drugs are preferably inhaled because this route minimizes systemic absorption and, thus, improves the ratio of the therapeutic benefit to the potential side-effects in elderly patients.

Elderly asthmatic patients mainly include subjects who acquired the disease during childhood or adolescence and whose disease progressed over time or relapsed after periods of remission (Elderly asthmatic, long duration); however, the first manifestations of asthma may also occur in the late adulthood or after 65 years of age (elderly asthmatic, late onset).

Little is known about the natural history of asthma in elderly patients, but there is evidence in literature that the elderly asthmatic patient is underdiagnosed, undertreated, has a higher risk of hospitalization, has a lower quality of life, and experiences greater morbidity and mortality. Underdiagnosed and undertreated of asthma in the elderly may be due to diagnosis misclassification or under-reporting of symptoms.

Underestimation of the prevalence of asthma may be due to confusion with chronic obstructive pulmonary disease (COPD).

#### CASE

Difference between COPD and asthma

Keven Short is a 46-year-old African American male who is overweight and smokes a pack of cigarettes daily. He is suspected of having asthma or COPD and is referred to the clinic for spirometry testing. The

nurse measures his baseline FEV1/FVC. Bronchial provocation testing with histamine lowers his FEV1 value by 25%. Kevin then undergoes before-and-after inhalation therapy with a short-acting bronchodilator; the second test shows an improvement in his FEV1. Together, the findings suggest a diagnosis of asthma.

The under diagnosis may occur because of an age-related reduction in perception of shortness of breath. In elderly patients there is a close relationship between the severity of wheezing complaints and impairment of the forced expiratory volume in 1 second (FEV1). Elderly patients with long-standing asthma have more severe airway obstruction than patients with recently acquired disease but patients with newly diagnosed asthma experienced a more rapid rate of decline FEV1 than patients with chronic asthma. Elderly patients did not show the elevated rate of allergy skin tests reactivity or high serum IgE levels. However, elderly asthmatic patients have more evidence of atrophy than age-matched controls without asthma as determined by increased immunoglobulin E (IgE) levels and positive skin test. Inhaled corticosteroids (ICSs) have been shown to slow this decline. One can speculate, then, that if aggressive anti-inflammatory therapy had been started earlier in the course of the disease, some of this damage to the airways may have been prevented.

Other risk factors that may contribute to a poor response to conventional therapy must be excluded. Some comorbid conditions may complicate asthma care. A recent study showed that sinusitis, heartburn, COPD, Congestive Heart Failure, and smoking are significantly higher in the over 65-year age group. A number of medications used for comorbid conditions may worsen asthma. ASA and NSAIDs are commonly prescribed in the elderly and may cause late-onset asthma. On the other hand medication used for asthma worsens comorbid conditions. Oral and typical  $\beta$ -adrenergic blocking agents and other antiarrhythmic agents, including verapamil, and others with acknowledged  $\beta$ -blocker potential can exacerbate or cause asthma in those who are predisposed to the disease.

## **Managing asthma in elderly patients**

As for patients of all age groups:

- the choice of initial treatment is guided by the severity of untreated asthma at the time of diagnosis
- subsequent modifications of the treatment regimen will depend on the degree of symptom control achieved at regular ongoing review.
- the diagnosis should be reconsidered in a patient whose symptoms respond poorly to therapy.

Comorbidities in older patients will influence the choice of delivery devices:

- Patients who are frail, weak, or have arthritis affecting the hands may need to use additional aids or undergo a trial of various devices to determine the optimal delivery method
- Patients with cognitive disorders may require a care giver to help them use MDIs and spacers
- Delivery of drugs by nebulizer may be necessary in some patients.

When prescribing asthma medications for elderly patients, choose doses cautiously and monitor closely for adverse effects. Clinical trials conducted for registration purposes have generally included few elderly patients.

Consider these issues and consult the Approved Product Information as necessary:

- When prescribing oral corticosteroids, consider the possibility of reactivation of tuberculosis and monitor closely, particularly in those born in countries with high prevalence's.
- Lower initial doses (compared with general adult doses) are recommended for some drugs (e.g. salbutamol).
- Clearance of some drugs (e.g. theophylline) is decreased in the elderly and in those with impaired liver function.
- Consider potential interactions with other drugs, e.g.:
  - The risk of hypokalemia is increased by the concomitant use of beta<sub>2</sub> agonists and diuretics
  - Theophylline and aminophylline interact with a range of agents. If these are used, start with a low dose and monitor closely for drug-drug interactions.
- Elderly patients with multiple comorbidities may experience difficulties taking complex medication regimens correctly. A Home Medicines Review may be useful.

## Types of Asthma

Asthma generally is categorized into two types that partially explain the most common exposures: extrinsic and intrinsic.

**Extrinsic (allergic) asthma** is the most common variety and develops with exposure to specific allergenic substances such as dusts, mites, animal dander, molds, yeasts, and fungi. Extrinsic asthma is most commonly seen in children.

In this form of asthma, hypersensitivity to an allergen mediates an immunoglobulin E (IgE) antibody reaction in the airway. IgE binds to allergens and then to mast cells, causing mast cell degranulation. Degranulation is a cellular process that releases antimicrobial cytotoxic molecules from secretory vesicles called granules found inside some cells involved in the immune system. This results in the release of histamine and other inflammatory substances, and the allergic cascade begins.

**Intrinsic (idiosyncratic or non-allergenic) asthma** is a result of neurological imbalances in the autonomic nervous system in which the alpha and beta adrenergic as well as the cholinergic sites of the system are not properly coordinated. This form of asthma is associated with respiratory tract infections, emotions, exercise, or airway cooling. Inflammation of the airway follows similar pathologic pathways as in allergic asthma, but there is no evidence of an IgE-mediated reaction (Eberle et al., 2015).

## EXERCISE-INDUCED ASTHMA

Exercise-induced asthma (EIA) is an intrinsic type of asthma that affects people of all ages. It is characterized by transient airway obstruction that typically occurs 5 to 15 minutes after strenuous exertion, peaks at 8 to 15 minutes after exercise, and eventually spontaneously resolves in about 20 to 30 minutes. EIA is prevalent in 90% of people with asthma, and among athletes it is estimated to range between 3% and 11%.

The exact cause of EIA is unclear. Theories include:

- Respiratory heat and/or water loss from the bronchial mucosa
- Mucosal drying and increased osmolarity, stimulating mast cell degranulation
- Rapid airway rewarming after exercise, causing vascular congestion, increased permeability, and edema leading to obstruction
- Hyperventilation, causing discharge of bronchospastic chemical mediators (Hess et al., 2012)

## OCCUPATIONAL ASTHMA

Occupational asthma, an intrinsic type, is caused by inhaling fumes, gases, dust, or other potentially harmful substances while on the job. Persons with a family history of allergies are more likely to develop occupational asthma, particularly to some substances such as flour, animals, and latex. Occupational asthma has become the most common work-related lung disease in developed countries and accounts for up to 15% of adult-onset asthma cases in the United States (Malo et al., 2014).

There are two types of occupational asthma:

- **Immunologic** asthma develops only after months or years of exposure to an agent present in the workplace during which time sensitization develops.
- **Non-immunologic** (irritant-induced) asthma occurs without a latency period after an intense exposure to an irritating dust, mist, vapor, or fume. The pathophysiologic mechanism underlying non-immunologic asthma is not well understood, and it is not known why the asthmatic response persists in certain people. Mechanisms believed to be involved include genetic predisposition, immunologically mediated responses, and nonspecific airway inflammation (Hess et al., 2012).

Over 250 substances have been identified as potential occupational triggers of asthma and the list is growing. A few of these chemicals and substances include:

Isocyanates used in the manufacture of polyurethane, paints, steel, and electronics  
 Trimellitic anhydrides (TMA) used in many plastics and epoxies  
 Western red cedar, oak, redwood, and mahogany  
 Metal salts (platinum, nickel, and chrome) and metal working fluids  
 Vegetable dusts (soybeans, grains, flour, cotton, and gums)  
 Biologic organisms (*Bacillus subtilis*, pancreatic enzymes)  
 Xylanase used in the baking industry  
 Pharmaceuticals (penicillin, phenylglycine acid chloride)  
 Glutaraldehyde used to sterilize medical equipment  
 Red dye made from the cochineal insect  
 Diacetyl, the main chemical in artificial butter flavoring used in popcorn

Workers in these industries and others, including farmers, hairdressers, and those who work in the garment industries are at risk for asthma.

**Preventing Occupational Asthma.** In people whose asthma is caused by workplace conditions, improved ventilation or face masks may help.

Sometimes, however, even low levels of chemical substances can trigger an asthma attack. In such cases, leaving the job is the only way to prevent the condition from getting worse. Because such a step can be

emotionally and financially threatening, workers should be sure that occupational substances are the cause of the asthma by having a complete check-up by a lung specialist.

If the diagnosis of occupational asthma is certain, patients should obtain advice on available compensation plans for disability. The effects of workplace asthma can be permanent. However, in one study, 70% of people with asthma experienced significant improvement in symptoms after leaving the job.

## NOCTURNAL ASTHMA

Nocturnal asthma can be either intrinsic or extrinsic and refers to asthma that worsens during the night, most often between 2 A.M. and 4 A.M. There are several explanations for this.

- **Reclining position.** During sleep, airways tend to narrow, which may cause increased resistance to airflow, increased blood volume in the lungs, and decreased lung volume. Drainage from sinus infections or postnasal drips may trigger nighttime coughing, which can cause more tightening of the airways.
- **Hormones and circadian rhythms.** Circadian changes in epinephrine, histamine, and other inflammatory mediators, cortisol, vagal tone, body temperature, and lower airway secretions are mechanisms believed to be involved in nocturnal asthma. Epinephrine helps keep the bronchial muscles relaxed and suppresses the release of other substances, such as histamines, that cause mucus secretion and bronchospasm. Cortisol also protects against asthma, and the levels of these two substances are lowest between midnight and 4 A.M. Histamine levels, however, tend to peak at this time, all of which increases the potential for symptoms. It is important to recognize that individuals who have reversed sleep patterns (i.e., sleeping during the day and working at night) have the same circadian changes that increase potential for asthma.
- **Allergen exposure.** House dust, dust mites, animal dander, and/or other allergens are concentrated in bedding. After inhaling these allergens for a few hours, asthma symptoms develop.
- **Air conditioning or colder night air.** Breathing cooler air may cause loss of heat and moisture from the airway.
- **GERD** (gastroesophageal reflux disorder). Reflux of stomach acid up through the esophagus and into the larynx may stimulate a bronchial spasm. This worsens when lying down or if asthma medications (theophylline or albuterol) have been taken that relax the sphincter between the stomach and the esophagus.  
(ALA, 2015a; Karriem-Norwood, 2014a)

## COUGH-VARIANT ASTHMA

Cough-variant asthma can be either intrinsic or extrinsic and accounts for about 25% to 35% of cases of chronic cough. The main symptom is a chronic, nonproductive cough. Anyone can get cough-variant asthma at any time, but it is common in young children with childhood asthma. Cough-variant asthma may lead to the development of other asthma symptoms such as wheezing and dyspnea.

Causes may include exposure to allergens, breathing in cold air, post-upper respiratory infection, and the use of beta blocker medications for various conditions, including eye drops for treatment of glaucoma.

Aspirin intolerance is the cause in up to 30% of patients with severe cough-variant asthma and in <10% of all patients with cough-variant asthma (Merck Manual, 2014).

## Pharmacology Step Therapy

The step treatment of asthma is based on severity of symptoms and the patient's age.

The Global Initiative for Asthma (2015) recommends the steps described in the following table:

STEP THERAPY		
Step	Description	Alternatives
1	As needed short-acting beta-2 agonist (SABA) with no controller	<ul style="list-style-type: none"> <li>Regular low-dose inhaled corticosteroid (ICS) for patients with exacerbation risks</li> </ul>
2	Regular low-dose ICS plus as-needed SABA	<ul style="list-style-type: none"> <li>Leukotriene receptor agonist (LTRA) ICS + long-acting beta-2 agonist (LABA)</li> <li>Medium-dose ICS</li> </ul>
3	Low-dose ICS + LABA or medium-dose ICS plus as-needed SABA	<ul style="list-style-type: none"> <li>For children 6–11 years: medium-dose ICS or low-dose ICS + LABA</li> </ul>
4	Low-dose ICS + formoterol maintenance and reliever therapy, or medium dose ICS + LABA as maintenance plus as-needed SABA	<ul style="list-style-type: none"> <li>Add-on tiotropium by soft-mist inhaler for adults 18 and over with a history of exacerbations</li> <li>High-dose ICS + LABA, LTRA, or slow-release theophylline for adults</li> <li>Children 6–11 years: refer for expert assessment and advice</li> </ul>
5	Refer for expert investigation and add-on treatment with omalizumab	<ul style="list-style-type: none"> <li>Add-on tiotropium by soft-mist inhaler for adults with history of exacerbations</li> </ul>

Once control of asthma is achieved and maintained for at least three months, a gradual reduction of the maintenance therapy should be tried in order to identify the minimum therapy required to maintain control.

### NOTE:

- **The stepwise approach presents general guidelines to assist clinical decision-making; it is not intended to be a specific prescription. Asthma is highly variable; clinicians should tailor specific medication plans to the needs and circumstances of individual patients.**
- Gain control as quickly as possible; then decrease treatment to the least medication necessary to maintain control. Gaining control may be accomplished by either starting treatment at the step most appropriate to the initial severity of the condition or starting at a higher level of therapy (e.g., a course of systemic corticosteroids or higher dose of inhaled corticosteroids).
- A rescue course of systemic corticosteroids may be needed at any time and at any step.
- Some patients with intermittent asthma experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms. This may be especially common with exacerbations provoked by respiratory infections. A short course of systemic corticosteroids is recommended.

- At each step, patients should control their environment to avoid or control factors that make their asthma worse (e.g., allergens, irritants); this requires specific diagnosis and education.

It is important that an asthma action plan be written out for every asthma patient. Forms are available for download at [www.lung.org](http://www.lung.org). This plan shows each step for managing asthma, covering everything from mild to severe symptoms. It helps the patient keep track of exactly what to do each day, and in case of an attack.

Control of symptoms and risk reduction are the main features of long-term asthma management.

## **Control of Symptoms**

Symptom control relies on medication that is adjusted in a continuous cycle of assessment, fine-tuning, and review of response. Medications are prescribed at the minimum necessary to maintain control of symptoms.

## **MANAGING SPECIAL SITUATIONS IN ASTHMA**

### **Seasonal Asthma**

Some patients experience asthma symptoms only in relationship to certain pollens and molds. Such seasonal asthma should be treated according to the stepwise approach to long-term management of asthma. One of the most effective ways to treat seasonal allergies linked to pollen is immunotherapy (allergy shots). If the patient has seasonal asthma on a predictable basis, antihistamines, nasal steroids, Cromolyn nasal spray, and decongestants are commonly prescribed.

### **Cough Variant Asthma**

The existence of cough variant asthma (cough as the only respiratory symptom without any evidence of airway obstruction) is controversial. There are varying thoughts on the appropriateness of the common practice of using inhaled  $\beta_2$  agonists in the treatment of children with cough without any other evidence of airway obstruction. A 2009 PubMed Health review found that there is nothing at present to suggest that treatment with  $\beta_2$  agonists will be beneficial in treating nonspecific isolated cough in children. In fact, in children presenting with isolated chronic cough there was no significant difference between salbutamol treated group and placebo group.

### **Exercise-Induced Bronchospasm**

Exercise-induced bronchospasm is an obstruction of transient airflow that usually occurs five to 15 minutes after physical exertion. Although this condition is highly preventable, it is still underrecognized and affects fitness and quality of life. Diagnosis is based on the results of a detailed history, including assessment of asthma triggers, symptoms suggestive of exercise-induced bronchoconstriction, and a normal forced expiratory volume at one second at rest. A trial of therapy with an inhaled beta agonist may be tried, with the subsequent addition of inhaled anti-inflammatory agents or ipratropium bromide. Nonpharmacologic measures, such as increased physical conditioning, warm-up exercises, and covering the mouth and nose to protect the patient from cold, should be instituted. If symptoms persist, pulmonary function

testing is warranted to rule out underlying lung disease. With proper treatment and precautions, these patients can participate in any physical activity they wish to.

## **Management Strategies**

One goal of management is to enable patients to participate in any activity they choose without experiencing asthma symptoms. EIB should not limit either participation or success in vigorous activities.

### **Recommended treatments include:**

**First line of treatment:** Inhaled beta agonists for the management of EIB, both as prophylaxis and to treat the bronchospasm that occurs with exercise. Short-acting inhaled beta<sub>2</sub> -agonists used shortly before exercise (or as close to exercise as possible) may be helpful for 2 to 3 hours.

**Cromolyn and Nedocromil** are anti-inflammatory agents that can work in cooperation with beta agonists.

**Inhaled corticosteroids** have been demonstrated to be useful in the treatment of EIB.

**Before exercise** warm up for at least ten minutes, cover mouth and nose during cold weather, decrease intensity of exercise before stopping, and wait at least two hours after a meal before beginning vigorous exercise.

**Teachers and coaches need to be notified that a child has EIB**, should be able to participate in activities, and may need inhaled medication before activity.

## **Surgery and Asthma**

Patients with moderate to severe asthma are at higher risk of having problems during and after surgery than people who do not have asthma. Careful asthma control in the weeks before surgery may help reduce the risk of problems. For some people with severe asthma, a short treatment with corticosteroids may improve their lung function before surgery and prevent problems. Patients with asthma should have an evaluation before surgery that includes a review of symptoms, medication use (particularly the use of systemic corticosteroids for longer than 2 weeks in the past 6 months), and measurement of pulmonary function.

## **Pregnancy and Asthma**

If asthma is well-controlled during pregnancy, there's little or no risk of asthma-related complications. However, severe or poorly controlled asthma during pregnancy might increase the risk of various problems, including: severe morning sickness, vaginal bleeding, high blood pressure or preeclampsia, low birth weight, complicated labor and premature labor. Of course, the patient must be monitored closely by her physician, but luckily most asthma medications can be safely used during pregnancy.

## **Stress and Asthma**

Stress causes a surge of stress hormones in the body. These are released to prepare us to either run away from danger or fight it (the "fight or flight" response). People react with symptoms such as a faster heart rate, tense muscles and breathing that is shallow and fast (hyperventilating). This change to the breathing

pattern can put a person at a higher risk of asthma symptoms, such as tight chest and coughing. This is why it is important for nurses to help patients recognize their stress triggers and teach them to anticipate/control them.

## MEDICATION MANAGEMENT

Medication management for a patient diagnosed with asthma should be based on the patient's severity of symptoms and should follow step-therapy guidelines (see "Pharmacology Step Therapy" above). Medication effectiveness should be assessed at two- to six-week intervals, and if the patient is doing well, medications should be reduced according to step therapy until the lowest level has been reached that maintains satisfactory asthma control (GINA, 2015).

## ASSESSING CONTROL

Once a minimum level has been reached, the patient should be seen every one to six months for symptom and lung function assessments. Women who are pregnant should be assessed every four to six weeks.

Assessment of control can be done using a validated asthma questionnaire. These include:

- Asthma Control Test (ACT)
- Asthma Control Questionnaire (ACQ)
- Asthma Therapy Assessment Questionnaire (ATAQ)

Each questionnaire may address different issues, but they all include the basic questions:

In the past four weeks, have you had:

- Daytime symptoms more than twice a week?
- Night wakening due to asthma symptoms?
- To use quick-relief medication more than twice a week?
- Any activity limitation due to asthma?

If the patient has experienced none of these, symptoms are considered **well controlled**. If the patient has experienced one or two of these, symptoms are **partially controlled**. If the patient has experienced three or four, symptoms are **uncontrolled**.

Lung function testing is done using spirometry after treatment has begun and again when symptoms have stabilized. This should be done at least every one to two years.

Ongoing home monitoring can be done using a peak flow meter to monitor changes in lung function, or patients can monitor symptoms by keeping a diary or journal for communication with their healthcare provider.

## REMOTE MONITORING

A trial has been conducted to determine the effectiveness of remote monitoring of asthma inhaler use. The device senses each inhaler actuation and uploads details to a mobile phone application. It also sends reports

and change of status alerts to their providers. It is expected that over time it will become more standard (Phend, 2013).

**Regular follow-up visits (at 1- to 6-month intervals) are essential.** Clinicians need to assess whether control of asthma has been maintained and if a step down in therapy is appropriate. Clinicians also need to monitor and review the daily self-management and action plans, the medications, and the patient’s self-management behaviors (e.g., inhaler and peak flow monitoring techniques, actions to control factors that aggravate their asthma).

**Figure 4-2 Delivery of Asthma Education by Caregivers During Patient Care Visits ↓**

**Recommendations for Initial Visit**

**Recommendations for First Follow-up Visit**

**Recommendations for Second Follow-up Visit**

**Recommendations for All Subsequent Visits**

<b>Recommendations for Initial Visit</b>		
<b>Assessment Questions</b>	<b>Information</b>	<b>Skills</b>
Focus on:  Concerns  Quality of life  Expectations  Goals of treatment	Teach in simple language:	Teach and demonstrate:
"What worries you most about your asthma?"  "What do you want to accomplish at this visit?"  "What do you want to be able to do that you can't do now because of your asthma?"  "What do you expect from treatment?"  "What medicines have you tried?"	What is asthma?  A chronic lung disease. The airways are very sensitive. They become inflamed and narrow; breathing becomes difficult.  Asthma treatments: two types of medicine are needed:  Long-term control: medications that prevent symptoms, often by reducing inflammation	Inhaler and spacer/holding chamber use. Check performance.  Self-monitoring skills that are tied to an action plan:  Recognize intensity and frequency of asthma symptoms  Review the signs of deterioration and the need to reevaluate therapy:  Waking at night with asthma

<p>"What other questions do you have for - Increased medication use me today?"</p>	<p>Quick relief: short-acting bronchodilator</p> <p>Bring all medications to every appointment.</p>	<p>Increased medication use</p> <p>Decreased activity tolerance</p> <p>Use of a simple, written self-management plan (see figure 4-4) and action plan</p>
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**Recommendations for First Follow-up Visit (2 to 4 weeks or sooner as needed)**

<b>Assessment Questions</b>	<b>Information</b>	<b>Skills</b>
<p>Focus on:</p> <ul style="list-style-type: none"> <li>Concerns</li> <li>Quality of life</li> <li>Expectations</li> <li>Goals of treatment</li> </ul>	<p>Teach in simple language:</p>	<p>Teach and demonstrate:</p>
<p>Ask relevant questions from previous visit and also ask:</p> <p>"What medications are you taking?"</p> <p>"How and when are you taking them?"</p> <p>"What problems have you had using your medications?"</p> <p>"Please show me how you use your inhaled medications."</p>	<p>Use of two types of medications. Remind patient to bring all medications and the peak flow meter to every appointment for review.</p> <p>Self-evaluation of progress in asthma control using symptoms and peak flow as a guide.</p>	<p>Use of a daily self-management plan.</p> <p>Review and adjust as needed.</p> <p>Use of an action plan. Review and adjust as needed.</p> <p>Peak flow monitoring and daily diary recording</p> <p>Correct inhaler and spacer/holding chamber</p>

**Recommendations for Second Follow-up Visit**

<b>Assessment Questions</b>	<b>Information</b>	<b>Skills</b>
<p>Focus on:</p>	<p>Teach in simple language:</p>	<p>Teach or review and demonstrate:</p>

<p>Expectations of visit</p> <p>Goals of treatment</p> <p>Medications</p> <p>Quality of life</p>		
<p>Ask relevant questions from previous visits and also ask:</p> <p>"Have you noticed anything in your home, work, or school that makes your asthma worse?"</p> <p>"Describe for me how you know when to call your doctor or go to the hospital for asthma care."</p> <p>"What questions do you have about the action plan?" "Can we make it easier?"</p> <p>"Are your medications causing you any problems?"</p>	<p>Relevant environmental control/avoidance strategies (see figure 2-4).</p> <p>How to identify home, work, or school exposures that can cause or worsen asthma.</p> <p>How to control house-dust mites, animal exposures if applicable</p> <p>How to avoid cigarette smoke (active and passive)</p> <p>Review all medications.</p> <p>Review and interpret from daily diary:</p> <p>Peak flow measures</p> <p>Symptom scores</p>	<p>Inhaler/spacer/holding chamber technique.</p> <p>Peak flow monitoring technique.</p> <p>Use of daily self-management plan. Review and adjust as needed.</p> <p>Review use of action plan. Confirm that patient knows what to do if asthma gets worse.</p>

<b>Recommendations for All Subsequent Visits</b>		
<b>Assessment Questions</b>	<b>Information</b>	<b>Skills</b>
<p>Focus on:</p> <p>Expectations of visit</p> <p>Goals of treatment</p>	<p>Teach in simple language:</p>	<p>Teach or review and demonstrate:</p>

Medications		
Quality of life		
<p>Ask relevant questions from previous visits and also ask:</p> <p>"How have you tried to control things that make your asthma worse?"</p> <p>"Please show me how you use your inhaled medication."</p>	<p>Review and reinforce all:</p> <p>Educational messages</p> <p>Environmental control strategies at home, work, or school.</p> <p>Medications</p> <p>Review and interpret from daily diary:</p> <p>Peak flow measures</p> <p>Symptom scores</p>	<p>Inhaler/spacer/holding chamber technique.</p> <p>Peak flow monitoring technique.</p> <p>Use of daily self-management plan.</p> <p>Review and adjust as needed.</p> <p>Review use of action plan.</p> <p>Confirm that patient knows what to do if asthma gets worse.</p> <p>Periodically review and adjust written action plan.</p>

**Promoting Open Communication to Encourage Patient Adherence ↓**

**Friendly Manner:**

Show attentiveness (eye contact, attentive listening, etc.)

Give encouragement with nonverbal communication (nodding agreement, smiling, etc.)

Give verbal praise for effective management strategies

Use interactive conversation (e.g., asking open-ended questions)

**Reassuring Communication:**

Elicit patient’s underlying concerns about asthma

Allay fears with specific reassuring information

**STRATEGIES TO AVOID COMMON ASTHMA TRIGGERS**

Trigger	Exposure Reduction
<b>Animals</b>	<ul style="list-style-type: none"> <li>Keep pets with fur or feathers out of the home.</li> </ul>

(dander, saliva, or urine from animals and birds)

### **Dust mites**

(live on human skin cells that have been shed, and that colonize beds, upholstered furniture, and carpets)

### **Cockroaches**

### **Outdoor pollens and molds**

(from trees, grasses, weeds, etc.; often seasonal)

### **Molds (fungi)**

(common in humid climates and in homes with continual areas of dampness; usually black in color)

- If pets cannot be kept outdoors, keep them out of the bedroom and keep the door closed.
- Install a HEPA air cleaner in the bedroom.
- Keep pets off upholstered furniture and away from stuffed toys.
- Reduce indoor humidity and do not use humidifiers.
- Wash mattress covers and bedding in hot water each week.
- Wash stuffed animals frequently and dry completely.
- Steam clean bedding, mattresses, and furniture that cannot be washed.
- Use dust-proof pillow and mattress covers.
  
- Remove carpeting from the home.
- Vacuum weekly with a HEPA vacuum cleaner.
- Avoid lying on upholstered furniture.
- Do not leave food or garbage uncovered.
- Clean up spills and food crumbs right away.
  
- Store food in airtight containers. Use traps, poison baits, powders, gels, or pastes to kill cockroaches (asthma patients should avoid sprays).
- Keep food out of the bedroom.
- Store cooking oils in the refrigerator.
- Try to stay indoors with air conditioning on and windows closed, especially during the midday and the afternoon.
- Wash clothes and shower after gardening or playing outdoors.
- When traveling by car, use air conditioning on in the recirculation mode.
- Avoid hanging sheets or clothes outside to dry.
- Do not mow the lawn.
- Wash pets after long outdoor play.
  
- Do not rake leaves or compost without wearing a dust mask.
- Get daily air-quality forecasts of pollen counts.
- Look for and repair leaks in household plumbing.
- Clean moldy surfaces with a diluted bleach solution (one cup per gallon of water). If that does not work, have surfaces cleaned by professionals.
- Lower the humidity in the home and do not use vaporizers or humidifiers.
- Wear a mask when sweeping, vacuuming, or doing yard work; use a vacuum with a HEPA filter.
- Remove carpet from basements, bathrooms, and bedrooms.

- Clean bathrooms with mold-killing products.
- Add mold inhibitors to paints before application and repaint disinfected surfaces with a paint-fungicide mixture.
- Equip the furnace with a high-efficiency filter; replace the filter every three months and have the furnace serviced every six months (CDC, 2014b).

**Cigarette smoking**

- Do not allow smoking in the home, car, or anywhere nearby.
- Quit smoking. Ask a healthcare provider for help to quit and perhaps a referral to a smoking program.
- If family members smoke, ask them to quit.

**Wood smoke, strong odors and sprays, chemical vapors**

- Avoid strong odors and sprays such as perfume, powder, hair spray, paints, incense, air fresheners, cleaning products, candles, and new carpeting.
- Avoid inhaling smoke from burning wood.
- When in a workplace with chemical vapors, limit or avoid exposure altogether by using respiratory protective gear (ALA, 2015c).

**Outdoor air pollution**

- When the level of outdoor pollution is high, stay indoors as much as possible and avoid exertion when being outdoors.
- Check the Environmental Protection Agency’s website or other sources for daily updates on air quality.
- Choose routes for walking or exercising that avoid major streets or highways.

**Viruses, colds, influenza, bronchitis**

- Wash hands often.
- Avoid touching eyes, nose, or mouth.
- Avoid contact with people who have colds.
- Get a flu shot every year, preferably in the fall if over 6 months old.

Avoid taking any of the following drugs:

**Nonselective beta blockers**  
(can cause bronchoconstriction and make airway constriction difficult to reverse with quick-relief medicines)

- Carteolol
- Levobunolol
- Metipranolol
- Nadolol
- Pindolol
- Propranolol
- Sotalol
- Timolol

<b>Aspirin and NSAIDs*</b>	<ul style="list-style-type: none"> <li>• Avoid aspirin and NSAIDs if sensitive to them.</li> </ul> <p>(*Aspirin and NSAIDs can trigger severe or fatal attacks; most common in those with Samter’s triad, a combination of asthma, aspirin sensitivity, and nasal polyps [Karriem-Norwood, 2014b].)</p>
<b>Exercise and activity</b>	<ul style="list-style-type: none"> <li>• Take rescue medicines before sports or exercise to prevent symptoms, if directed by a healthcare provider.</li> <li>• Warm up/cool down for 5 to 10 minutes before and after sports or exercise.</li> <li>• Cover nose and mouth with a scarf when exercising in the cold.</li> <li>• Use controller medications (corticosteroids) as prescribed.</li> </ul>
<b>Emotions</b> (fear, stress, laughter, crying, anger, anxiety)	<ul style="list-style-type: none"> <li>• Become aware of things, events, or people that cause stress.</li> <li>• Avoid unnecessary stress; leave stress-provoking situations if possible.</li> <li>• Find constructive and positive ways to reduce anger, anxiety, or fear.</li> <li>• Get adequate sleep to help reduce emotional instability.</li> <li>• Eat a healthy diet.</li> <li>• Exercise regularly.</li> </ul>

In order for a person to be able to control their symptoms, they have to be fully committed and on board with their management plan. A great way to achieve this is to have the patient fill out and commit to a self-management plan, such as the one below.

**Figure 4-4 Asthma Daily Self-Management Plan (Examples) ↓**

**ASTHMA SELF-MANAGEMENT PLAN FOR**  
 \_\_\_\_\_ (Name)

**YOUR TREATMENT GOALS**

- Be free from severe symptoms day and night, including sleeping through the night
- Have the best possible lung function
- Be able to participate fully in any activities of your choice
- Not miss work or school because of asthma symptoms
- Not need emergency visits or hospitalizations for asthma

- Use asthma medications to control asthma with as few side effects as possible

Add personal goals here: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## YOUR DAILY MEDICATIONS

Daily Medication	How Much To Take	When To Take It

When a person can see the benefits of controlling their asthma, and set goals for themselves, they become more committed to a plan to maintain and take control of their own health.

## MANAGEMENT OF ASTHMA EXACERBATIONS (ATTACKS)

The most effective strategy for dealing with an **asthma attack** is early treatment.

### Four Principles of Management

There are four principles to consider in the management of asthma exacerbations:

- Correcting hypoxemia
- Reversing airflow obstruction
- Assessing treatment progress
- Avoiding exacerbations

### CORRECTING HYPOXEMIA

Therapy for an asthma attack begins with correcting any hypoxemia and maintaining sufficient blood oxygenation. Hypoxemia is a blood oxygen concentration (an arterial blood oxygen partial pressure [PaO<sub>2</sub>]) of less than 60 mm Hg. Clinical signs of hypoxemia are restlessness, tachycardia, and cardiac irritability (i.e., a tendency to develop irregularities in rate and rhythm). Prolonged or significant hypoxemia will lead to bradycardia, hypotension, and cardiac arrest.

An asthma attack will produce hypoxemia, and this must be corrected. In a mild attack, short-acting bronchodilators can usually relieve the bronchoconstriction sufficiently for the patient's breathing to maintain appropriate blood oxygen levels. In a severe attack, supplemental oxygen is needed.

## REVERSING AIRFLOW OBSTRUCTION

The hallmark of an asthma attack is a significant increase in the difficulty of moving air through the bronchi and bronchioles of the lungs. For the patient to maintain a healthy level of oxygen in the blood, the airway obstruction must be reduced, so one goal when treating an asthma attack is to widen the airways and lessen the obstruction. Airflow obstruction is most quickly reversed by inhaling short-acting bronchodilators and then taking systemic corticosteroids.

## ASSESSING TREATMENT PROGRESS

The extent and the time course of medical treatment for an asthma attack must be tailored to each specific situation, and often the initial treatment is modified as events progress. For moderate and severe attacks, patients should be evaluated clinically, their blood oxygen saturation (measured via pulse oximetry) followed, and their FEV1 (forced expiratory volume) measured at regular intervals. Acutely ill patients must be treated immediately; for them, initial lung function tests are distressing and unnecessary.

## AVOIDING EXACERBATIONS

At the end of acute treatment, the final goal is to reduce the likelihood that the patient will have additional attacks. Often a course of systemic corticosteroids is prescribed. Asthma attacks can be a sign that the patient's disease is not being managed optimally. Therefore, regardless of the severity of the current attack, at the end of their treatment, all patients seen by a primary care provider should be counseled, given any necessary medications, provided with a telephone number for questions, and scheduled for a follow-up visit.

Relief from an asthma attack requires proper treatment, and it is the patient or the patient's family who have the responsibility for initiating that treatment. For this reason, when a patient is diagnosed with asthma, the patient or the family should be given a written plan that explains how to deal with an asthma attack.

## Self-Management of an Asthma Attack

Asthma patients should have a **quick-relief inhaler** that they can carry with them to school, work, or any place outside the home. At home, patients with moderate or severe asthma should have additional medications (e.g., oral corticosteroids) and a peak flow meter, and children should have a compressor-driven nebulizer.

All asthma patients need a **written plan of action**—an instruction manual on how to handle an attack. This plan should be written clearly enough for a family member or friend to follow. The plan should be tailored to the individual patient.

An emergency action plan sets out four steps for treating attacks:

- Assess the severity of symptoms
- Take quick-relief medications
- Get medical advice

- Follow the after-the-attack instructions

## STEP 1: ASSESSING SEVERITY

### *Classifications of Severity of an Asthma Exacerbation*

<b>Degree of severity</b>	<b>Symptoms and signs</b>	<b>Initial PEF (or FEV<sub>1</sub>)</b>	<b>Clinical course</b>
Mild	Dyspnea only with activity (assess tachypnea in young children)	PEF $\geq$ 70 percent of predicted or personal best	Usually treated at home Prompt relief with inhaled short-acting beta <sub>2</sub> agonist Possible short course of oral systemic corticosteroids
Moderate	Dyspnea interferes with or limits usual activity	PEF 40 to 69 percent of predicted or personal best	Usually requires office or emergency department visit Relief from frequent inhaled short-acting beta <sub>2</sub> agonist Oral systemic corticosteroids; some symptoms last for one to two days after treatment begins
Severe	Dyspnea at rest; interferes with conversation	PEF $<$ 40 percent of predicted or personal best	Usually requires emergency department visit and likely hospitalization Partial relief from frequent inhaled short-acting beta <sub>2</sub> agonist Oral systemic corticosteroids; some symptoms last for more than three days after treatment begins Adjunctive therapies are helpful
Subset: life threatening	Too dyspneic to speak; perspiration	PEF $<$ 25 percent of predicted or personal best	Requires emergency department visit/hospitalization; possible intensive care unit Minimal or no relief from frequent inhaled short-acting beta <sub>2</sub> agonist Intravenous corticosteroids Adjunctive therapies are helpful

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FEV<sub>1</sub> = forced expiratory volume in one second; PEF = peak expiratory flow.

Adapted from the National Heart Lung and Blood Institute. National Asthma Education and Prevention Program. Expert panel report 3: Guidelines for the diagnosis and management of asthma; 2007:375..

## RESPONDING TO AN ATTACK WHEN NO INHALER IS AVAILABLE

An individual experiencing an asthma attack but who does not have a quick-relief inhaler at hand can be instructed to follow these steps:

- Get away from the asthma trigger as soon as possible and go to an air-conditioned environment or other place with clean air.
- Sit upright; stooping over or lying down constricts breathing.
- Take long, deep breaths to help slow down breathing and prevent hyperventilation, breathing in through the nose to the count of four and then out through the mouth to the count of six. Purse the lips during exhalation to slow exhalation and keep airways open longer.
- Stay calm to prevent further tightening of chest muscles and make breathing easier.
- Press on acupressure points in the front parts of the inner shoulders just above the armpits and the outer edges of the creases of the bent elbows. Pressing on one area at a time for a few consecutive minutes may relax muscles.
- Drink a cup or two of a hot caffeinated beverage (coffee or nonherbal tea), which can help open up the airways slightly and help loosen mucus, providing some relief. (Caffeine is mobilized into theophylline, which is a drug used to prevent and treat asthma by relaxing airways and decreasing the lungs' response to irritants.)
- Take magnesium and vitamin C during the attack (for adults). (Magnesium is a bronchodilator that relaxes the airways, and vitamin C has a slight antihistamine effect.)
- Take pseudoephedrine (e.g., Sudafed), a nasal decongestant.
- Seek emergency medical help if wheezing, coughing, and breathing difficulty do not subside after a period of rest.

Source: SGH, 2015; Firshein, 2013.

### **STEP 3: GET APPROPRIATE MEDICAL ADVICE**

#### **Severe or Extremely Severe Initial Symptoms**

Regardless of the usual severity of their asthma, all patients need a list of symptoms—such as extreme breathlessness, insufficient breath to speak more than a few words at a time, or drowsiness—that suggest the onset of an extremely severe attack. These symptoms should prompt patients to call 911 immediately while taking their quick-relief medicine.

#### **Poor Response to Quick-Relief Medicines**

If symptoms are worsening, or if after 30 minutes marked wheezing and difficulty breathing persist, or if the PEF is less than 50% of the patient's predicted or personal-best value, the patient should follow the above medication regimen (Step 2), contact his or her primary care provider immediately, and proceed to an emergency department, calling 911 rather than driving oneself. If the patient is drowsy, confused, sweating, or turning blue, call 911 immediately.

#### **Incomplete Response to Quick-Relief Medicines**

If after 30 minutes wheezing or difficulty breathing or if the PEF is between 50% and 80% of the patient's personal-best value, the patient should follow the above medication regimen (Step 2) and contact his or her primary care provider within 24 hours for further instructions.

#### **Complete Response to Quick-Relief Medicines**

If after 30 minutes the patient no longer has wheezing or difficulty breathing and the PEF is at least 80% of the patient's personal-best value, the patient should follow the above medication regimen (Step 2) and contact his or her primary care provider later for follow-up instructions.

#### **STEP 4: FOLLOW AFTER-THE-ATTACK INSTRUCTIONS**

After an asthma attack, the patient should continue stepped-up treatments for several days. A full recovery will take 1 to 2 days for moderate symptoms and more than 3 days for severe symptoms. Improvement can be gradual. The underlying disease flare-up will last for 2 to 3 weeks. Always contact the primary care provider within a day of the attack for specific after-the-attack instructions.

#### **EMS Management of an Attack**

Quick treatment with oxygen and bronchodilators is the optimal treatment for a severe asthma attack, and EMS transport is the preferred way for a patient with a severe asthma attack to get to an emergency department.

EMS teams should be trained in the recognition of and response to asthma attacks, and they should be trained to recognize imminent respiratory failure and asphyxiation. They should also have written protocols for the prehospital treatment of asthma attacks in children and adults. The type of prehospital care that is provided will depend on the level of training of the EMS personnel called to the scene (e.g., first responder, EMT-basic, EMT-advanced, or paramedic).

The basic protocol should begin with evaluation of the patient while in the transport vehicle. EMS responders should:

- Check vital signs and level of consciousness
- Listen for breath sounds
- Record oxygen saturation (SaO<sub>2</sub>)
- Administer oxygen

It is ideal for EMS technicians to have standing orders to provide inhaled albuterol for patients experiencing asthma symptoms. This may be administered by nebulizer, either hand-held, small-volume nebulizer or in conjunction with a continuous positive airway pressure (CPAP) device or bag valve mask.

For patients who do not respond to this medication, parenteral beta-agonist therapy may be given, the most common of which is epinephrine administered subcutaneously or intramuscularly. Magnesium sulfate (Epsom salt) intravenously may also be administered for its effect as a smooth muscle relaxant.

In addition, many EMS systems are recommending the use of CPAP systems to reduce the work of breathing, hold airway structures open, and improve oxygenation (Ogilvie, 2012).

### **SPECIAL CONSIDERATIONS FOR MANAGING ASTHMA IN DIFFERENT AGE GROUPS**

#### **Infants and Young Children (5 Years of Age and Younger)**

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## **Key Recommendations for Managing Asthma in Infants and Young Children**

**Diagnosing asthma in infants is often difficult, yet under-diagnosis and under-treatment are key problems in this age group. Thus, a diagnostic trial of inhaled bronchodilators and anti-inflammatory medications may be helpful.**

**In general, infants and young children consistently requiring symptomatic treatment more than two times per week should be given daily anti-inflammatory therapy.**

**When initiating daily anti-inflammatory therapy, a trial of cromolyn or nedocromil is often given due to the safety profile of these medications.**

**Response to therapy should be carefully monitored. Once control of asthma symptoms is established and sustained, a careful step down in therapy should be attempted. If clear benefit is not observed, alternative therapies or diagnoses should be considered.**

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## **Diagnosis**

Several studies show that as many as 50 to 80 percent of children with asthma develop symptoms before their fifth birthday. Diagnosis can be difficult in this age group and has important implications. On the one hand, asthma in early childhood is frequently under-diagnosed (receiving such labels as chronic bronchitis, wheezy bronchitis, recurrent pneumonia, gastroesophageal reflux, and recurrent upper respiratory tract infections), and thus many infants and young children do not receive adequate therapy. On the other hand, not all wheeze and cough are caused by asthma, and caution is needed to avoid giving infants and young children inappropriately prolonged asthma therapy. Episodic or chronic wheeze, cough, and breathlessness also may be seen in other less common conditions, including cystic fibrosis, vascular ring, tracheomalacia, primary immunodeficiency, congenital heart disease, parasitic disease, and foreign body aspiration.

Among children 5 years of age and younger, the most common cause of asthma symptoms is viral respiratory infection. At present, the relative contributions of airway inflammation, bronchial smooth muscle abnormalities, or other structural factors in producing wheeze with acute viral upper respiratory infections are unknown. There appear to be two general patterns of illness in infants and children who have wheezing with acute viral upper respiratory infections: a remission of symptoms in the preschool years and persistence of asthma throughout childhood. There are no clear markers to predict the prognosis for an individual child; however, the factors more strongly associated with continuing asthma are allergy, a family history of allergy or asthma, and perinatal exposure to passive smoke and aero-allergens.

## **EMERGENCY DEPARTMENT AND HOSPITAL MANAGEMENT OF ASTHMA EXACERBATIONS**

Severe exacerbations of asthma are potentially life threatening. Care must be prompt. Effective initial therapies (i.e., a short-acting beta<sub>2</sub>-agonist and the means of giving it by aerosol and a source of supplemental oxygen) should be available in a caregiver's office. However, serious exacerbations require close observation for deterioration, frequent treatment, and repetitive measurement of lung function.

Therefore, most severe exacerbations of asthma require prompt transfer to an emergency department for a complete course of therapy.

The administration of oxygen to maintain saturation of at least 94 percent is recommended in all patients presenting with a moderate to severe asthma exacerbation. Oxygen should be administered as soon as possible, preferably in the prehospital phase in an office setting or in transport by emergency medical services. It has been proposed that the helium and oxygen mixture (heliox), however, there are insufficient data to support the use of heliox in the treatment of acute asthma exacerbation.

Inhaled short-acting beta<sub>2</sub> agonist treatment is the mainstay of office or emergency department treatment of moderate to severe asthma exacerbations. In patients with severe exacerbations, continuous beta<sub>2</sub> agonist administration has been shown to improve pulmonary function measurements and reduce hospital admission with no notable differences in pulse, blood pressure, or tremor.

The administration of systemic corticosteroids for adults and children (one to 18 years of age) within one hour of arrival at the emergency room decreases the need for hospitalization.

## **POSTDISCHARGE CARE**

Patients sent home from the emergency department with systemic corticosteroids (a five- to 10-day nontapering course of 50- to 100-mg prednisone per day in adults) have decreased relapse of asthma symptoms, future hospitalizations, and use of short-acting beta<sub>2</sub> agonists.

**Emphasize the need for continual, regular care in an outpatient setting. Refer the patient to a follow-up medical appointment.** A visit to the emergency department is often an indication of inadequate long-term management of asthma or inadequate plans for handling exacerbations. Notify the patient's health care professional (or provide a referral to one if the patient does not name a source of asthma care), and instruct the patient to seek a follow-up medical appointment within 3 to 5 days. When possible, schedule such an appointment prior to the patient's discharge. The follow-up visit should include a detailed review of the patients' medications, inhaler and peak flow meter technique, and development of comprehensive daily management and action plans that will help prevent exacerbations and urgent care visits. Referral to an asthma specialist for consultation should be considered because this has been reported to reduce the rate of subsequent emergency department visits.

**Review written discharge medications** and, whenever possible, provide patient education on avoidance of asthma triggers and correct use of an inhaler.

**Instruct the patient in a simple action plan** for increasing medications or returning for care should asthma worsen.

**Consider issuing a peak flow meter** and providing patient education on how to measure and record daily PEF rates.

### **Provide patient education:**

An exacerbation severe enough to require hospitalization may reflect a failure of the patient's self-management plan. Hospitalized patients may be particularly receptive to information and advice about their illness; take the opportunity to review patient understanding of the causes of asthma

exacerbations, the purposes and correct uses of treatment, and the actions to be taken for worsening symptoms or peak flow values.

# Education for a Partnership in Asthma Care

## Key Points

Patient education should begin at the time of diagnosis and be integrated into *every* step of clinical asthma care.

It is essential that education be provided by *all* members of the health care team. The principal clinician should introduce the key educational messages and negotiate agreements with patients; these messages should be reinforced and expanded by all members of the health care team.

Teach asthma self-management, tailoring the approach to the needs of each patient. Maintain a sensitivity to cultural beliefs and practices. Teach and reinforce at *every* opportunity:

- Basic facts about asthma

- Roles of medications

- Skills: inhaler/spacer/holding chamber use, self-monitoring

- Environmental control measures

- When and how to take rescue actions

Jointly develop treatment goals.

To encourage an active partnership, provide all patients with a written daily self-management plan and an action plan for exacerbations. Action plans are especially important for patients with moderate-to-persistent asthma and patients with a history of severe exacerbations. Provide appropriate patients with a daily asthma diary.

Encourage adherence by promoting open communication; individualizing, reviewing, and adjusting plans as needed; emphasizing goals and outcomes; and encouraging family involvement.

Patient education is an essential component of successful asthma management. Current management approaches require patients and families to effectively carry out complex pharmacologic regimens, institute environmental control strategies, detect and self-treat most asthma exacerbations, and communicate appropriately with health care providers. Patient education is the mechanism through which patients learn to successfully accomplish those tasks. It is also a powerful tool for helping patients gain the motivation, skill, and confidence to control their asthma. Research shows that asthma education can be cost-effective and can reduce morbidity for both adults and children, especially among high-risk patients. This Unit covers strategies for enhancing the delivery of patient education and improving the likelihood that patients will follow clinical recommendations, as well as key messages to communicate to the patient.

## CASE

### **John, AGE 11**

John Beckman is an 11-year-old boy whose identical twin brother, Adam, was diagnosed with asthma at age 8. John is brought to the pediatrician's office by his mother, Laura, who tells the office nurse that John has been experiencing episodes of wheezing and shortness of breath over the last two weeks, during which time there have been several days of high humidity and poor air quality.

When asked about John's medical history as part of the nursing assessment, Laura cannot recall any early respiratory infections, though she notes that he seems to have become more susceptible to colds in recent years. When asked about her own history, Laura recalls periodic episodes of wheezing and coughing when she was a young girl, but she was never screened for asthma.

Because John's twin brother has asthma, Laura possibly having had asthma as a young girl, and John's reactivity to temperature and air pollution, it is decided to screen and test John for asthma. These tests are completed in the office, and a diagnosis of asthma is confirmed.

## CASE

### Patient Education

### **John, AGE 11**

John, the 11-year-old identical twin who was brought to the pediatrician's office by his mother (as described in the case above), returned to the office to meet with the nurse after being diagnosed with asthma and given a prescription for quick-relief inhaler. The following patient education was accomplished at this visit.

- The nurse gave John the inhaler, described how it is used, and told him he is to use it when he experiences an asthma attack while at home or at school. The nurse then explained how the inhaler works, demonstrated the technique, and had John return the demonstration using a dummy inhaler. She also gave him a pamphlet that pictorially describes the use of the inhaler and instructions on the prescribed dosage and frequency of inhaler use.
- The nurse gave John tips to help him assess the severity of an attack, noting that when he starts to wheeze, cough, and have difficulty breathing or talking during normal activities, those symptoms signal a need for the use of the inhaler.
- The nurse reviewed the use of the peak flow meter with John and his mother. John practiced using it to arrive at his "personal best." This and detailed instructions on how to assess John's values were discussed.
- The nurse helped prepare a written set of instructions for John and a separate, more detailed set of instructions for his mother. The mother's instructions focused more specifically on when to repeat bronchodilator treatment, call the doctor, or take John to the emergency department based on his response to the quick-relief bronchodilator (as determined by peak flow values and the severity and/or persistence of symptoms).
- The nurse made a separate copy of the mother's instructions for the school nurse, which John's mother promised to deliver herself.

## ESTABLISH A PARTNERSHIP

**Patient education should begin at the time of diagnosis and be integrated into every step of medical care, in the context of medical appointments and other clinician-patient communication.** When clinicians take the time to provide education, it sends a powerful message to patients and families about the importance of being knowledgeable self-management of asthma. Specific educational messages delivered in the context of a medical care appointment clearly communicate the importance of collaboration in the treatment of asthma.

From the time of diagnosis, the clinician and other members of the health care team should begin to build a partnership with the patient and family. Building the partnership requires that clinicians promote open communication and ensure that patients have a basic and accurate foundation of knowledge about asthma, understand the treatment approach, and have the self-management skills necessary to monitor the disease objectively and take medication effectively.

**When nurses, pharmacists, respiratory therapists, and other health care professionals are available to support and expand patient education, a team approach should be used. The principal clinician should introduce the key educational messages and negotiate agreements with patients.** Different members of the health care team should reinforce and expand these messages during office visits and telephone calls or in more formal educational sessions.

Communication and coordination within the team are critical. **Team members should document in the patient's record the key educational points, patient concerns, and actions the patient agrees to take.** This will enable all members of the team to be consistent and to reinforce the educational points and the progress being made.

*Check off or document that the following key messages have been covered:*

### Basic Facts About Asthma

- The contrast between asthmatic and normal airways
- What happens to the airways in an asthma attack

### Roles of Medications

- How medications work
- Long-term control: medications that prevent symptoms, often by reducing inflammation
- Quick relief: short-acting bronchodilator relaxes muscles around airways
- Stress the importance of long-term-control medications and not to expect quick relief from them.

### Skills

- Inhaler use (patient demonstrate)
- Spacer/holding chamber use
- Symptom monitoring, peak flow monitoring, and recognizing early signs of deterioration

### **Environmental Control Measures**

- Identifying and avoiding environmental precipitants or exposures

### **When and How To Take Rescue Actions**

- Responding to changes in asthma severity (daily self-management plan and action plan)

### **Teach Asthma Self-Management**

**Clinicians teach patients and families the essential information, medication skills, self-monitoring techniques, and environmental control measures patients require.** These key points should be adapted to meet the individual patient's needs. **Clinicians should:**

**Teach basic facts about asthma** so that the patient and family understand the rationale for needed actions. Give a brief verbal description of what asthma is and the intended role of each medication. Do not overwhelm the patient with too much information all at once, but repeat the important messages at each visit. Ask the patient to bring all medications to each appointment for review.

**Teach the patient necessary medication skills, such as correct use of the inhaler and spacer/holding chamber and knowing when and how to take quick-relief medications.**

**Teach self-monitoring skills: symptom monitoring, peak flow monitoring as appropriate, and recognizing early signs of deterioration.**

**Teach relevant environmental control/avoidance strategies.** Teach how environmental precipitants or exposures can make the patient's asthma worse (e.g., allergens and irritants) at home, school, and work and how to recognize both immediate and delayed reactions.

### **Jointly Develop Treatment Goals**

Fundamental to building a partnership is for clinicians and patients to jointly develop and agree on both short- and long-term treatment goals. Such agreements can encourage active participation, enhance the partnership, and improve asthma management. **Clinicians should:**

**Determine the patient's personal treatment goals.** Ask how asthma interferes with the patient's life (e.g., inability to sleep through the night, play a sport) and incorporate the responses into personal treatment goals. Asthma-specific quality-of-life instruments may be useful.

**Share the general goals of asthma treatment with the patient and family.** Tell patients, "Our goals are to have you:

Be free from severe symptoms day and night, including sleeping through the night."

Have the best possible lung function."

Be able to participate fully in any activities of your choice."

Not miss work or school because of asthma symptoms."

Need fewer or no urgent care visits or hospitalizations for asthma."

Use medications to control asthma with as few side effects as possible."

Be satisfied with your asthma care."

**Agree on the goals of treatment.** The clinicians, the patient, and when appropriate, the patient's family should agree on the goals of asthma management, which include both the patient's personal goals and the general goals (see list above) suggested by the clinicians.

### **Provide the Patient With Tools for Self-Management**

**Clinicians should develop a written, individualized, daily self-management plan in consultation with the patient.** Include the recommended doses and frequencies of daily medications and the daily self-management activities needed to achieve the agreed-on goals. Review and refine the plan at subsequent follow-up visits. List the treatment goals in the plan and explain how following the plan will help the patient reach those goals. Emphasizing the patient's personal goals is essential to enhancing adherence. For example, ask, "Have you had any problems taking your bronchodilator immediately before playing basketball? Has it helped you stay in the game?"

**Discuss the long-term benefits of following the written, daily self-management plan.** For some patients, focusing on long-term treatment goals and discussing the "big picture" of asthma control and how medications can be adjusted over time may improve adherence.

**Also at the first visit, jointly develop a written action plan to help the patient manage asthma exacerbations.** This is especially important for patients with moderate-to-severe persistent asthma and patients with a history of severe exacerbations. Review and refine the plan at follow-up visits. The action plan directs the patient to adjust medicines at home in response to particular signs, symptoms, and peak flow measurements. It should also list the PEF levels and symptoms indicating the need for acute care and emergency telephone numbers for the caregiver, emergency department, rapid transportation, and family/friend for aid and support. Clinicians should choose an action plan that suits their practice, patients, and style.

**Clinicians should provide an asthma diary to appropriate patients for self-monitoring symptoms, peak flow measurements, frequency of daily quick-relief inhaler medication use, and activity restriction.**

### **Encourage Adherence**

An important part of patient education is encouraging adherence.

**Use effective techniques to promote open communication.** Research suggests that certain clinician behaviors are associated with patient adherence and/or satisfaction with care.

**Early in each visit, elicit the patient's concerns, perceptions, and unresolved questions about his or her asthma.** A question such as "What worries you most about your asthma?," which cannot be answered yes or no, encourages patients and families to voice issues, personal beliefs, or concerns they may be apprehensive about discussing or may not think are of interest to the clinician. These potential barriers to adherence can be dealt with only if they are identified. By asking about and discussing such concerns, clinicians build trust and a sense of partnership with the patient. Most non-adherence originates in personal beliefs or concerns about asthma that have not been discussed with the clinician. Until such fears and worries are identified and addressed, patients will not be able to adhere to the clinician's recommendations.

**Assess the patient's and family's perceptions of the severity level of the disease.** Two questions may prove useful: "How severe do you think your asthma is?" and "How much danger do you believe you are in from your asthma?" When patients are identified who are overwhelmed by fear of death, put their fears in perspective by providing them with the results of objective assessments and expert opinion. A clearly written, detailed action plan that directs the patient how to respond to worsening asthma may be extremely helpful in reducing anxiety. Patients' perceptions about their disease severity and its threat to their well-being influence self-management behavior and use of the health care system.

**Assess the patient's and family's level of social support.** Ask, "Who among your family or friends can you turn to for help if your asthma worsens?" Counsel patients to identify an asthma "partner" among their family or friends who is willing to be educated and provide support. Include at least one of these individuals in follow-up appointments with the patient so that he or she can hear what is expected of the patient in following the self-management and action plans.

**Encourage or enlist family involvement.** Ask patients to identify ways their family members can help them follow the plans. Ask the patient to share the plans with family members, elicit their input, and agree on actions they can help with. It may be helpful for children and parents to discuss this with a clinician present.

Consider referral to a psychologist, social worker, psychiatrist, or other licensed professional when stress seems to unduly interfere with daily asthma management. As with other chronic diseases, emotional and social stress may be a confounding factor for many patients struggling with asthma control. Although stress does not cause asthma, it can play a role in precipitating asthma exacerbations and can complicate an individual's attempts at self-management. Referral to a local support group may be useful.

**Use methods to increase the chances that the patient will adhere to the written, daily self-management plan.** For instance, adherence to the self-management plan is enhanced when the plan is simplified as much as possible, when the number of medications and frequency of daily doses are minimized, when the medication doses and frequency fit into the patient's and family's daily routine, and when the plan considers the patient's ability to afford the medications. Because nonadherence is difficult for clinicians to detect, it is prudent to explore potential barriers to adherence with every patient by asking what concerns they have about medicines (e.g., safety) or other aspects of treatment.

## CASE

Donna Hart is a 24-year-old teacher's aide who works in a public elementary school. She has come to her healthcare provider's office complaining of a chest cold that she has had for two weeks and that does not

seem to be getting better. She complains of frequent bouts of coughing and bringing up thick, sticky mucus. She also says she has had some occasional wheezing and difficulty breathing. Her sleep has been disturbed at least three nights a week since this all started.

Following a physical examination she is referred to the office nurse for a complete asthma assessment. The nurse has Donna fill out an asthma screening questionnaire. Her responses indicate a family history of asthma, a personal history of allergies, worsening of coughing and wheezing during periods of humid weather and poor air quality, more frequent episodes of sleep disturbances over the past two months, and a cigarette smoking habit (though she indicates that she is trying to quit).

When asked about her work situation, Donna notes that in addition to using a blackboard and chalk during the school day and “magic markers” to grade students’ papers, she is regularly exposed to first- and second-graders who come to school with coughs and colds. She adds that the school is located in an urban neighborhood not far from a factory with smokestacks that spew out thick, black smoke.

Following review of the assessment with her healthcare provider, Deborah is referred for lung function testing, and the results confirm a diagnosis of asthma.

## **Tailor Education to the Needs of the Individual Patient**

**Assess cultural or ethnic beliefs or practices that may influence self-management activities and modify educational approaches, as needed.** Cultural variables may affect patient understanding of and adherence to medical regimens. Open-ended questions such as "In your community, what does having asthma mean?" can elicit informative responses. The culturally sensitive clinician should attempt to find ways to incorporate harmless or potentially beneficial remedies with the pharmacologic plan. For example, a prevalent belief among the Latino population is that illnesses are either "hot" or "cold". Asthma is viewed as a "cold" illness amenable to "hot" treatment. Suggesting that asthma medications be taken with hot tea or hot water incorporates this belief into the therapeutic regimen and helps build the therapeutic partnership. When harmful home remedies are being used, clinicians should discourage their use by suggesting a culturally acceptable alternative as a replacement or recommending a safer route of administration. These and other strategies may be useful in working with ethnic minorities.

**Every effort should be made to discuss asthma care, especially the self-management plan, in the patient’s native language so that educational messages are fully understood.** Research suggests that lack of language concordance between the clinician and the patient affects adherence and appropriate use of health care services. Language barriers also may complicate the assessment of cultural differences. If interpreters are used, they should be equally competent in both English and the patient’s language and knowledgeable about medical terms.

## **MAINTAIN THE PARTNERSHIP**

As part of ongoing care, the clinician should continue to build the partnership by being a sympathetic coach and by helping the patient follow the self-management plan and take other needed actions. **Educational**

**efforts should be continuous**, because it may take up to 6 months for the impact of education to be evident. Furthermore, it is necessary to periodically review information and skills covered previously because patient self-management behavior is likely to decline over time.

**In particular, it is essential that clinicians demonstrate, review, evaluate, and correct inhaler/spacer/holding chamber technique at each visit because these skills deteriorate rapidly.**

Written instructions are helpful, but insufficient. Research suggests that patients tend to make specific mistakes in using inhalers that need to be corrected. Patients especially need to be reminded to inhale slowly and to activate the inhaler only *once* for each breath.

**Clinicians should continue to promote open communication with the patient and family by addressing the following elements in each follow-up visit:**

**Continue asking patients early *in each visit* what concerns they have about their asthma and what they especially want addressed during the visit.**

**Review the short-term goals agreed on in the initial visit.** Assess how well they are being achieved (e.g., was the patient's wish to engage in physical activity achieved?). Revise the goals as needed. Achievement of short-term goals should be discussed as indicators that the patient is moving toward long-term goals. Give positive verbal reinforcement for achievement of a goal and recognize the patient's success in moving closer to full control of the disease.

**Review the daily self-management plan and the steps the patient was to take. Adjust the plan as needed** (e.g., the recommendations of how to use medicines if the dose or type is not working). Identify other problems the patient has in following the agreed-on steps (e.g., disguising the bad taste of medicine); treat these as areas needing more work, not as adherence failures. Write a self-management plan to help school personnel manage a child's asthma.

**Periodically review the asthma action plan and revise as necessary.** Confirm that the patient knows what to do if his or her asthma gets worse.

**Continue teaching and reinforcing key educational messages.** Provide information and teach skills over several visits so as not to overwhelm the patient with too much information at one time. Repeat important points often.

Give patients simple, brief written materials that reinforce the actions recommended and skills taught.

## CASE

### Inhaler Education

Kelli is a 35-year-old woman who has recently been diagnosed with asthma. She has an appointment with the office nurse to receive additional education on controlling her disease. During the visit her medications are discussed and reviewed, as well as the new asthma action plan developed between herself and her primary physician.

Before Kelli leaves the office, the nurse asks her to demonstrate the use of her inhaler. A dummy inhaler is provided, and as the nurse watches, Kelli proceeds through the steps.

Following her demonstration, the nurse points out three problems with her technique. First, she did not fully exhale all the air in her lungs before inhaling the medication. Secondly, she did not shake the inhaler again before administering a second dose. And lastly, she did not begin to inhale until she had sprayed the medicine into her mouth.

The nurse next demonstrates the proper technique for Kelli, who then returns the demonstration. She is given a pamphlet to refer to at home that visually guides her through the technique.

## **SUPPLEMENT PATIENT EDUCATION DELIVERED BY CLINICIANS**

All patients may benefit from a *formal asthma education program* that has been evaluated and reported in the literature to be effective. These programs should be taught by qualified asthma educators who are knowledgeable about asthma and experienced in patient education. Communication among the asthma educator, the clinicians providing direct care, and the patient/family is critical. When formal programs are available in local communities, they can *supplement, but not replace*, patient education provided in the office. Individual and group programs have been developed and tested for patients of all ages, including parents of very young children (birth to 4 years).

These patient education programs should be delivered as designed. Some validity and effectiveness may be compromised when segments of various programs are pieced together or when programs are condensed. In the interest of saving time, educators should not delete educational strategies, such as using small groups or scheduling multiple sessions spaced with "homework" assignments, because these strategies have demonstrated effectiveness in motivating individuals to make significant behavior changes.

## **PROVIDE PATIENT EDUCATION IN OTHER CLINICAL SETTINGS**

**Patient education also should be delivered in the context of emergency department visits and hospitalizations.** Asthma exacerbations may represent teachable moments when patients are more receptive to educational messages. Research on adults with asthma who are referred by emergency department providers to an asthma education program shows that education can decrease utilization of emergency services. Educational programs delivered to hospitalized children and adult asthma patients show increased knowledge and use of self-management behaviors, reduced length of hospital stay, and overall reduction in asthma readmissions.

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## ASTHMA PHARMACOLOGY

1. All sources agree that \_\_\_\_\_ are the leading cause of the exacerbation of asthma, and may contribute to the development of this disease.
  - a. polluted atmospheres
  - b. viral respiratory infections
  - c. stressors
  - d. genetic tendencies
  
2. Which of the following are the most important keys to controlling asthma in children and adults.
  - a. medication, exercise, and diet
  - b. homeopathic medications and meditation
  - c. diagnosis, long term treatment, and education
  - d. medication, peer support, and education
  
3. Asthma attacks are classified into four levels of severity. Attacks that occur less than two times a week, are asymptomatic between exacerbations, and whose exacerbations are brief would be classified as:
  - a. Severe persistent
  - b. Moderate persistent
  - c. Mild persistent
  - d. Mild intermittent
  
4. For an acute asthma attack, it is OK to use a long acting inhaler such as Qvar or Flovent **IF** there is no short acting inhaler available.
  - a. True
  - b. False

5. Asthma is a chronic disorder with recurrent episodes of airflow limitation, mucus production, and cough which requires:
- Both long-term-control medications and quick acting medications
  - Steroids and frequent visits to a physician
  - Treatment only when symptoms are present
  - Wearing an medical ID bracelet at all times
6. Anticholinergics:
- Therapy of choice for relief of acute symptoms and prevention of exercise induced bronchospasm (EIB)
  - When inhaled, prevents the release of histamine and other inflammatory substances, keeping airways from swelling
  - These drugs are bronchodilators, relaxing the muscles around the bronchi. They also reduce excess mucus, which is produced during an asthma attack.
  - Include cromolyn sodium (Intal) and nedocromil (Tilade)
7. All of the following are true about short-acting beta<sub>2</sub> –agonists (SABSs) **except**:
- They begin acting in less than five minutes, and last for three to six hours.
  - They are inhaled and relax smooth muscles of the bronchioles while decreasing swelling that impedes airflow.
  - Therapy of choice for relief of acute symptoms and prevention of EIB
  - They prevent the binding of IgE to the receptors on basophils and mast cells
8. Montelukast (Singulair), zafirlukast (Accolate), and zileuton (Zyflo) are all medications in which category?
- Leukotriene modifiers
  - Mast cell stabilizers
  - Methylxanthines
  - Long-acting beta<sub>2</sub> –agonists
9. All the following are true about corticosteroids **except**:
- They are the most potent and effective anti-inflammatory medication currently available
  - Are never used in a combination medication
  - Are variants of the natural hormone cortisol
  - Reduce airway hyperresponsiveness, and inhibit inflammatory cell migration and activation

10. Rinsing and spitting after using an asthma inhaler is frequently recommend to prevent:
- Bad breath
  - Allergic reactions
  - Fungal infections
  - Discoloring of teeth
11. A side effect of corticosteroid use can be Cushing syndrome. Symptoms to watch for include all the following **except**:
- Fatty deposits under the skin, especially of the face, upper back, torso, and supraclavicular region
  - Sudden growth spurts in children
  - Infertility, decreased libido, and impotence in men
  - Progressive proximal muscle weakness
12. Complementary alternative medicine may be of help for people with asthma. Which statement is **not** true:
- Acupuncture has been proven to help asthma patients
  - Chiropractic manipulation might reduce the number of asthma attacks and the need for medication, particularly in children
  - Complementary and alternative medicine (CAM) asthma treatments range from breathing exercises to herbal remedies
  - Alternative healing methods are not substitutes for recommended pharmacologic
13. Inspiratory muscle training is taught by physical therapists in the treatment of asthma. The goal of these techniques is to:
- Prevent the lungs from reacting to an allergic reaction, which can lead to an asthma attack
  - Control our allergic response to prevent an asthma attack
  - Relax our bodies so we can avoid an asthma attack
  - Strengthen both inspiratory and/or expiratory muscles in an effort to reduce the patient's perception of dyspnea, aid in overcoming airway resistance, and avoid hyperinflation due to insufficient expiratory strength

14. Hospitals commonly give which antioxidant intravenously for severe asthma attacks.

- a. Magnesium
- b. Vitamin C
- c. Omega-3 fatty acids
- d. Vitamin E

15. Bronchial thermoplasty:

- a. Is a treatment for asthma that has been around for a long time
- b. Requires one out-patient treatment at a hospital or clinic
- c. Involves lung airways being treated with mild heat via an electrode
- d. Frequently eliminates the need for asthma medications

16. \_\_\_\_\_ are the most common trigger for an asthma attack.

- a. Temperature changes
- b. Exposure to pet dander
- c. Allergies
- d. Stressful situations

17. Immunotherapy is:

- a. Repeatedly exposing a child to an allergen until he/she gets used to it
- b. Complete and total avoidance of an allergen
- c. Figuring out what a person is allergic to
- d. Giving small amounts of the allergen over time, to build up the body's own immunity to the allergy.

18. There are several devices available for delivering drugs directly into the lungs. The common aerosol devices include:

- a. Nebulizer
- b. Metered-dose inhaler (MDI)
- c. Spacers, or valved holding chambers (VHCs)
- d. All the above

19. A nebulizer is:

- a. A spacer is a simple tube added to the mouthpiece of an MDI to move the inhaler farther from the patient's
- b. pressurized canister contains medication, and is activated by compressing it to deliver a metered dose of the drug to be inhaled
- c. A device that does not use a chemical propellant to push the medication out of the inhaler
- d. An electric machine used to change medication from a liquid to a mist so that it can be more easily inhaled into the lungs through a mouthpiece or mask worn over the nose and mouth

20. This is the most common device used to deliver medications in an ambulatory setting.

- a. A nebulizer
- b. A MDI
- c. A spacer
- d. A dry powder inhaler

21. Advantages of spacers include all **except** the following:

- a. It is the most common device used to deliver medications to infants and small children.
- b. Have a one-way valve that keeps the patient from exhaling into the MDI
- c. Moves the medication past the mouth, allowing it to go deep into the lungs.
- d. A spacer is a simple tube added to the mouthpiece of an MDI to move the inhaler farther from the patient's mouth

22. A dry powder inhaler (DPI) is a device that does not use a chemical propellant to push the medication out of the inhaler. Instead, the medication is released through the mouthpiece by deep and fast inspiration. Because of this:
- This device is not indicated for use in children under 12 because of the requirement of high inspiratory flow.
  - This is the most common device used to deliver medications in an ambulatory setting
  - It is often referred to as a “breathing treatment”
  - It can spray medicine as fast as 60 miles per hour
23. A 2011 study published in the Journal of General medicine revealed that out of 100 hospitalized patients who routinely used an inhaler, \_\_\_\_ used their MDI incorrectly
- 10 %
  - 30 %
  - 86 %
  - 72 %
24. If a patient is taking both bronchodilator and anti-inflammatory medicines, which is usually taken first?
- Bronchodilator
  - Anti-inflammatory
25. When first teaching the correct use of a Metered Dose Inhaler, do all the following except:
- Have the patient show you how they think it works, and then correct their mistakes
  - Demonstrate how to use each inhaled medicine
  - Tell the patient what each medication is for, and label inhaler if needed
  - Teach them the advantages and disadvantages of using an inhaler

26. The following criteria indicate who may benefit from using a spacer or holding chamber **except**:

- a. The young patient
- b. The patient with coordination problems
- c. The patient with irritable airways
- d. The patient who prefers a nebulizer

27. Most asthma patients use MDIs for their quick-relief medications. The following steps are essential, **except** for:

- a. Shake the canister for five seconds, left out all your breath, and close lips around the mouthpiece or one to two inches in front of our open mouth
- b. Take two doses in close succession while depressing the canister of the device
- c. As you start to slowly inhale, press down on the inhaler one time. Inhale slowly and deeply, and to a count of ten if possible
- d. When inhaling quick-relief medicine, wait 30 to 60 seconds between puffs. For other medicines it is not necessary to wait before taking the prescribed number of puffs

28. The step-wise approach to controlling asthma outlines four steps of severity. Someone with daily symptoms, daily use of short-acting inhaled beta<sub>2</sub>-agonists, exacerbations that affect activity, and exacerbations up to twice weekly would be categorized as:

- a. Severe Persistent
- b. Moderate Persistent
- c. Mild Persistent
- d. Mild Intermittent

29. In general, \_\_\_\_\_ added to the medical regimen should be the first medication reduced.

- a. The first medication
- b. The strongest medication
- c. The last medication
- d. All the above

30. An infant or small child with asthma will always have asthma as an adult.

- a. True
- b. False

31. Extrinsic (allergic) asthma is the most commonly seen in:

- a. Children
- b. Teenagers
- c. Young adults
- d. Older adult

32. Nocturnal asthma can be either intrinsic or extrinsic, and refers to asthma that worsens during the night. This may be caused by all the following **except**:

- a. Reclining position
- b. Hormones and circadian rhythms
- c. Snoring
- d. GERD (gastroesophageal reflux disorder)

33. Once control of asthma is achieved and maintained for at least \_\_\_\_\_, a gradual reduction of the maintenance therapy should be tried in order to identify the minimum therapy required to maintain control.

- a. One year
- b. Six months
- c. One month
- d. Three months

34. Dust mites are a common allergy trigger. To reduce exposure to dust mites, do all the following **except**:

- a. Run a humidifier at all times
- b. Wash bedding in hot water every week
- c. Get rid of carpeting
- d. Steam clean bedding, mattresses, and furniture that cannot be washed

35. Aspirin and NSAIDs can trigger severe or fatal attacks

- a. True
- b. False

36. EIB should not limit either participation or success in vigorous activities. Recommended treatments include:

- a. Take rescue medicines before sports or exercise to prevent symptoms, if directed by a healthcare provider.
- b. Warm up/cool down for 5 to 10 minutes before and after sports or exercise.
- c. Cover nose and mouth with a scarf when exercising in the cold.
- d. All the above

37. Research shows that asthma education can do everything below **except**:

- a. Reduce morbidity for both adults and children
- b. Guarantee a patient will outgrow their asthma
- c. Help patients gain the motivation, skill, and confidence to control their asthma
- d. Improve the likelihood that patients will follow clinical recommendations

38. Current research for the treatment of cough variant asthma in children (cough as the only respiratory symptom without any evidence of airway obstruction):

- a. Should always be swift and deliberate
- b. Determined there was no significant difference between salbutamol treated group and placebo group.
- c. Has determined the appropriateness of the common practice of using inhaled  $\beta_2$  agonists
- d. Is a sign of severe asthma attacks later in life

39. A person with exercise-induced bronchospasm:

- a. Should be excluded from participating in sports
- b. Should not be working at jobs with heavy physical demand based solely on EIB
- c. Can be managed is to prevent or reduce the symptoms of EIB, to enable patients to exercise at all intensity levels without serious respiratory limitations.
- d. Are excluding from joining the military

40. First line of treatment for the prevention of EIB in:

- a. Inhaled beta agonists
- b. Cromolyn and Nedocromil
- c. Inhaled corticosteroids
- d. A hearty meal one hour before exercise

41. Asthma patients are at risk for specific complications during and after \_\_\_\_\_.

- a. Summer months
- b. Sleep
- c. Surgery
- d. None of the above

42. While women with asthma can safely become pregnant,
- They cannot take any asthma medications without endangering their baby
  - They should be on bedrest to avoid any asthma attacks
  - They need to be closely monitored by their physician
  - They must have a caesarian section avoid the stress of labor
43. \_\_\_\_\_ is an obstruction of transient airflow that usually occurs five to 15 minutes after physical exertion
- Exercise-induced bronchospasm
  - A seasonal asthma attack
  - Wheezing
  - None of the above
44. The amount and frequency of medication given is dictated by asthma severity and directed toward:
- A sedentary lifestyle
  - A goal of using rescue inhalers only
  - Suppression of airway inflammation.
  - Elimination of oral medications
45. According to the National Heart, Lung, and Blood Institute, the immunohistopathologic features of asthma include inflammatory cell infiltration **except**:
- Neutrophils and Eosinophils
  - Lymphocytes and Mast cell activation
  - Epithelial cell injury
  - Red and White blood cell injury

46. Circadian and hormone changes are consistent with which type of asthma:

- a. Exercise induce
- b. Occupational
- c. Nocturnal
- d. Cough-varient

47. Examples of short-acting inhaled beta<sub>2</sub> –agonists are:

- a. Levalbuterol, Terbutaline, and Albuteral
- b. Ipratropium bromide
- c. Methylprednisolone, Prednisolone, and Prednisone
- d. Zafirlukast and Montelukar

48. A long acting anticholinergics such as Tiotropium or Ipratropium with Albuteral:

- a. Is for maintenance, not for acute attacks
- b. Should only be used when the patient has symptoms
- c. Should be given at least one hour before or two hours after meals
- d. Should be given in a health care setting only due to the risk of anaphylaxis

49. All of the following are true regarding mast cell stabilizers **except**:

- a. They are a preventative treatment taken prior to exposure to exercise or allergens
- b. May cause an unpleasant taste in the mouth of some patients
- c. Block early and late reaction to an allergen, and interfere with chloride channel function
- d. May cause signs of Cushings disease

50. All the following are true regarding asthma **except**:

- a. There is no cure for asthma
- b. It can affect people of all ages
- c. Airway muscles become loose and unresponsive to triggers
- d. Airways narrow and swell, and produce extra mucus