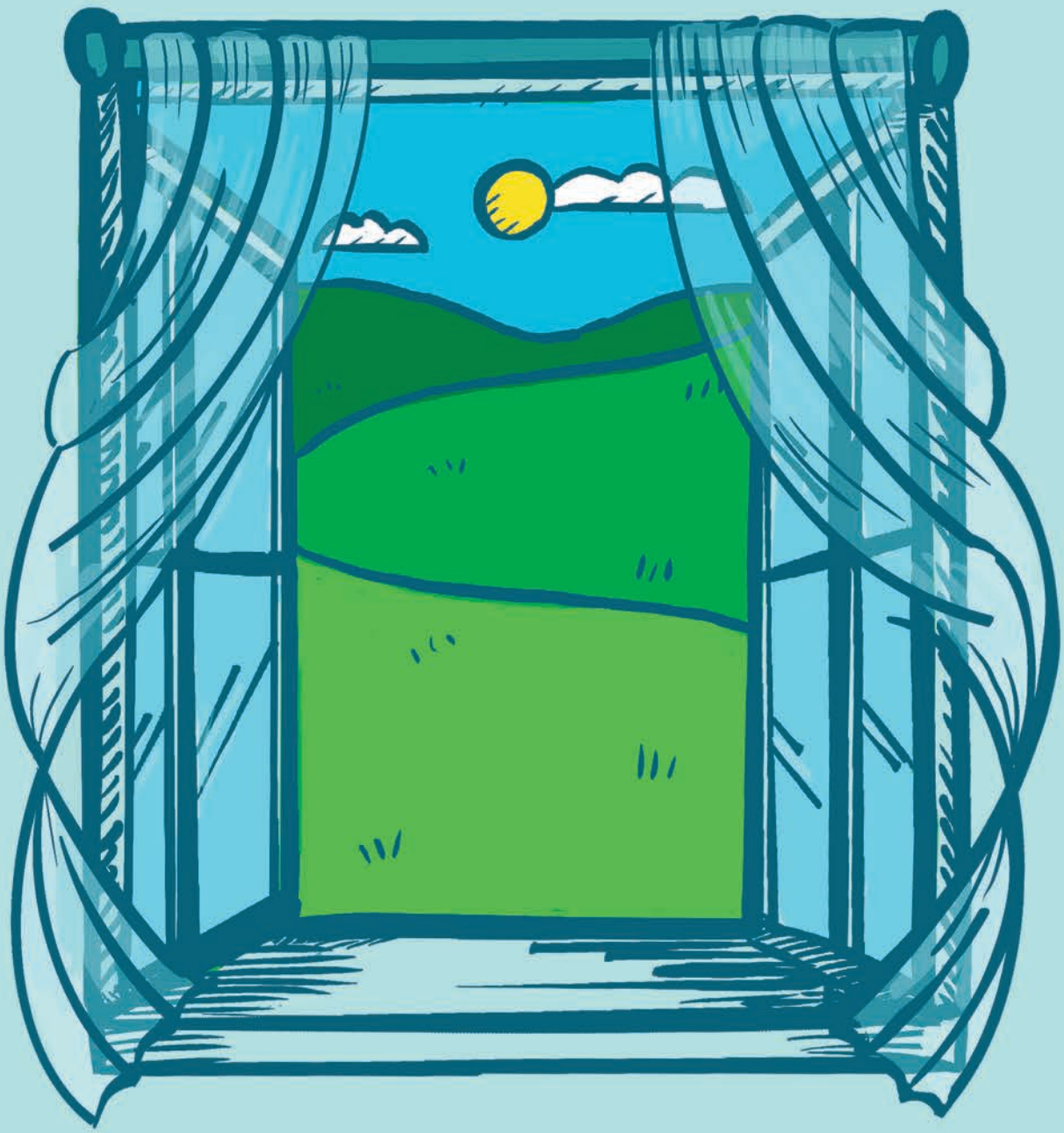
Guide To Asthma

Mass General Brigham



Fourth Edition

mass general brigham asthma center

GUIDE TO ASTHMA

Fourth Edition

Learning About Asthma In Seven Easy Steps

Brigham and Women's Hospital
Massachusetts General Hospital
Brigham and Women's Faulkner Hospital
Newton-Wellesley Hospital
North Shore Medical Center
Pentucket Medical
Hawthorne Medical
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Fourth Edition

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Contents

Introduction to the Fourth Edition

Medical science continues to advance at a galloping pace. In the 12 years since the last edition of our *Guide to Asthma* was released, we have witnessed remarkable progress, from gene editing to novel vaccine development to the use of artificial intelligence in medical decision-making. Our understanding and treatment of asthma are no exceptions. Given the important advances in our knowledge about asthma, including new inhalers, new treatment strategies, and a whole new category of injectable medications, we thought it timely to release a new edition of our Asthma Center's *Guide to Asthma*.

We should first re-introduce ourselves. We are now the Mass General Brigham Asthma Center. The collaboration that brought together the Brigham and Women's and Massachusetts General Hospitals, along with related community hospitals and practice groups, was re-branded in 2019 from *Partners HealthCare* to *Mass General Brigham*.

Our Asthma Center continues to bring together allergists and pulmonologists in a broad collaboration that includes, besides Brigham and Women's and Massachusetts General Hospitals, Brigham and Women's Faulkner Hospital, Newton-Wellesley Hospital, North Shore Medical Center, and practices at Harbor Medical, Pentucket Medical, and Care New England.

We should also acknowledge that we are just now emerging from the worst pandemic that the world has seen in 100 years. Virtually everyone in this country and the world has been impacted by the devastation wrought by Covid-19 infection. Despite expectations to the contrary, it seems that persons with asthma were in general no more adversely affected by Covid-19 infection than those without underlying asthma. Nonetheless, respiratory viruses are generally hard on breathing and the airways of the lungs, and we didn't need another serious and potentially deadly chest infection with which to cope.

While we wait for a cure for asthma, our goal, like yours, is well-controlled asthma – few symptoms, infrequent need for your "quick-relief" bronchodilator medication, rare flare-ups or "attacks" of asthma, and being as active as you wish, without limitation due to your breathing. This goal is now easier to achieve and achievable for more and more persons with asthma thanks to important advances in asthma management made over the last decade. Here are 3 highlights.

- Powerful medication combinations are available for asthma control that need be taken only once or twice daily. Research has proven that the long-acting beta-agonist bronchodilators (such as formoterol, salmeterol, and vilanterol) are safe if used in combination with an inhaled corticosteroid (such as beclomethasone, budesonide, ciclesonide, fluticasone propionate, fluticasone furoate, or mometasone). For those who have lived through the instructions, "take your inhaler 4 times a day, every day," once- or twice-daily dosing is great progress – no more demanding than regular

tooth brushing. In addition, for severe asthma, an inhaler for once-daily administration is available that combines two different long-acting bronchodilators (vilanterol and umeclidinium) with an inhaled steroid (fluticasone furoate), a "three-in-one" combination that is both powerful and convenient.

- Rapid-acting bronchodilators, like albuterol, formoterol, and levalbuterol, provide quick relief of symptoms by causing the bronchial muscles to relax and allowing the bronchial tubes to open wider, but they do nothing to quell the inflammation affecting the walls of the bronchial tubes. In recent years it has been discovered – and documented with multiple clinical studies in persons with asthma – that if you use an inhaled steroid every time you use your quick-acting bronchodilator, you achieve better asthma control and greater protection against severe asthma attacks than if you use your bronchodilator alone. To make the use of this dual administration more convenient, combination inhalers containing both a quick-acting bronchodilator and a corticosteroid are now available, utilizing either a short-acting bronchodilator (albuterol with budesonide) or long-acting bronchodilator with quick onset of action (formoterol with budesonide or with mometasone). The concept behind this strategy, dubbed Anti-Inflammatory Rescue or AIR, is discussed in more detail in Lesson 5.
- In the last edition of *Guide to Asthma*, we introduced the injectable medication, omalizumab (*Xolair*®), as the first in a novel category of medications available to treat asthma, referred to broadly as "biologics," that specifically help persons with severe asthma refractory to other medications. This group of medicines has expanded dramatically in the last 10 years, now with 5 additional monoclonal antibodies available, targeting different chemicals important in creating and maintaining the inflamed bronchial tubes of asthma. For persons with severe asthma of a certain type, these medicines have been a "game changer." It is now the rare person who needs daily oral steroids, like prednisone, to control his/her asthma. Injections once every 2 or 4 weeks can bring remarkable control to what was previously "difficult-to-control" or refractory asthma.

Our work continues. We have no cure for asthma. Studies are on-going regarding strategies to prevent the development of asthma in young children at risk because of their allergic tendencies, but so far, we cannot prevent asthma from starting. And we recognize that medications are expensive and never free of potential side effects. Knowing that progress in medical science, though never quite fast enough, moves forward at dazzling speed, we remain optimistic for further breakthroughs in asthma management in the years ahead. If you wish to support the efforts of the Mass General Brigham Asthma Center in our research, education, patient care, and community equity, we would greatly appreciate your donation at: http://bwhgiving.org/asthmacenter, or by check payable to **Brigham and Women's Hospital/Asthma Center** and mailed to Brigham and Women's Hospital, 263 Huntington Ave., #318, Boston, MA 02115.

We wish you good health and especially good breathing!

Introduction to the Third Edition

It has been nearly 10 years since members of Partners Asthma Center prepared the Second Edition of our *Guide to Asthma.* Since then, new medications to treat asthma have been made available and new approaches to using the available medications have been recommended. Although there is still no cure for asthma, enough new information has become available that we felt compelled to prepare for our patients and their families a Third Edition of our *Guide to Asthma*.

Perhaps the single most important evolution in asthma care has been the new emphasis on asthma *control* rather than asthma *severity*. This shift is based on the understanding that persons with mild, moderate, or even severe asthma can achieve good asthma control with the proper medications and treatment strategies. The concept of well-controlled asthma includes the following goals: symptoms of asthma requiring quick-reliever therapy no more than 2 days out of the week; nighttime awakenings due to asthma no more than 2 nights out of the month; freedom to exercise as you wish; maintenance of normal or near-normal lung function; and rare (no more than once a year) asthma attacks of a severity to require oral steroids (e.g., prednisone).

Over the past 10 years, new medications have been released and others have disappeared from the market. Most dramatically, we have seen the disappearance of metered-dose inhalers using as their propellants chlorofluorocarbons (CFCs), because of the detrimental effect of these chemicals on the ozone layer in the atmosphere. In their stead has come a new generation of metered-dose inhalers using ozone-friendly hydrofluoroalkanes (HFAs). Alternatively, inhaled medications are available as dry-powder inhalers, using the force of a strong inhalation to pull the medication from the delivery device. Some dry-powder inhalers are loaded one capsule at a time; others are multi-dose devices, for which the next dose of medication is prepared with the twist of a wheel or movement of a lever.

Change can be good, and it can also be daunting. It means learning new things and incorporating these changes into one's daily life. We are committed to helping you learn the knowledge and skills that you need to keep your asthma well controlled and to prevent it from dominating your life.

We are also aware that the speed of change in medicine in general and asthma in particular seems constantly to increase. For this reason (and to save printing costs!), we have turned to electronic media to share with you current information about asthma. We hope that you will follow our asthma blog at www.pacasthma.blogspot.com and utilize the many educational resources available at our Partners Asthma Center website, www.asthma.partners.org. We wish you good breathing, now and forever.

Introduction to the Second Edition

Treatments for asthma continue to evolve at a fast pace. Even in the three years since *Partners Asthma Center's Guide to Asthma* was first printed, we have seen important changes.

New medications have been developed. An inhaled corticosteroid called *Qvar*® has replaced older steroid inhalers (containing the same type of steroid medication), *Beclovent*® and *Vanceril*®. Another long-acting inhaled bronchodilator, called formoterol (*Foradil*®), similar to salmeterol (*Serevent*®), has become available as a dry-powder inhaler. The combination of two different preventer medications, an inhaled steroid and a long-acting bronchodilator, is now provided in one inhaler device, called *Advair*®. In people with asthma more severe than just mild asthma, this combination has proved highly effective. In addition, its dry-powder delivery device, called a *Diskus*®, has been highly popular for its simplicity and built-in dose counter.

In this Second Edition of our *Guide to Asthma*, we have incorporated these new developments into a systematic discussion of what asthma is, how to assess your asthma, how to treat asthma both preventively and for relief of symptoms, and how to prepare for attacks of difficult breathing in asthma.

We also find ourselves on the brink of still other, dramatically new approaches to treating asthma. Currently in development (and nearing readiness for approval and marketing) is a unique biologic molecule that removes allergy proteins from the blood. Given as an injection once or twice monthly, it reduces symptoms of asthma and decreases dependency on anti-inflammatory medication. This medicine, called omalizumab (*Xolair*®), and other "designer molecules" like it, will likely revolutionize treatment of difficult asthma and allergies in the years ahead.

Medical science is making great advances in the areas of asthma and allergies. As a result, it is worth your while to be an "asthma scholar" and to learn all that you can about asthma. We hope that you find this Second Edition of *Guide to Asthma* a good beginning.

Introduction to the First Edition

Having asthma can be intimidating!

There are many "dos and don'ts," a variety of different medications for different purposes, lots of advice to be had from family, friends, and even strangers, and plenty of misinformation always available.

For instance, you may have heard that asthma is mostly due to psychological weakness ("it's all in your head"). Someone may have recommended a special diet to you; someone else may have suggested that you stay away from those same foods. You may have been told that asthma medications can be addictive and shouldn't be taken regularly. Or you may believe that asthma goes away when you are feeling well, so that there is no need for medicines to treat asthma except when you are sick.

The staff at the Partners Asthma Center has written this asthma *Guide* to correct these and other misconceptions about asthma. We want to make available to you correct information about asthma in a readable form.

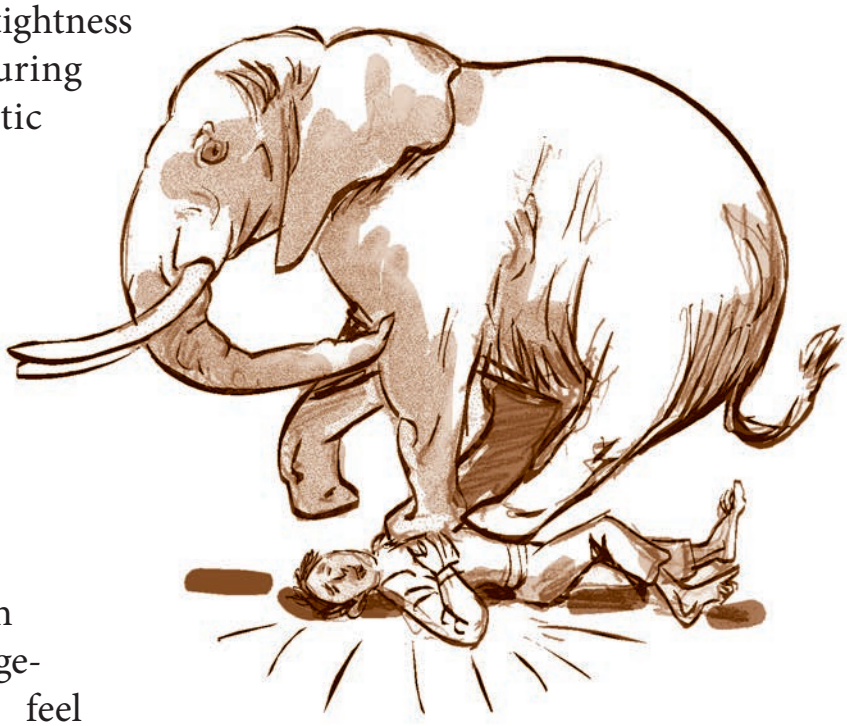
After you make your way through the seven simple lessons in this *Guide*, you will have a better understanding about asthma and its treatment. You will be able to explain — to yourself and to others — what asthma is, how it is best prevented, and how it can be treated. You will know how to deal with sudden difficulty in breathing due to asthma, an asthma attack.

It is true that having asthma may sometimes be intimidating. But knowing the facts about asthma can put you in control again. We can't make asthma "just go away," but we can help you take charge of your asthma. Armed with the knowledge and skills outlined in this booklet, you can make lung health happen.

LESSON 1

What Is Asthma?

Different people experience asthma differently. Some people with asthma have cough, wheezing, and difficulty breathing nearly every day. Others feel perfectly well in between occasional "attacks" of chest congestion and wheezing. Some Olympic athletes with asthma experience only a tightness in the chest during world-class athletic competition.



All people with asthma share the tendency that their breathing passageways (the bronchial tubes) narrow more than normal. Breathing through narrowed air passageways makes one feel

short of breath and may cause a whistling sound, like a flute, called wheezes. Excess mucus made in the walls of the bronchial tubes can fill up the breathing passageways, resulting in cough, chest congestion, and sometimes lots of phlegm to be coughed up.

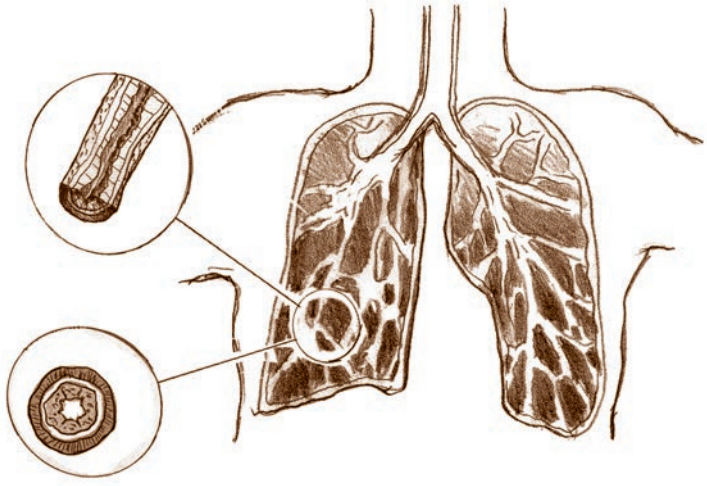
What is special about asthma is that the narrowing of the breathing tubes and the mucus production can come and go. With asthma sometimes you can breathe normally; at other times breathing can be very labored, as though you were trying to breathe through a straw while an elephant sits on your chest. Present *all the time* in asthma is the POTENTIAL for the airways to become narrowed and filled with mucus. Having asthma means always being prone to abnormal narrowing of your airways.

A normal air passageway

No one knows exactly what causes asthma. In part we inherit a tendency toward asthma in our genes, and in part we are exposed to things in the air we breathe that bring out this tendency. One simple example: you may inherit a tendency to make allergic reactions to cat dander.

Growing up with a cat and being exposed every day to the cat dander to which you are allergic can lead to allergic irritation of your bronchial tubes. Once irritated or inflamed in this way, the bronchial tubes react not only to cat dander but also to all of the other usual stimuli that make asthma worse, like smoke and exercise and respiratory infections.

If you have asthma, your bronchial tubes stay irritated even on a good day, when your breathing is normal and you feel well. You are unaware of this sensitivity of your breathing tubes until something sets off a reaction. Then two things can happen, causing the breathing passages to narrow. One is contraction of the muscles that surround the breathing tubes, the other is swelling of the walls of the tubes and weeping of mucus into the tubes. It is worth making note that two different processes can cause breathing to become difficult in asthma, because two different types of treatments will be used to restore the breathing to normal.



A narrowed air passageway

Children with asthma often grow out of

their illness, especially in adolescence. Adults rarely have their asthma just "go away." On the other hand, asthma does not turn into emphysema, and with good medical care it does not need to worsen as one grows older. In fact, if you have asthma, you should anticipate that you will be able to be free of symptoms and fully active almost all the time. Don't settle for anything less.

One final comment: if any of the terms used in this *Guide* are unfamiliar, you may find helpful the explanations offered in **Appendix 1**, Defining Terms.

KEY POINTS

- ✔ Asthma is the tendency, always present, for the breathing tubes to narrow too much.
- ✔ It results in part from our genes and in part from things in the air that we breathe.
- ✔ Our goal is that, despite your asthma, you should be fully active and free of symptoms almost all the time.

LESSON 2

Asthma "Triggers"

If you have had asthma for any length of time, you have likely come to identify some of the things that make it worse. You may have found that if you run to catch the bus on a cold winter's day, you begin to cough and breathe heavily once you sit quietly in your bus seat. Perhaps if you are around cigarette smoke or strong perfumes, you experience tightening in your chest and need to use your asthma medications. And if a simple head cold settles in your chest, you begin to wheeze and become seriously short of breath.

Knowing what will set off your asthma symptoms is important because it is then often possible to stay healthy simply by avoiding those "sparks" that can cause your asthma to flare up. Sometimes avoidance is relatively easy, like

staying away from the pet cat at your mother-in-law's house. Other times it involves hard work, like removing mold and mildew from the bathroom or reducing dust accumulation in the bedroom. The pay off is better breathing and fewer attacks of asthma.

It may not be possible each time to pinpoint exactly what makes one's asthma worse. But everyone with asthma has a group of known items that will "trigger off" their asthma symptoms. We share in common some asthma triggers, like vigorous exercise, cigarette smoke exposure, emotional stress, heavy air pollution, and

viral respiratory infections. Other triggers are based on our particular allergic sensitivities and will differ among different people. For instance, some persons with asthma are made worse by the pollens of springtime flowering trees and grasses, others are not.

Most of the allergens that provoke worsening asthma are airborne and cause trouble when breathed in. Common examples include dust, cat and dog dander, bird feathers, cockroach particles, and mold/mildew. These are allergic-type triggers that we are as likely to encounter indoors in our homes as outside in the backyard. If you are uncertain about your allergic sensitivities, allergy testing (skin tests or blood tests) can help to identify those things that cause you to make an allergic reaction.

Certain medicines can be asthma triggers. All persons with asthma should avoid the group of medicines called beta blockers, used to treat heart disease, high blood pressure, and glaucoma. Aspirin is a trigger for asthma in a small number of adults (about 1 in 20 persons with asthma). If your asthma is made worse by aspirin, you must also avoid all of the non-steroidal anti-inflammatory drugs (NSAIDs) like ibuprofen, naproxen, and keto-

rolac that are widely used for pain relief. Acetaminophen (*Tylenol*®) is generally safe for use if you have aspirin sensitivity.

The workplace can also be filled with asthma triggers. Certain occupations are particularly difficult, including many manufacturing jobs, construction work, and food processing industries. Leaving that particular work area is the best option; use of a respirator mask is sometimes possible as an alternative.

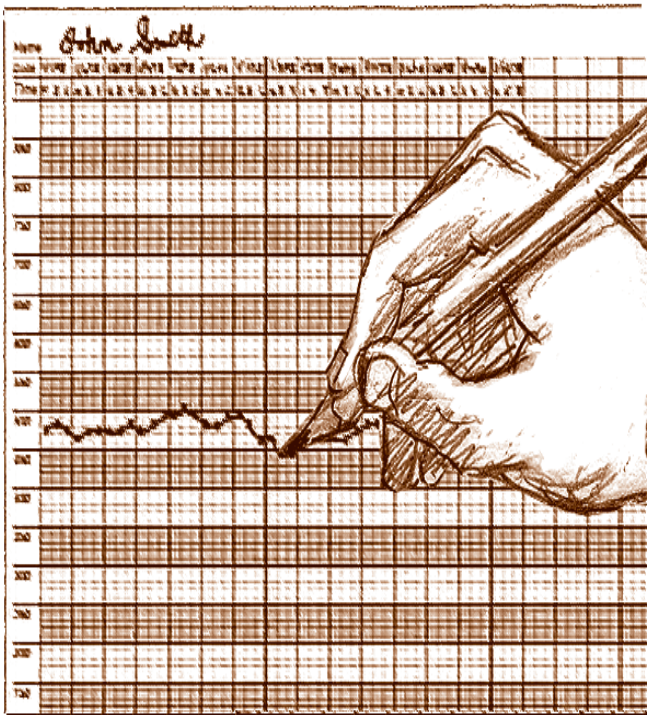
A good place to begin to get your asthma under better control is in your home. Take care to eliminate or minimize those triggers in the home that may be making your asthma worse. Doing so may also help to keep your allergic children from ever developing asthma.

KEY POINTS

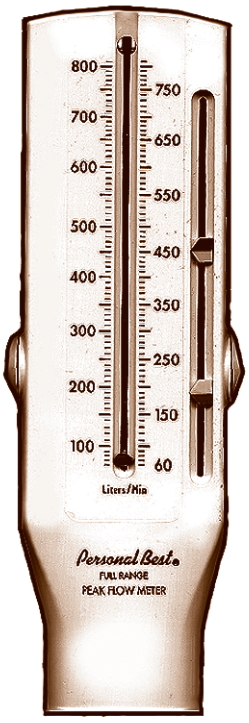
- ✔ Certain typical "triggers" – like exercise, respiratory infections, strong fumes, dust, and animal dander – can set off asthma symptoms.
- ✔ You can identify your own triggers by your personal experiences, sometimes with the help of allergy testing.
- ✔ Eliminating asthma triggers in your home is a good way to begin to get better control of your asthma.

LESSON 3

Making Measurements of Your Asthma



"How bad is my asthma?" One can judge the severity of asthma in different ways. How often in the past year have you had to go the doctor's office, Urgent Care, or to a hospital Emergency Department with a severe attack of asthma? Our goal is *never.* How often have you had to stay home, miss work, or cancel your family plans for the day because of asthma? Our goal is *very rarely*. How often do you awaken at night because of cough, shortness of breath, or tightness in the chest. Our goal is *almost never*. To what extent do you have to limit your physical activities because of your asthma? Our goal is *not at all*. And how often do you need to use your asthma medications for relief of your asthma symptoms. Our goal is *one or two days a week at most*.



A peak flow meter.

Remember that with asthma your breathing can change quickly, from one day to the next and sometimes even from hour to hour. You may wish to assess how your asthma is *right now*, especially as changes are happening in your life. For example, when you move to a new home, when you start (or stop) a medication, when you are coming down with a head cold, what effect is it having on your breathing? And how does your breathing compare with the lung capacity of other people who do not have any breathing problems?

Sometimes you can answer these questions simply by paying attention to the way you feel. However, often you may be unaware of changes that occur in your breathing tubes, or you may attribute the symptoms you feel to other things ("It must be my cold that makes me feel so short of breath"). A more certain way to find out exactly how your asthma is doing is to measure your breathing; that is, measure how fast you can blow air out of your lungs. When your asthma is well controlled, air flows rapidly through the breathing tubes. When you are having difficulty, the breathing tubes are narrowed and air can be forced only slowly out of the lungs.

Measuring your breathing is easy using a simple piece of equipment called a peak flow meter. Peak flow meters are small, plastic devices that can easily fit into your pocket, purse, or medicine cabinet. Most are designed with an indicator that moves when you blow air into them, and a scale of numbers to show how far you can move the indicator. The scale records how fast you can blow air from your lungs in liters per minute (L/min). Some newer peak flow meters are electronic, with a digital read-out of your peak flow. Most pharmacies carry peak flow meters, and they are also available on-line via the internet.

To use your peak flow meter, first set the indicator at zero. Then, take a full deep breath in, put your lips tight around the mouthpiece, and give a quick, short blast out using your breathing muscles. Note on the scale where you were able to move the indicator. Then set it back to zero and repeat the procedure twice more. The best of your three tries is your peak flow.

With a peak flow meter you can compare your breathing to that of other per-

sons without asthma (see tables in **Appendix 2**; note that there is considerable variability in normal peak flow values, up to 80-100 L/min, among healthy persons of the same age, sex, and height). Of greatest use, you can also compare your breathing today with your own peak flow measured on a good day when you are free of any asthma symptoms (your "personal best" peak flow). You can know — and also tell your healthcare provider — exactly how your asthma is doing; you don't have to guess.

KEY POINTS

- ✔ Sometimes you can tell how your asthma is doing just by how you feel, but sometimes you can't.
- ✔ To figure out exactly how active your asthma is *right now*, measure your breathing with a peak flow meter.
- ✔ Try to learn and remember what your own *best* peak flow number is.

LESSON 4

Making Your Home Safe for Asthma

Most of us do not like the idea of having to take medicines every day. We would welcome another approach to controlling our asthma, one that helps us to minimize or perhaps even eliminate our need for daily medicines. One approach has been proven helpful. It is not acupuncture, a special diet, or transcendental meditation. What works is identifying those things in your environment — particularly in your home — that make your asthma worse and either eliminating them or reducing your exposure to them.

Some people have compared the irritated bronchial tubes of asthma to a scraped knee after a fall on the pavement. The irritants and allergens that we breathe in every day are like harsh chemicals poured on the wound. If we can avoid them, the swelling and sensitivity lessen. One gradually notices less coughing, fewer nighttime awakenings, easier breathing, and less frequent need for medications to relieve the symptoms of asthma.

Some changes that you can make are straightforward. Don't smoke cigarettes, cigars, or a pipe, and don't allow smoking in your home. Try to find another home for your pet cat or dog or bird. At a minimum, keep the pet out of the bedroom. Stand-alone room air filters, called high-efficiency particulate air (HEPA) filters, can reduce the amount of animal dander floating in the air and are especially helpful when placed in the bedroom and family room. Remember, people can have allergic reactions to any furry or feathered animals but not to fish or reptiles.

Other changes in your home environment take greater effort. Many people with asthma are allergic to tiny particles contained within dust, the droppings left behind by the microscopic creature, the house dust mite. Practical things can be done to kill the mites and reduce contact

with their droppings. Zippered allergen-proof wraps can be used to cover your pillows, mattress, and box springs, keeping the allergic material from rising into the air. Washing the sheets and pillowcases weekly in hot water kills mites that accumulate on top. Removing carpeting from the bedroom also helps a lot. Curtains, drapes, and stuffed animals are also dust breeders. If you are the family duster, wet mop rather than sweep and use special HEPA filter bags in your vacuum cleaner to prevent circulating the dust particles out the exhaust system.

Mold and mildew can grow indoors in persistently damp places. Common locations are a wet basement, around the kitchen sink, and in bathrooms. With a keen sense of smell, you can usually detect mold growth. Washing mildewed surfaces with dilute bleach (mixed 1 part bleach to 10 parts water) will kill the mold. If your

basement tends to become flooded with water, avoid having carpeting on the cement floor.

It is true that if you are allergic to outdoor pollens, you cannot fully avoid them without living in a bubble. However, air conditioning helps. It filters the outdoor air and cools the inside so that windows can be kept shut. An air purifier with a HEPA filter is also effective in clearing pollen from the indoor air.

Get vaccinated against common respiratory viruses, including influenza (your annual "flu shot") and where appropriate, Covid-19 and respiratory syncytial virus (RSV). It is impossible to avoid every cold germ, but, as much as one can, staying away from other people who are sick with colds and washing one's hands after touching contaminated surfaces can help.

KEY POINTS

- ✔ No smoking in the home!
- ✔ You can make changes in your home to avoid dust, mildew, animal danders, and even outdoor pollen.
- ✔ Get the flu vaccine each year and where appropriate, Covid-19 and RSV vaccines.

LESSON 5

Treating Your Asthma with Medicines: *The Controllers*

We have all come to accept the importance of prevention of tooth decay, and we apply toothpaste to our teeth once or twice daily. So too, treatments taken once or twice each day are generally effective in preventing asthma symptoms and severe, potentially dangerous asthma attacks. And we can all agree that breathing freely is at least as important as preventing cavities.

Medicines can act to keep asthma well controlled in two ways. First, and most importantly, they can reduce the swelling and inflammation of the bronchial tubes, making the airways less sensitive to the triggers of asthma. Second, they can work throughout the day to stimulate the bronchial muscles to relax, helping to prevent the muscle spasms that narrow the bronchial tubes.

The best treatments to reduce the excessive sensitivity of the bronchial tubes are the inhaled corticosteroids. These "steroids" are anti-inflammatory (not muscle building). They are safe because in the usual doses only miniscule amounts of medication enter the bloodstream, similar to the idea of rubbing a steroid cream onto one's skin if the problem is a red, itchy rash due to an allergic reaction. Regular use of inhaled steroids in asthma has been proven to: improve your sense of well being, reduce symptoms of asthma, increase your breathing capacity, and decrease the risk of asthma attacks.

Bronchodilators act within minutes to relax the muscles causing constriction of the bronchial tubes. Long-acting bronchodilators with continued action for 12-24 hours have been added to inhaled steroids in combination inhalers that deliver both types of medication in a single spray or "puff" of medication. These combination inhalers are safe and highly effective for anyone with more than occasional mild asthma, whereas use of a long-acting inhaled bronchodilator without an inhaled steroid increases the risk of a severe and potentially life-threatening attack and is to be avoided. In the next chapter (Lesson #6: "Treating Your Asthma with Medicines: *The Quick Relievers*"), we will discuss a novel approach to mild

asthma where use of a combination inhaler containing both a corticosteroid and a bronchodilator can be used intermittently, guided by symptoms of asthma, rather than daily on a regularly scheduled basis.

Theophylline, once the most popular bronchodilator medication in asthma, is now rarely prescribed. It is less effective than inhaled long-acting bronchodilators and causes more side effects, including the risk of dangerous heart arrhythmias and seizures if the safe dose is exceeded.

Other medications used to keep asthma under good control are the leukotriene [pronounced loo-ko-**try**-een] blockers. These tablets, taken once or twice daily, help reduce airway inflammation and block spasm of the bronchial muscles. Occasionally, they cause mood or behavioral changes, including depression, but for the most part they are very safe and free of side effects. In an occasional person with asthma, the leukotriene blockers can substitute for an inhaled steroid; in most instances, however, they are not as effective.

For those with severe asthma prone to frequent attacks, often needing oral steroid tablets to control asthma flares, a whole new category of medications has become available to achieve good asthma control. As a group, they are referred to as

"biologics." They are laboratory-made proteins designed to block specific key chemicals causing asthmatic inflammation. They are injections (or in one case, an intravenous infusion) given every 2 to 4 weeks. In those suffering severe asthma that had been refractory to the usual inhaled or oral medications, these targeted "biologics" have often proved dramatically effective, "a breath of fresh air."

Some persons with asthma need to take their preventive medicine only during allergy season or following a respiratory infection. However, for most people who have persistent asthma — with more than only very occasional symptoms — preventive medicines are an everyday thing. Two good reasons to take your "controller(s)" every day: you will feel better, and you will live safer from asthma attacks.

KEY POINTS

- ✔ If your asthma is troublesome despite intermittent use of your inhaler, you may benefit from taking a regular controller medication every day.
- ✔ Controller medications include 1) inhaled steroids, 2) inhaled steroids combined with a long-acting bronchodilator, 3) leukotriene blockers, and 4) injectable "biologics" used to treat severe, refractory asthma.
- ✔ Regular controller therapy is meant to make you breathe better and to protect you against attacks of asthma.

TABLE 1. Several of these medications are now available in a generic version. More information about the different types of inhalers and how best to use them is contained in **Appendix 3**.

COMMON CONTROLLER MEDICINES

GENERIC NAME	BRAND NAME	FORMULATION
Inhaled Corticosteroids		
Beclomethasone	*Qvar*	Metered-dose inhaler
Budesonide	*Pulmicort*	Dry-powder inhaler
Ciclesonide	*Alvesco*	Metered-dose inhaler
Fluticasone furoate	*Arnuity*	Dry-powder inhaler
Fluticasone propionate	*ArmonAir*	Metered-dose inhaler or dry-powder inhaler
Mometasone	*Asmanex*	Metered-dose inhaler or dry-powder inhaler
Inhaled Corticosteroids Combined with a Long-Acting Bronchodilator		
Budesonide + Formoterol	*Symbicort, Breyna*	Metered-dose inhaler
Fluticasone furoate + Vilanterol	*Breo*	Dry-powder inhaler
Fluticasone propionate + Salmeterol	*Advair, AirDuo, Wixela*	Metered-dose inhaler or dry-powder inhaler
Mometasone + Formoterol	*Dulera*	Metered-dose inhaler
Leukotriene Blockers		
Montelukast	*Singulair*	Once-daily tablet
Zafirlukast	*Accolate*	Twice-daily tablet
Zileuton	*Zyflo*	Twice-daily tablet

Table 2. The "Biologics."

"BIOLOGICS" USED TO TREAT ASTHMA		
GENERIC NAME	BRAND NAME	HOW ADMINISTERED
Benralizumab	*Fasenra*	Injection once every 4 weeks for 3 doses, then once every 8 weeks
Dupilumab	*Dupixent*	Injection every 2 weeks
Mepolizumab	*Nucala*	Injection every 4 weeks
Omalizumab	*Xolair*	Injection every 2-4 weeks depending on dose
Reslizumab	*Cinqair*	Intravenous infusion every 4 weeks
Tezepelumab	*Tezspire*	Injection every 4 weeks

LESSON 6

Treating Your Asthma with Medicines: *The Quick Relievers*

If asthma causes you to feel short of breath, tight in the chest, with troublesome coughing and wheezing, most often you want to have something immediately at hand to provide quick relief. The medicine to turn to is a quick-acting bronchodilator, a medicine that relieves symptoms by causing the muscles that surround the bronchial tubes to relax and the tubes to open wider.

An inhaler used with a spacer to improve medication delivery.

When taken by inhalation, the quick-acting bronchodilators begin to work within 3-5 minutes. The most widely used quick-acting inhaled bronchodilators are albuterol and levalbuterol. These medicines continue to work for

Table 3.
Quick-relief Bronchodilators.

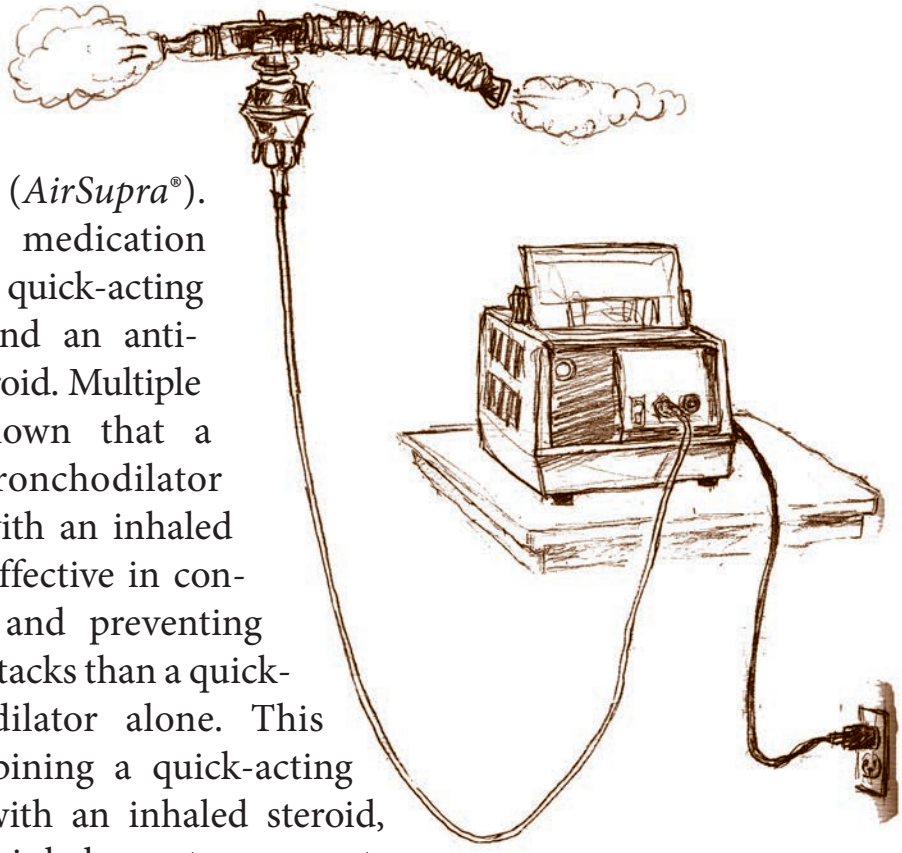
QUICK-RELIEF BRONCHODILATORS		
GENERIC NAME	BRAND NAME	FORMULATION
Albuterol	*ProAir* *Proventil* *Ventolin*	Metered-dose inhaler, dry-powder inhaler, and liquid for nebulization
Albuterol + budesonide	*AirSupra*	Metered-dose inhaler
Formoterol + budesonide	*Breyna* *Symbicort*	Metered-dose inhaler
Formoterol + mometaone	*Dulera*	Metered-dose inhaler
Levalbuterol	*Xopenex*	Metered-dose inhaler and liquid for nebulization

approximately 4-6 hours and are referred to as short-acting bronchodilators. They are available as metered-dose inhalers and liquid for nebulization. Albuterol is also available as a dry-powder inhaler, including one with a built-in, electronic dose-counter and associated app for documentation of use. We do not recommend the over-the-counter preparations for quick asthma relief, such as *Primatene Mist*® or *Asthmanefrin*®, finding them to be less effective and to have more frequent side effects.

Some people with asthma find that the most powerful way to inhale their quick-relief bronchodilator is as a continuous mist generated by an electric compressor and nebulizer. A liquid form of the medicine is placed in the nebulizer cup, and a mist is breathed in and out over approximately 5-10 minutes. A lot of medicine is reliably delivered to the bronchial tubes in this way. Its major disadvantage is its lack of convenience. Each dose must be added to the nebulizer cup one at a time; and only selected nebulizer systems are small enough to be transported in your purse or back-

pack for prompt use at any time.

Recently, albuterol has been made available combined with an inhaled steroid (budesonide) in a single metered-dose inhaler device (*AirSupra*®). Each puff of medication includes both a quick-acting bronchodilator and an anti-inflammatory steroid. Multiple studies have shown that a quick-acting bronchodilator taken together with an inhaled steroid is more effective in controlling asthma and preventing serious asthma attacks than a quick-acting bronchodilator alone. This strategy of combining a quick-acting bronchodilator with an inhaled steroid, either as a single inhaler or two separate inhalers, has been referred to as "anti-inflammatory rescue" (AIR).



A nebulizer and compressor.

Of interest, one of the long-acting bronchodilators, with a duration of action of approximately 12 hours (formoterol), also has a rapid onset of effect, as quick as albuterol. This quick-relief, long-acting bronchodilator is available only in combination with an inhaled steroid. The single inhaler

can be used every day as “controller” therapy and as-needed for quick relief of symptoms, a strategy referred to as single maintenance and reliever therapy (SMART).

Quick-relief bronchodilators are best inhaled (rather than taken in tablet form) because when breathed in they work more quickly, provide more relief, and have fewer side-effects. To be effective, however, they need to be deeply inhaled into the bronchial tubes, not squirted onto the back of the throat. If coordinating a metered-dose inhaler and timing its firing to your breathing proves difficult, you can use a holding chamber device ("spacer") to improve medication delivery. Alternatives include changing to a dry-powder inhaler or possibly a nebulizer system. If you use a spacer with your regular controller medicine, you can use the same one with your quick reliever. More information about proper use of your inhalers is contained in **Appendix 3**.

Contrary to older teachings, it is not necessary to use your quick-relief bronchodilator prior to inhaling your controller medication. In fact, you don't need to take the quick reliever on any regular schedule. Use it when you need it to get rid of your asthma symptoms; don't use it when you don't have any symptoms.

At a medical visit, your healthcare provider will probably ask you about how

often you have needed to take your quick-relief bronchodilator. This information is a useful measure of how active your asthma is. Our goal is that with good asthma control, you will need to use your quick-relief bronchodilator infrequently, ideally no more than one or two days out of the week.

Another use for your quick-relief bronchodilator is to take it 10-20 minutes before predictable exposure to something that typically sets off your asthma. Used in this way, the quick-relief bronchodilator often can prevent tightening of the bronchial tubes that would otherwise have occurred. Preventive use of your quick-relief bronchodilator is especially effective before exercise or exertion in cold weather.

KEY POINTS

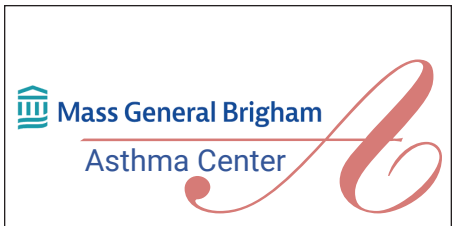
- ✔ Quick relievers are inhaled bronchodilators. They begin to open the breathing tubes in 3-5 minutes. When combined with an inhaled steroid, they are particularly effective at controlling your symptoms and decreasing your risk of severe asthma attacks.
- ✔ They don't need to be taken on any regular schedule. Use your quick reliever only as needed.
- ✔ Inhaled bronchodilators taken *before* exercise or exertion in cold air are effective at preventing asthma symptoms from developing.

LESSON 7

What to Do for an Asthma Attack? Your *Asthma Action Plan*

One of the major reasons for learning more about asthma — and so, one of the purposes of this *Guide to Asthma* — is to help you make good decisions if and when you suffer an asthma attack. If you find yourself having trouble breathing, perhaps gasping to catch your breath, the worst thing that you can do is to panic. Panic only makes it harder to breathe and more difficult to make smart choices. The best thing to do is to take calm action to restore your breathing to normal.

Begin by considering in advance what you would do if faced with an asthma attack. Later in this *Guide to Asthma*, you will have a chance to practice your decision-making on some made-up case examples. It is also a good idea to discuss



My Asthma Action Plan

Name:_____

My Physicians' Names:
Primary:
Dr._____

Asthma:
Dr._____

My Asthma Medications:

_____
_____
_____
_____
_____
_____

My Other Medications:

_____
_____
_____
_____

Medication Allergies:

_____
_____
_____
_____

your plan of action with your medical provider and then to write out your Asthma Action Plan. Keep your written Action Plan someplace handy.

Based on what you have learned about asthma from the previous sections of this *Guide*, together with your own experiences, you are ready to plan a strategy for handling asthma attacks. Always remember that you need not manage your care alone. Friends and family may be near to help. Medical advice from your doctor or an associate is only a phone call away. If nothing else seems to be working, you can always summon emergency help by dialing "911" on your telephone.

How best to deal with an asthma attack depends in part on how bad the attack is. Sometimes you can recognize a severe attack based on how you feel. You are having a severe attack if you have shortness of breath walking slowly on level ground, if your speaking is interrupted to catch your breath, if you are perspiring and can't lie down because of difficulty breathing. At other times you may have severe narrowing of your breathing tubes but be unable to detect it based on how you feel — or you may deny to yourself just how bad it really is.

A peak flow meter is very useful in this situation. With it you can clarify how se-

vere your asthma attack is, and you can measure whether you are getting better with treatment. If your peak flow is less than half of your best value, you are having a severe attack. For most persons, a peak flow of less than 200 liters per minute indicates a severe attack.

The first step to relieve an asthma attack is to use your quick-acting bronchodilator (such as albuterol). Although the usual dose is 2 puffs, in a sudden severe crisis of breathing, you can safely use as many as 4 puffs at a time. Under normal circumstances, it is usually recommended that you use your quick-relief bronchodilator no more than 4 times a day. To treat an asthma attack, however, you can safely use it as often as every 20 minutes for as long as 1-2 hours, if needed. If available, a nebulizer system can be used in the same way, every 20 minutes for several doses. The major side effects to anticipate are a jittery feeling and racing of the heart.

Remember that the quick-relief bronchodilators treat only part of an asthma attack, the part due to constriction of the muscles surrounding the bronchial tubes. The other part, the swelling of the walls of the bronchial tubes and over-production of mucus, requires anti-inflammatory steroids for treatment. Consequently, optimal acute relief combines a quick-acting

My Asthma Action Plan

My Best Peak Flow is:_____liters/minute.

When my peak flow is less than: _____liters/min (less than half of my best value), I am having a severe attack.

A. In the event of a Mild or Moderate asthma attack, I would first

_____

_____

_____

If there is no improvement, my next step would be to

_____

_____

_____

B. In the event of a SEVERE asthma attack, I would first

_____

_____

_____

If there is no improvement, my next step would be to

_____

_____

_____

If there is still no improvement,

Seek Emergency Help Immediately!

EMERGENCY PHONE NUMBERS:

My Asthma Doctor:

_____

(ask to page your asthma doctor or the covering fellow)

Ambulance:

_____or 911

Table 4. Oral Corticosteroids.

ORAL CORTICOSTEROIDS	
Steroid Tablets	
GENERIC NAME	BRAND NAME
prednisone*	Orasone Deltasone
prednisolone*	Pediapred Prelone
methylprednisolone*	Medrol

* Medications available in generic form (that is, manufactured and sold typically by a company other than the original developer, usually at lower cost).

bronchodilator with an inhaled steroid, a strategy that, as we have noted, is called "anti-inflammatory rescue" or AIR. If you have available separate inhalers, you can use your steroid inhaler every time that you use your quick-acting bronchodilator inhaler, one right after the other, an equal number of puffs. Or you may have the convenience of an inhaler that combines a quick-acting bronchodilator together with a corticosteroid in one device, in which case you can simply take 2 puffs of the combination inhaler, such as albuterol + budesonide (*AirSupra*®), formoterol + budesonide (*Symbicort*®), or formoterol + mometasone (*Dulera*®).

It is worth emphasizing: if you are having a serious asthma flare, do not rely on repeated use of your bronchodilator alone to get better. If you routinely take an inhaled steroid, this would be a good time to increase the dose, perhaps to as many as 4 puffs 2-4 times a day until feeling better. If your routine controller medication combines an inhaled steroid with a long-acting bronchodilator other than formoterol, such as salmeterol or vilanterol, then you should not increase the frequency of use beyond the usual recommended once-daily (for example, *Breo*®) or twice-daily (for example, *Advair*®, *AirDuo*®, or

Wixela®) dosing schedule. However, if you are not already at the highest dose of one of these combination inhalers, your medical provider may prescribe a combination inhaler with a higher concentration of steroid in each puff (for example, *Advair*® 500/50 rather than 100/50 strength, or *Breo*® 200/25 rather than 100/25 strength).

For a severe attack or one not getting better with inhaled steroids, you will need to take prescription steroid tablets, such as prednisone or methylprednisolone, *Medrol*®. A typical starting dose of prednisone is 40-60 milligrams per day and can be taken all together as a single dose each day. The corticosteroid tablets usually take 6 or more hours to take effect. You will need to continue to use your quick-relief bronchodilator in the meantime, as often as every hour, if needed. Your medical provider may want you to have corticosteroid tablets available at home to use in the event of a severe asthma attack; or your provider may call your pharmacy with a prescription when you need one. In either case, be sure to keep your healthcare provider informed if you are having serious difficulty with your breathing.

Severe asthma attacks can be dangerous. If you are not getting better despite following your Asthma Action Plan, get help immediately.

KEY POINTS

- ✔ Make an "Asthma Action Plan" with your medical provider.
- ✔ If available, use your peak flow meter to judge how severe the attack is and to help tell your medical provider how you are doing.
- ✔ During an asthma attack you can use your quick-relief bronchodilator as often as every 20 minutes, preferably together with an inhaled steroid taken with each dose of bronchodilator.
- ✔ For a mild-to-moderate asthma attack, increase the amount of inhaled steroids that you take. Very high doses will be safe for the period of time (typically 1-2 weeks) that they are needed.
- ✔ Oral steroids (like prednisone or *Medrol*®) are generally required to treat a severe attack.
- ✔ Severe asthma attacks can be dangerous. If you are not getting better, seek help immediately.

Asthma Management Practice Sessions

"What Would You Do If...?"

IF you have asthma, it is possible — even likely — that at some time in your life, you will find yourself having symptoms of an asthma attack. Cough, chest tightness, wheezing, and difficulty breathing may come on suddenly or gradually. You may have only one of these symptoms or all of them. The attack may be brought on by a respiratory tract infection (a "chest cold") or exposure to something to which you are allergic. It may be triggered by smoke, strong fumes, or a change in your medicines. Possibly you will not be able to identify any cause; your breathing will just become labored for no clear reason.

Our goal, like yours, is that you never have an asthma attack — or, at most, very rarely. At the same time, we would like you to be prepared and know what to do to help yourself if an asthma attack develops. We encourage you to be prepared for what may be a rare event.

We think that the best approach is for you to consider in advance what you would do in the event of an attack of asthma. What would you do first for a mild or moderate attack? What would you do if you didn't quickly get better? What would you do if you were suffering a severe asthma attack? What if the initial treatment didn't work?

Having read through this *Guide to Asthma*, especially ***Lesson #7 ("What to Do for an Asthma***

Attack? Your Asthma Action Plan"), you will have some ideas about actions that you can take in the event of an asthma attack. You also will want to discuss your asthma action plan with your medical provider and perhaps share some of this information with family members and/or close friends, your asthma "care team."

In this section, we offer you the opportunity to practice your responses to fictional asthma attacks. Some of these made-up case examples may mirror your own situation closely; others may not be relevant to your asthma or to the treatments that you have available to use at home. We hope that all these Practice Sessions give you the opportunity to pretend that you are having to deal with worsening of your asthma.

As in real life, you will be asked to make some initial decisions. Part of that decision making is knowing when to seek help. Remember that managing an asthma attack does not mean having to stay at home and care for your asthma yourself. Rather, it means two important things: First, knowing what initial steps you can take to get better, and second, knowing where and how to get help when you need it quickly.

Practice Session 1

"The Head Cold"

IMAGINE that your asthma has been generally well controlled. As your controller medicine you take a steroid inhaler (2 puffs twice daily) on a regular basis. Most days you do not need your quick-relief bronchodilator (albuterol inhaler) at all. Other days you use it perhaps once or at most twice over the course of a day, although you always carry it with you.

Last week you had a head cold, as did other members of your family. You had a low-grade fever for two days, with sore throat and nasal congestion. Earlier this week your cold seemed to improve, but you started coughing a lot. Last night you were awakened repeatedly with coughing and slept much of the night propped up on pillows. You used the albuterol inhaler twice overnight with some relief.

Today you are still coughing and raising clear phlegm (like "egg white"). In addition, you find yourself short of breath with even light exertion, such as walking 50 feet. You use your albuterol inhaler again, but it doesn't seem to help for more than about 5 minutes. If available, you check your peak flow with your peak flow meter. You are dismayed to find that your peak flow is only 180 liters per minute, less that half of your usual (400 L/min).

What would you do next?

DISCUSSION:

The first point is to recognize that this episode is more than just a bad "cold." It is a severe asthma attack. It is not normal for a routine chest infection to cause shortness of breath when one walks only a short distance. In this example a head and chest cold has set off a flare of the underlying asthma. You recognize that this is a severe attack because of your frequent need for your rescue bronchodilator (albuterol) and the limited benefit that it provides. The low peak flow value, less than half of the usual best value, confirms that this is a severe attack.

If you have a nebulizer system at home, this would be a good time to use it to deliver a quick-relief bronchodilator (such as albuterol) by continuous mist. If you don't have a nebulizer, use your quick-relief bronchodilator inhaler (with a spacer, if you have one, to maximize delivery of the medication to the airways) and take 4 puffs, each spaced approximately one minute apart. If you don't have a spacer available, use the inhaler as carefully as you can without one. You can continue to take your quick-relief bronchodilator (by nebulizer or by inhaler) every 20 minutes for 1-2 hours if needed.

It would be a mistake to rely solely on your bronchodilator medicine for treatment of a severe asthma attack. If you continue to have intense asthma symptoms after using your bronchodilator 2-3 times, you can be certain that a major part of the problem is swelling of the bronchial tubes and filling up of the bronchial tubes with mucus. The air passageways are severely inflamed, and no amount of bronchodilator alone will treat this part of the problem. The treatment for swelling and inflammation of the bronchial tubes is corticosteroids ("steroids").

When you are having a severe attack like this one, it is generally necessary to take steroids by mouth as tablets or liquid. Your medical provider will likely want to prescribe prednisone or methylprednisolone (*Medrol*®). You should call your medical provider (or covering provider) emergently to discuss your condition and likely get a prescription for oral steroid medication. It

will be particularly helpful if you can tell your healthcare provider what your peak flow value is. This information will help him or her to gauge how serious this attack is and how best to respond to it.

If you previously have had a severe attack of asthma, your medical provider may have given you some steroid tablets to have at home. This would be a good time to take some, perhaps 40-60 milligrams. You should also plan to notify your medical provider that you are ill and that you have begun a course of steroid tablets.

Steroid tablets usually take several hours (6 or more hours) to exert an effect. You can continue to use your bronchodilator (for example, albuterol inhaler) as often as every hour while waiting for the steroids to take effect. You should rest and relax as much as possible. As long as your breathing (and peak flow) are steady or improving during this time, you will do fine.

On the other hand, if your breathing is getting worse, you will need to seek emergency help. Quickly get to a nearby urgent care center or emergency department. A severe asthma attack can be dangerous, especially if you are getting worse despite frequent use of your bronchodilator. Indicators that would make you or a family member want to call 911 for an emergency rescue team might include the following: unable to speak more than a word or two because of shortness of breath, passing out or nearly passing out, bluish discoloration of the lips and skin due to lack of oxygen, and peak flow less than 100 liters per minute.

After recovering from this attack, you may want to discuss with your medical provider any possible strategies to be used in the future to prevent a severe asthma attack from being triggered by a "simple" viral respiratory tract infection. He/she may have some helpful strategies to try, including use of an inhaled steroid every time that you use your quick-relief albuterol inhaler; switching your rescue inhaler to an albuterol plus inhaled steroid combination device; increasing your dose of inhaled steroids to 4 puffs 4 times a day early in the course of the infection; and checking your peak flow during the illness, to detect declines in your breathing capacity before they become severe.

Practice Session 2

"The Neighbors' Cat"

IMAGINE that as part of your asthma you have multiple allergic sensitivities, including to cats. Nonetheless, you have been feeling well this fall, using your inhaled steroid medication, beclomethasone (*Qvar*®), every day, two inhalations twice daily (except when you fall asleep without remembering your evening dose!). You are active and enjoy working out at the gym. You routinely use your bronchodilator inhaler, levalbuterol (*Xopenex*®), before exercising but otherwise rarely seem to need it. Sometimes you wonder whether you still have asthma at all.

Today you are invited to your neighbors' home for dinner. They took in a stray cat last month, but because of your allergies, they promise to keep the cat outside or in the basement during your visit

The evening seemed to be going fine, until you sat on a certain sofa. Soon thereafter you began to sneeze and to develop watery, itchy eyes. You feel a tightening in your chest and itching below your chin. You use your bronchodilator inhaler once but get only minor relief. You start to have coughing and raise some clear mucus. Your neighbor offers you some water.

What would you do now?

DISCUSSION:

Step one is pretty clear: leave the neighbors' house. It is likely that you are allergic to something in their house, probably cat dander on the sofa and elsewhere throughout the house. The best first step in treating an asthma attack, if possible, is to remove yourself from exposure to your asthma "trigger."

In this circumstance, it is safe to use your bronchodilator inhaler more often than the usual limit of 4-5 times per day. If necessary, you can take it as often as every 20-30 minutes for 1-2 hours or until you feel more comfortable. A newer strategy ("anti-inflammatory rescue" or AIR) is to use your steroid inhaler, 2 puffs, each time that you use your levalbuterol inhaler, thereby treating at the same time both the spasm of the bronchial muscles and the allergic inflammation of the bronchial tubes.

If available, use your peak flow meter to check your peak flow. It will help you to judge how severe this asthma attack is. You may be able to estimate its severity by how you feel, especially by how breathless you are as you walk around. However, sometimes you can be fooled. The greatest concern is that you might underestimate just how sick you really are. Many people tend to minimize their symptoms; we don't want to admit that something might be seriously wrong.

If you check your peak flow and find it to be more than half of your normal best value, you can be reassured that this is a mild-to-moderate attack. If your peak flow is less than half of your normal best value, you are having a severe attack, in which case you will need more intensive treatment and greater caution.

Practice Session 2

"The Neighbors' Cat"

[continued]

WHEN you arrive back home, you find that you can walk up to your second-story apartment without much shortness of breath. You continue to experience some coughing and wheezing. You use your quick-relief bronchodilator again, and soon thereafter you check your peak flow. It is 320 liters per minute, whereas normally your peak flow is quite steady at 400 liters per minute.

What would you do at this point?

DISCUSSION:

A good strategy for treating a mild-to-moderate asthma attack is to increase your dose of inhaled steroids. In this example, you would begin taking four puffs from your steroid inhaler two to four times a day. The results are usually not as rapid and dramatic as with steroids in tablet form (e.g., prednisone or methylprednisolone), but side effects are far fewer.

It is likely that by removing yourself from the cat dander and by increasing your dose of inhaled steroids, you will bring your asthma back under control over the next 12-24 hours. During this time, keep a close watch on your asthma symptoms and, if possible, your peak flow values to make sure that you are improving. If you are not getting better, you should contact your medical provider. If you are improving, continue the extra puffs of the inhaled steroid for 3-4 extra days, and if then all better, you can resume your usual dose.

This practice example illustrates an effective strategy for using your inhaled steroids: increase the dose when your asthma is poorly controlled, decrease the dose to the lowest dose sufficient to control symptoms and prevent attacks when your asthma is well controlled. Choosing the appropriate doses should be done with your medical provider.

Practice Session 3

"Home Improvements"

YOU have "exercise-induced asthma." By this term ("exercise-induced asthma"), your doctor means that you have asthma and that exercise is the main trigger that brings on narrowing of your airways.

Your doctor has given you an albuterol inhaler to take prior to exercising in order to prevent your symptoms of cough, wheeze, and chest tightness. If you develop any of these symptoms at any other time, you use your albuterol inhaler (usually one puff is sufficient) and obtain rapid relief.

This week the workmen have come to begin the long-awaited renovations on your bedroom. There is lots of plaster dust in the air, and you find yourself coughing at night. You think little of it (your spouse, who doesn't have asthma, has also had some coughing) until you develop a low-grade fever and a miserable "head cold." Your coughing now keeps you (and your spouse) up most of the night. You can't lie down in bed without becoming short of breath. Each breath is accompanied by an uncomfortable rattling in your chest. It is difficult to talk or do any light

physical exertion without stimulating long bouts of coughing.

You suspect that this severe coughing and chest congestion may be a sign of your asthma. You borrow your neighbor's peak flow meter to measure your breathing capacity. The peak flow result, 300 liters per minute, is only two thirds of the value measured when you were in your doctor's office. You use your albuterol inhaler with improvement. The coughing lessens and your peak flow increases to 330 liters per minute. However, 30 minutes later you are again coughing severely, and the peak flow is now 280 liters per minute.

What would you do next?

DISCUSSION:

Our strong recommendation, in brief, is "get help." You are having a serious asthmatic attack, and the medication that you have available to treat asthma, the albuterol inhaler, is not providing more than very temporary relief. You will need stronger therapies both to get better and to prevent your getting worse, possibly dangerously ill.

Many people in this circumstance report that their quick-relief bronchodilator "stopped working." In fact, what has probably happened is that the bronchial tubes have become swollen and filled with mucus. The problem is no longer just spasm of the muscles surrounding the bronchial tubes, and the solution can no longer be just a medicine that causes those muscles to relax. You now need an anti-inflammatory medicine — a steroid medicine — to reduce the swelling and excess mucus production. This type of medicine for asthma treatment is not available "over-the-counter"; you will need a doctor's prescription.

The action that you take will depend on the healthcare resources available to you at that moment. Perhaps you will call your doctor's office and get advice immediately. Perhaps you will make an urgent visit to your doctor's office. Perhaps you will need to go to a nearby emergency department or other urgent care facility. Do not delay. The danger in waiting is that your asthma may worsen quickly, perhaps to the point that every breath becomes an effort and that even walking slowly seems like an impossible task. Before this crisis stage, before calling a rescue squad or "911" becomes your only option, seek medical help.

While you await a call from your doctor or during your trip to a medical facility, you can continue to use your quick-relief bronchodilator inhaler. It will likely continue to help a little bit for short periods. You can take up to 4 puffs at a time, up to every 20-30 minutes for the next hour or two, until other medical treatments are begun.

It would be a mistake, however, to rely solely on the temporary improvement that your albuterol inhaler provides. This is the most common mistake made in severe asthma attacks, the very serious attacks that end in hospitalization or even death. The brief, minor help in breathing that the albuterol inhaler gives can fool you into thinking that you are getting better. Or it may convince you that you will start getting better soon. All the while your bronchial tubes continue to swell and become plugged with mucus.

Steroid treatment for swelling of the bronchial tubes works better and quicker when started early. In this example, with the help of the peak flow meter, you can tell that you are getting worse, not better. There is no need to wait longer. Avoid the excuses, such as: "I hate to bother the doctor" or "I'm sure that I will get better if I just rest for a little bit." Start now to get the medical treatments that you need.

This might also be a good time to discuss with your medical provider other treatment options for your asthma, so that you don't have to experience a similar, somewhat scary asthma flare in the future. Your medical provider may recommend that you have a steroid inhaler available at home for use when your asthma flares, or perhaps switch you from as-needed use of albuterol to as-needed use of a combination bronchodilator plus steroid inhaler, like albuterol + budesonide (*AirSupra*®) or formoterol + budesonide (*Breyna*®, *Symbicort*®). It's good to have a plan for the future while hoping that the "next time" is a long way off!

Practice Session 4

"Blowing in the Wind"

THIS SPRING has been particularly difficult for your asthma. The grass and tree pollens to which you are allergic seem to coat every surface, indoors and outside. Your asthma, more troublesome over the last year or two, has become particularly severe in the last week. You have been coughing up pale yellow sputum, wheezing off and on, and feeling breathless when climbing stairs.

When you went to bed last night everything seemed o.k., but you wake up at 3:00 in the morning with the sense that an elephant is sitting on your chest. It is difficult to pull in air. Every breath seems an effort. You sit up in bed, reach for your quick-relief bronchodilator on the nearby bedside table, and then wait for some relief. You begin to think about what options you have if the inhaler does not help.

You take a lot of medicines on a regular basis for your asthma. You take an inhaled steroid combined with a long-acting beta-agonist bronchodilator (*Advair*®) twice daily, a leukotriene blocker (*Singulair*®) in the evening, and prednisone, currently 10 milligrams

every other day. You also have an over-the-counter antihistamine and decongestant combination that you are using twice daily and a steroid-containing nasal spray.

After 20 minutes you feel only a little bit better. You get out of bed, walk slowly to the kitchen, and make yourself some tea. Even though the doctor specifically mentioned that if you needed help you could call at any time, you are reluctant to call at this hour of the morning. You consider what else you might take for your asthma.

What would you do now?

DISCUSSION:

With so many asthma medicines at your disposal, you may be tempted to take extra doses of some or all of them. Consider carefully. You may consider increasing the frequency of your *Advair*® inhaler to more than twice daily or taking more than one inhalation at a time. However, because your combination steroid/long-acting bronchodilator inhaler contains a medicine (the long-acting bronchodilator, salmeterol) for which extra doses may not be safe, this approach would not be recommended. The same caution pertains to the once-daily combination steroid/long-acting bronchodilator combination inhaler called *Breo*®, containing vilanterol and fluticasone furoate. Only the long-acting beta-agonist bronchodilator, formoterol (part of the combination inhalers with brand names *Breyna*®, *Symbicort*® and *Dulera*®), has been tested in this way and shown to be safe in an asthma flare, up 12 puffs over the course of 24 hours.

If you happen to have available *Advair*® inhalers of differing strengths, you might now switch to one that contains a higher dose of the steroid portion (for example, to *Advair*® 500/50 strength from *Advair*® 100/50 strength), still at one inhalation twice daily of the dry-powder formulation.

Your leukotriene blocker medicine (*Singulair*®) is meant strictly as preventive therapy. Extra doses would not be effective in treating an asthma attack. Likewise, taking more than the usual dose of your antihistamine/decongestant combination or your nasal spray will not help your asthma. They are prescribed for allergic symptoms in your nose and eyes, not as treatment for your asthma.

In an asthma attack your best options are the quick-acting bronchodilator to open the constricted muscles surrounding the breathing tubes and steroids to reduce the swelling (inflammation) in the walls of the tubes. It is likely that for this attack you will need to increase the dose of the oral steroid (prednisone) that you are taking every other day. Often patients who have taken steroids in tablet form for many years try to avoid increasing the dose in order to avoid more of the serious medication side effects that steroids cause when taken by

mouth, absorbed from the stomach, and carried everywhere throughout the body via the bloodstream. However, remember that breathing is a priority! It may be necessary to increase the dose of prednisone to 10 or 20 milligrams every day for a time, then decrease again when feeling better (and when your peak flow has returned back to its usual). Be sure to notify your healthcare provider if you need to adjust your prednisone dose.

It will take time (at least several hours) for the increased dose of steroids to start to reduce the inflammation of the breathing tubes. In the meantime, you can use your quick-relief bronchodilator more frequently than is usually recommended (that is, more often than the usual limit of four times a day). If necessary, you can take 2-4 puffs every 20 minutes for up to 2 hours and then 2-4 puffs every hour. If you find that you do indeed need the inhaled bronchodilator that often, you are having a very severe attack. You should notify someone, preferably your healthcare provider, so that you can get help and advice during a serious attack … regardless of the hour!

While sitting in the kitchen, sipping your tea and waiting for your breathing to return to normal, it is good to stay relaxed and to breathe slowly and deeply. While waiting, you might also give some thought as to how you will plan to reduce your exposure to the springtime pollens. A good first step might be to keep the windows closed and to filter the indoor air with an air conditioner or window fan with attached filter. Have someone else do the dusting and vacuuming. If you must do it, clean with a damp cloth, use a vacuum cleaner with a built-in HEPA filter, and, if necessary, wear a face mask while cleaning.

And if you haven't done so already, consider seeing an asthma specialist (allergist or pulmonologist) about your asthma. With the development of injectable monoclonal antibodies ("biologics") to treat asthma, we have moved into a new era in the treatment of severe asthma, one in which the need for daily or every-other-day oral steroids is becoming rare. It is likely that you are a candidate for one of the biologics to treat your severe allergic asthma, help you wean off prednisone, and protect you from recurrent asthma attacks.

Practice Session 5

"A Walk in the Park"

JUST YESTERDAY you commented to a friend how well your asthma seems to be doing lately. You have been taking your controller medication, an ultra-long-acting bronchodilator combined with a corticosteroid inhaled once daily, and rarely need to use your quick-relief bronchodilator. People at work no longer recognize you by your ever-present cough. Even your sleeping has become more restful, no longer interrupted by coughing and a sense of chest tightness.

Today, at the insistence of family and friends, you have agreed to participate in a local July 4th walk-run family race. It is a hot and muggy summer day, and your breathing does not feel its best even when you are sitting quietly. When your turn comes, you go at it hard for 15 minutes, until your legs feel like rubber. Your breathing becomes labored, and you start to cough repetitively. You find the nearest bench and plop onto it "like a wet dishrag."

You search deep in all your pockets and waist bag for your quick-relief bronchodilator. When your asthma was under poor control, you could not have imagined going anywhere without it. You always carried one with you, besides

keeping one in your car, one at your office, and one by the bedside table at night. Now, to your dismay, you find that you have come out without bringing it with you.

As you feel your strength coming back to your arms and legs and your breathing slowing somewhat, you consider what to do next.

What would you do?

DISCUSSION:

Exercise has the potential to trigger symptoms in virtually everyone with asthma. Exercise causes us to breathe heavily, and as we do, we bring extra amounts of air down into our lungs and onto our bronchial tubes. Especially if the air that we breathe during exercise is cold and dry, or filled with air pollutants, fumes, or other irritating substances, exercise can cause the muscles surrounding the bronchial tubes to contract and the airways to narrow.

The good news, however, is that an attack of asthma brought on by exercise is generally short-lived. The bronchial muscles usually begin to relax over a period of minutes and your breathing tends to return to normal over the course of about 30-60 minutes. Also, there is much less inflammation and swelling of the bronchial tubes caused by exercise than by allergic triggers, such as cat dander or dust mites. Unless you are allergic to pollen and ran your race on a day with a high pollen count, there is a good chance that your breathing will continue to improve as you sit quietly and relax.

Staying calm is a good strategy for any asthma attack. Breathe slowly and deeply, and with each breath give adequate time for breathing out. Try counting three beats out for every one beat spent breathing in. Some people find as a helpful reminder the practice of breathing in through the nose and slowly out through the mouth ("sniff the roses; blow out the candles").

If your breathing remains difficult despite resting, you may decide to borrow a quick-relief bronchodilator inhaler from a friend or family member. Asthma is common and there is a good chance that you will find someone nearby willing to help. At the same time, it is a good rule never to use a medication with which you are unfamiliar. If there is any doubt that the offered medication is appropriate and safe for you, it is best to decline its use. If you find yourself gradually getting better, you would do best to wait until you return home and retrieve your own medicine.

What could you have done preventively?

You make a mental list of the things that you could have done differently so that this attack might have been prevented. Most importantly, you vow always to bring a quick-relief bronchodilator inhaler with you, even when your asthma is under good control. You also remember that using the quick-relief bronchodilator about 10-20 minutes before exercising is an effective strategy for preventing the bronchial muscle contraction brought on by exercise. Your quick-relief bronchodilator may be albuterol, levalbuterol, or formoterol, and it may have mixed with it an inhaled steroid (as in *AirSupra*®, *Dulera*®, or *Symbicort*®).

Other strategies do not require any medication. For one thing, you might have declined to participate in the race on a day when your breathing did not feel fully comfortable. Abstinence was one option! Also, many athletes with exercise-induced asthma find that a brief warm-up period before exercising (for example, light walking or jogging in place) and a brief cool-down period after exercising can help to minimize the effect of exercise on their breathing.

On a cold, winter's day (not July 4th!), it is helpful if you can avoid breathing cold air during exercise. You may decide to exercise indoors, or you can try wearing a thick scarf or facemask over your nose and mouth. With the scarf or mask, you can trap in front of your face some of the warm, moist air that you exhale, minimizing the amount of cold, dry air that penetrates down into your airways.

CONCLUSION

IT IS LIKELY that after reading this *Guide* and practicing your skills on the "Practice Sessions," you will still have many questions about your asthma. There will be specific items that you are not yet clear about. You will have heard different information about some points, including from reliable sources, and will want to clarify the conflicting opinions. And, we hope, you will want to learn more about many subjects not specifically discussed in this booklet, such as the role of allergy desensitization injections ("allergy shots") in asthma, managing asthma during pregnancy, and the long-term effects of asthma on your lungs.

Like all introductory guides, this asthma *Guide* is only a first step. Your learning about asthma will be lifelong. Many helpful sources of information are available to you. You begin, of course, with your own observations and experiences. You learn in this way about what works and what doesn't work for you.

We encourage you to discuss your asthma questions with your doctor or other medical provider. Your asthma care is a cooperative undertaking between you and your provider; your shared understanding about asthma will help to strengthen that collaboration.

At the Mass General Brigham Asthma Center, our doctors, nurses, physician assistants, and pulmonary function specialists are all eager to answer your questions. In addition, more information can be found in our patient education pamphlets: MGB Asthma Center

Patient Education Pamphlets (www.massgeneralbrigham.org/en/patient-care/services-and-specialties/asthma-center/resources-patients).

Many additional resources are available to you. Some are listed in **Appendix 4** of this *Guide*. Others you will find in your library, online, or from a friend.

Be a lifelong asthma learner — and keep breathing freely.

Appendix 1
Defining Terms

AIR: Anti-inflammatory rescue (AIR) is an asthma treatment strategy that combines use of an inhaled (anti-inflammatory) steroid every time a quick-relief bronchodilator is administered.

Allergen: a substance that stimulates the immune system to make an allergic reaction. In asthma, this substance is almost always breathed in. Only things of a certain shape and size can function as an allergen. For example, grains of pollen from grasses and trees can act as allergens; ozone, lead paint, cigarette smoke, and perfumes cannot.

Allergy: a characteristic type of reaction made by the body to certain specific substances that are foreign to it (that is, recognized by our immune system as not being a normal part of our body). Some people are genetically programmed to make allergic reactions, others are not. The immune cells and proteins involved in asthma constitute a distinct type of

allergic reaction, different from celiac disease (gluten intolerance), lactose intolerance, poison ivy reaction, and other reactions to foreign substances in our environment. The allergic reaction typical of asthma is also found in seasonal rhinitis and conjunctivitis (often referred to as "hay fever"), atopic dermatitis ("eczema"), hives, and some food allergies.

Beta-agonist: This term describes one family of bronchodilator medicines. All the members of this family share a common chemical structure. They are all derived from "adrenaline," which is also called "epinephrine." They act by stimulating a chemical pathway designated with the Greek letter B, beta.

Beta-blocker: A family of medications with many uses unrelated to asthma, such as treating heart disease or high blood pressure. These medications have the opposite effect on the bronchial tubes from beta-agonist bronchodilators and so have the potential for making asthma worse.

Biologics: man-made proteins (antibodies), all with the same structure (monoclonal antibodies), that bind to molecules in the body important in promoting inflammation, thereby blocking their action and reducing inflammation. Biologics are used to treat a variety of inflammatory (and other) diseases, including rheumatoid arthritis, inflammatory bowel dis-

ease, psoriasis, and now asthma.

Bronchial tubes: the system of branching tubes that carry air through the lungs to the tiny air sacs of the lungs (where oxygen can be passed into the blood and carbon dioxide released into the air around us).

Bronchodilator: a type of medication that acts to open the breathing passages by causing the muscles surrounding the bronchial tubes to relax.

Controllers: a term used to describe asthma medications that are designed to keep asthma under control and to prevent asthma attacks.

Corticosteroids: a family of medications that are designed to reduce inflammation. They are often referred to simply as "steroids," and must be distinguished from the muscle-building (anabolic) steroids used by some weightlifters and competitive athletes. Corticosteroids are the anti-inflammatory steroids.

Covid-19: a serious respiratory infection caused by the SARS-CoV-2 virus (severe acute respiratory syndrome coronavirus 2).

Dander: skin flakes from the surface of animals, whether they have fur or hair.

Dry-powder inhaler: a device for delivering asthma medication in which the medication is released in the form of a very fine, aerosolized powder. Different from metered-dose inhalers (see below),

these devices include no propellant; no spray of medication is emitted from the inhaler. It is the force of your inhaled breath that pulls the medication out of the inhaler. Spacers cannot be used with dry-powder inhalers.

Dust mite: a tiny living animal visible only under the microscope. In its droppings are particles to which many people worldwide make allergic reactions. These mites are found living in dust particles and thrive best in warm and moist climates.

Emphysema: a disease of the lungs almost always caused by long-term cigarette smoking. In emphysema, the lungs lose their normal springiness. As a result, it becomes difficult to exhale air from the lungs -- and in that way emphysema is similar to asthma. However, in many other ways it is different than asthma. Asthma does not turn into emphysema.

HEPA filter: an indoor device used to remove irritants and allergens from the air that we breathe. High-efficiency particulate air (HEPA) filters are made as stand-alone electric machines used to clear room air as well as attachments that can be added to central home air systems or incorporated into vacuum cleaners.

Inflammation: Inflammation in asthma refers to swelling and irritation of the bronchial tubes. Many different processes

can cause inflammation in the body, as you know from once having had a sunburn or a "skinned" knee. In asthma one generally finds a characteristic allergic type of inflammation.

Leukotrienes: chemicals made in the body as part of allergic reactions. Many chemicals are released in an allergic reaction. Histamine is one that has been known for many years. Leukotrienes are another, very powerful group of such chemicals. Antihistamines are not effective as treatment for asthma, but "anti-leukotrienes" have proved to be somewhat effective.

Metered-dose inhaler: a device used to deliver asthma medication, utilizing a propellant to create a "puff" of medication when the device is activated. For most of these devices, activation consists of depressing the metal canister in its plastic holder. A precise ("metered") dose of medication is released in each puff. For the medicine to be effective, you need to breathe the puff of medication deeply into your lungs with a slow, steady inhalation, then hold your breath briefly to let the medication settle onto the surface of the breathing tubes.

Nebulizer: a machine that takes a liquid form of medicine and converts it into a mist to be breathed in.

Peak flow: a measure of how fast you can blow air out of your lungs. In asthma, your peak flow reflects the extent to which your bronchial tubes are normally open or abnormally narrowed. In that way, it measures how close your breathing is to normal at that moment that you measure it.

Respiratory syncytial virus (RSV): a respiratory virus that commonly attacks the bronchial tubes, causing severe cough and wheezing.

Quick reliever: a term used to describe asthma medications that work quickly (typically within 3-5 minutes) to relax the bronchial muscles, open the bronchial tubes, and improve breathing. They have also been called "rescue" medications or "my emergency inhaler."

SMART: a treatment strategy for asthma that uses one inhaler (containing both a long-acting bronchodilator and a steroid) as regular controller and as-needed quick reliever (single maintenance and reliever therapy).

Spacer: a hollow chamber into which inhaled medicines can be squirted prior to breathing them in. They are used with metered-dose inhalers to help deliver medication more effectively to the bronchial tubes and to reduce the amount of medicine left behind on the tongue and throat.

Steroids: see "Corticosteroids."

Theophylline: a distant chemical cousin of caffeine that was once widely used as a bronchodilator to treat asthma. It is now rarely prescribed, supplanted by safer and stronger long-acting inhaled bronchodilators.

Trigger (of asthma): anything that can set off asthma symptoms. Many different categories of stimuli can trigger asthma symptoms, including allergens, inhaled irritants, strong odors, certain medications, respiratory tract infections, exercise, and strong emotions.

Wheezing: a whistling sound coming from the chest as air passes through narrowed bronchial tubes. In asthma, it most commonly occurs when breathing out (exhaling).

Appendix 2

Tables of Normal Peak Flow Values*

women

Age	Height				
	55”	60”	65”	70”	75”
20	390	423	460	496	529
25	385	418	454	490	523
30	380	413	448	483	516
35	375	408	442	476	509
40	370	402	436	470	502
45	365	397	430	464	495
50	360	391	424	457	488
55	355	386	418	451	482
60	350	380	412	445	475
65	345	375	406	439	468
70	340	369	400	432	461

men

Age	Height				
	60”	65”	70”	75”	80”
20	554	602	649	693	740
25	543	590	636	679	725
30	532	577	622	664	710
35	521	565	609	651	695
40	509	552	596	636	680
45	498	540	583	622	665
50	486	527	569	607	649
55	475	515	556	593	634
60	463	502	542	578	618
65	452	490	529	564	603
70	440	477	515	550	587

Peak Flow Values in Liters/Minute

* Note that the values shown are the average normal values for healthy persons of a given age and height. There will always be a range of normal values; not everyone can be expected to have exactly the same value. Men can have peak flow values as low as 100 liters/minute less than the average value shown and still fall within the normal range. Women can have peak flow values as low as 80 liters/minute less than the average value shown and still fall within the normal range.

Appendix 3
Using Your Inhalers Effectively

Many inhaled asthma medications come in the form of a metal canister inside a plastic dispenser. Inside the canister is medication in aerosol form. To deliver the medication, one presses down (and then releases) the canister in its holder. From its nozzle is delivered a spray containing each time the same amount of medication. This type of inhaler is called a **metered-dose inhaler** or MDI. Before pressing the canister to release the medication, it is good to give it one or two shakes so that the medication is evenly mixed within the canister, and, of course, be sure to remove the cap that covers the mouthpiece.

The key to proper use of these inhalers is drawing the spray or mist released from the mouthpiece of the inhaler deep into the lungs and onto the bronchial tubes. To begin, put your lips and teeth tightly around the mouthpiece of the inhaler.

Then, three steps are important. First, start breathing in as soon as the spray has been made. If you wait to breathe in too long after making the spray, you lose a lot of medication that settles onto your tongue and mouth rather than being drawn onto your breathing tubes. At the other extreme, if you breathe in deeply before the spray is made, you will not have enough breath left to pull the medicine onto the bronchial tubes. So, to do it just right, at the same time that you are pressing down on the canister and making the spray, begin to breathe in.

Second, breathe in slowly. It takes time to distribute the medication to the thousands of bronchial tubes. Too fast a breath puts most of the medicine onto the back of the throat and the upper breathing passageways only. Try not to rush as you breathe in; it should take about 3-4 seconds to pull in a slow, full breath.

Third, hold your breath for a few seconds at the end of the slow, deep breath. If you breathe out immediately, you lose some of the medication in what you exhale. Give the medicine a chance to settle onto the breathing tubes by holding your breath for about 5 seconds before exhaling.

A different medication delivery form is the **dry-powder inhaler**. With this device, a fine powder is released as you pull in a breath through the inhaler. No pres-

surized spray is generated. It is the force of the inhaled breath that puts the powder into its aerosolized form.

Each dry-powder inhaler device involves a slightly different procedure to make the next dose ready for delivery. Your pharmacist or medical provider can demonstrate how to prepare the next dose for delivery. In addition, informative videos are available on-line via the internet.

Spacers can assist in the delivery of inhaled medications. Spacers are holding chambers into which one sprays the medicine and from which one then breathes it in. Spacers serve two major purposes: they help to improve coordination of inhaled medications, and they reduce the amount of inhaled medication that is deposited onto the tongue and back of the throat. For the inhaled steroids delivered by metered-dose inhaler, this latter benefit means that less medication is available to be absorbed into the bloodstream and carried throughout the body (beyond the bronchial tubes). Spacers can be used with pressurized metered-dose inhalers but not with dry-powder inhalers.

A novel type of inhaler, called a **soft-mist inhaler** (*Respimat*®), is used to deliver one asthma medication, called tiotropium (*Spiriva*®), a long-acting bronchodilator of the muscarinic antagonist ("anticholinergic") family.

All asthma inhalers now have a built-in **dose-counter**. Some are numeric, with the exact number of remaining doses displayed as a number; others have an arrow pointing to the number of remaining doses. When your inhaler is empty and the dose counter indicates zero doses remaining, you can be fooled by the sensation of a spray coming from the inhaler into thinking that there is medication left. There is no medication in that spray. When the dose counter indicates zero, your inhaler is truly empty of medication. One pharmaceutical company makes a dry-powder inhaler, called a *Digihaler®*, with a built-in electronic dose counter that can record each actuation on an app downloaded to your smartphone or computer. Similar electronic dose counters can be purchased as separate devices to attach to a variety of different inhaler types.

Finally, to state the obvious, it is best not to use expired medication! Most metered-dose inhalers have printed at the top of the metal canister their expiration date. Although it is true that medication remains active for a few weeks beyond the stated expiration date, the medication cannot reliably be expected to maintain its strength for many months thereafter. So, if your inhaler has expired, it is time to purchase a new one.

Appendix 4

Additional Asthma Learning Resources

Asthma Centers

Mass General Brigham Asthma Center
You can access patient educational information at our website: www.massgeneralbrigham.org/asthma, click on Patient Resources

Books written by members of the Mass General Brigham Asthma Center, now many years old, include:

Fanta CH, Haver KH, Cristiano LM. *Harvard Medical School Guide to Taking Control of Asthma.* New York: Free Press (Simon & Schuster); 2004.

Fanta CH, Carter EL, Stieb ES, Haver KE. *The Asthma Educator's Handbook.* New York: McGraw Hill; 2007.

For additional information:

Address: Mass General Brigham
Asthma Center
c/o Pulmonary and Critical Care
Medicine Division
PBBH Clinics-3
75 Francis St.
Boston, MA 02115

Phone: 800-9PARTNERS
(800-972-7863)
Fax: 617-732-7421
Email: asthma@mgb.org
Website: www.massgeneral-
brigham.org/asthma

National Jewish Health
Address: National Jewish Health
1400 Jackson Street
Denver, CO 80206
Phone: 800-222-LUNG
or 303-388-4461
Fax: 303-270-2102
Email: lungline@njc.org
Website: www.nationaljewish.org

Medical Societies

American Academy of Asthma, Allergy, and Immunology
Address: American Academy of Asthma,
Allergy, & Immunology
555 East Wells Street
Suite 1100
Milwaukee, WI 53202-3823
Phone: 414-272-6071
Website: www.aaaai.org

American College of Allergy, Asthma, and Immunology

Address: American College of Allergy, Asthma, and Immunology
85 West Algonquin Road
Suite 550
Arlington Heights, IL 60005
Phone: 847-427-1200
Fax: 847-427-9656
Email: mail@acaai.org
Website: www.acaai.org

American College of Chest Physicians

Address: American College of Chest Physicians
2595 Patriot Boulevard
Glenview, Illinois 60026
Phone: 800-343-2227
or 224-521-9800
Website: www.chestnet.org

American Thoracic Society

Address: American Thoracic Society
Phone: 212-315-8600
Fax: 212-315-6498
Email: atsinfo@thoracic.org
Website: www.thoracic.org

Patient Support Organizations

Allergy and Asthma Network

Address: Allergy and Asthma Network
10304 Eaton Place, Suite 100
Fairfax, VA 22030
Phone: 800-878-4403
Email: info@allergyasthmanetwork.org
Website: www.allergyasthmanetwork.org

American Lung Association

Address: American Lung Association – National Office
55 W. Wacker Drive
Suite 1150
Chicago, IL 60601
Phone: 800-LUNG-USA (800-586-4872) or 312-801-7630
Website: www.lung.org

Asthma and Allergy Foundation of America

Address: Asthma and Allergy Foundation of America
1235 South Clark Street
Suite 305
Arlington, VA 22202
Phone: 800-7-ASTHMA (800-727-8462)
Website: www.aafa.org

National and International Asthma Guidelines

National Asthma Education and Prevention Program of the National Heart, Lung and Blood Institutes

Website: www.nhlbi.nih.gov/resources/2020-focused-updates-asthma-management-guidelines; and www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma

Global Initiative for Asthma

Website: www.ginasthma.org

Mass General Brigham

Mass General Brigham Asthma Center is a collaboration among allergists and pulmonologists at Massachusetts General Hospital, Brigham and Women's Hospital, Brigham and Women's Faulkner Hospital, Newton-Wellesley Hospital, and Salem Hospital, providing comprehensive, multidisciplinary care for adults and children with asthma and related diseases.