A 24-year-old woman presents to an NP, reporting a two-year history of episodic cough, chest tightness, and shortness of breath. (This patient is a composite of several cases we’ve encountered in our practice.) Over the past three months, episodes have become slightly more frequent, occurring on an average of once a month, with weekly nighttime episodes that awaken her from sleep. Between episodes she feels completely well. Symptoms are precipitated by stress and exposure to cigarette smoke and are slightly worse in the spring and fall.

The patient had childhood allergies but has no other significant medical or surgical history. She’s never smoked and uses no medications. She lives in an apartment with wall-to-wall carpeting and has a cat. She works in a smoke-free office. She says she experiences slight chest tightness during our examination but displays no acute distress. Auscultation reveals infrequent end-expiratory wheezes. The physical examination is otherwise normal, except for mild swelling of the nasal mucosa.

With office spirometry, the patient demonstrates mild expiratory airflow obstruction. Repeat spirometry is normal 10 minutes after albuterol treatment.

Based on the patient’s levels of impairment and risk, the NP diagnoses her with mild persistent asthma and allergic rhinitis. She prescribes a low-dose inhaled corticosteroid and a short-acting rescue bronchodilator to address the asthma and a nasal corticosteroid to treat the allergic rhinitis. She educates the patient about basic asthma pathophysiology, proper medication use, and environmental control (suggesting, among other things, that she separate from her cat); provides written guidelines and a peak flow meter for monitoring asthma control; and schedules her for a follow-up visit in one month.

In this scenario, did the NP take the appropriate...
course of action? Were the medications she prescribed sufficient? Did she address the issues most important to asthma control? This article seeks to answer these questions.

**ASTHMA’S IMPACT**
In the United States, more than 16 million adults and about 7 million children have asthma. Annually, it’s responsible for roughly 11 million outpatient visits, 2 million ED visits, nearly 500,000 hospital admissions, and close to 4,000 deaths. It’s a common reason for school absenteeism among children, and causes adults to lose more than 10 million workdays each year. Although asthma is more common in boys than girls, it’s more common among women than men. Prevalence, hospitalization, and mortality rates have stabilized over the past decade or so but had been on the rise in both sexes and across all age and racial groups from 1977 through 1996. Among adult patients, hospitalization and mortality rates are generally highest for blacks and women.

**BEHIND THE OBSTRUCTION**
The chronic inflammation of asthma involves the action of various types of cells, most notably eosinophils and Th2 lymphocytes. Airway wall inflammation is associated with hypertrophy and hyperplasia of smooth muscle tissue and mucus plugging of the small and medium-sized airways. The bronchial epithelium is commonly disrupted and there is a thickening of the basement membrane (see Figure 1). Airway smooth muscle increases in mass, and airways become hyperreactive to a number of specific and nonspecific triggers.

Variable combinations of inflammation, intraluminal mucus, and bronchospasm obstruct expiratory airflow. Although such obstruction is usually reversible either spontaneously or with pharmacotherapy, the precipitating structural changes can result in airway remodeling and fixed airflow obstruction. There is no clear single cause of asthma. Although atopy is an important identifiable risk factor, findings from epidemiologic studies differ as to whether early exposure to some allergens increases or reduces the risk of subsequent asthma. The effects are particularly difficult to discern when early exposure occurs in association with frequent lower respiratory infection. Asthma is also recognized as having an inheritable component, though the genetics of the disease are poorly understood. More recently, obesity has been recognized as a risk factor, although the precise relationship isn’t yet understood.

**CLINICAL PRESENTATION**
Asthma is characterized by breathlessness, chest tightness, wheezing, and coughing. (Nasal congestion and postnasal drip are also common.) Symptoms vary from patient to patient and can vary in the same patient over time. Symptoms may occur spontaneously, or be precipitated or exacerbated by various triggers (see Selected Asthma Triggers). Asthma is commonly worse in the early morning hours or at night, corresponding to circadian variations in bronchomotor tone and bronchial reactivity.

Occupational asthma is triggered by various agents in the workplace and may occur weeks to years after exposure and sensitization. Separation from the inciting agent is essential in the management of occupational asthma but doesn’t always result in clinical improvement.

**ESTABLISHING THE DIAGNOSIS**
A diagnosis of asthma is based on characteristic signs and symptoms in the presence of airflow obstruction or hyperresponsiveness. The patient history should focus on
- symptoms.
- home and work environments.
- triggers.
- medication use.
- family history.
- social history.
- the impact of symptoms on daily life.

The hallmarks of airflow obstruction are expiratory wheezes and expiratory phase prolongation, although wheezes may be absent or diminished between obstructive episodes and when airflow rates are critically low. Indeed the quiet chest with minimal air

---

**Selected Asthma Triggers**

- Allergen exposure (for example, pollen, mold, air pollutants, dust mites, cockroaches, pet dander, and saliva)
- Medications (for example, aspirin, non-steroidal antiinflammatory drugs, and β-blockers)
- Illicit drugs (for example, heroin and cocaine)
- Upper respiratory tract infections
- Gastroesophageal reflux disease
- Strong odors or fumes
- Rhinosinusitis
- Smoke (cigarette and wood)
- Hormone levels (such as variations in asthma related to menstruation)
- Exercise
- Foods or drinks containing histamine or sulfites (such as beer, wine, shrimp, dried fruit, processed potatoes)
- Cold air
- Laughing
- Stress
entry is an ominous sign of an impending respiratory arrest. Other physical findings suggestive of asthma include nasal polyps, eczema, and atopic dermatitis. It’s important to point out, however, that the physical examination of a patient with asthma may be entirely normal.

**Spirometry** is a simple, office-based test that can reveal airflow obstruction, as well as its severity and responsiveness to bronchodilator treatment (see Figure 2). The key spirometric measures are the forced vital capacity (FVC) (or total volume exhaled) and the forced expiratory volume within the first second of exhaling from total lung capacity (FEV1). An FEV1/FVC ratio below 70% suggests airflow obstruction. Reversible airflow obstruction is defined as an increase of at least 200 mL and 12% above baseline in FEV1, FVC, or both, after administration of a short-acting bronchodilator, such as albuterol (Proventil and others).

A normal spirometry doesn’t exclude asthma, particularly when symptoms are infrequent or cough is the only symptom. In such situations, a provocative challenge with methacholine (Provocholine) or histamine (substances that cause airways to spasm and narrow when asthma is present) or exercise may trigger the obstructive process, demonstrating hyperreactivity, a central feature of asthma. Conversely, a negative test may help rule out the disease. Variable findings with a handheld peak flow meter also suggest asthma, particularly if flow rates are lower when symptoms are present and higher after albuterol treatment.

Although not central to the diagnosis of asthma, a chest X-ray may help exclude alternative diagnoses (see *Differential Diagnosis of Asthma*). Blood work may reveal eosinophilia and elevated immunoglobulin E levels.

**ASSESSING DISEASE SEVERITY AND CONTROL**
Assessing and monitoring asthma severity and control is essential. Severity is measured in part by how difficult it is to control the disease with treatment. Current evidence-based guidelines, which outline preferred and alternative therapies in a stepwise manner, enable clinicians to select appropriate initial therapy for patients on the basis of disease severity (see Figures 3 and 4).

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**Figure 1. Normal and Asthmatic Bronchiole**
The pathophysiologic hallmarks of asthma include airway wall inflammation, intraluminal mucus, and smooth muscle-mediated bronchoconstriction. Frequently the bronchial epithelium is disrupted and there is deposition of collagen beneath the basement membrane (referred to as basement membrane thickening).
Severity categories. After evaluating impairment (through symptom assessment and spirometry) and exacerbation risk, asthma can be classified into one of four severity categories: intermittent, mild persistent, moderate persistent, or severe persistent. Patients with intermittent asthma have normal pulmonary function tests between infrequent asthma episodes. They require only as-needed treatment with a short-acting bronchodilator but no daily asthma medication. Patients whose symptoms occur more than twice weekly or awaken them more than twice monthly and those whose routine pulmonary function tests demonstrate obstruction have persistent asthma and require a daily antiinflammatory control medication as well as a short-acting bronchodilator for rescue. Patients with severe persistent disease require higher doses of control agents than do those with mild or moderate persistent disease and, possibly, combination treatment with different classes of asthma medications.

Asthma control is the degree to which signs and symptoms, risk of future episodes, and loss of lung function are reduced through treatment and environmental control. Because both patients and health care providers tend to underrecognize and underreport asthma symptoms, control should be assessed at each visit using a validated tool such as the Asthma Therapy Assessment Questionnaire, the Asthma Control Questionnaire, or the Asthma Control Test (see Figure 5).

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Therapy Assessment Questionnaire, the Asthma Control Questionnaire, or the Asthma Control Test (see Figure 5). These questionnaires are easily accessed online and can be administered quickly. Periodic lung function measurement through spirometry and patient monitoring of peak flow and symptoms can further help clinicians determine control and adjust medication accordingly.

PHARMACOTHERAPY

If patient education and adherence are adequate, most cases of asthma can be managed with a limited number of medications and environmental control measures. Medications are divided into short-acting drugs for rescue and long-term drugs for control (see Table 1).

All patients should receive a short-acting (quick relief) bronchodilator to treat bronchospastic episodes. Those with persistent asthma require an additional long-term control agent to treat underlying airway inflammation. The most effective antiinflammatory medications (used either alone or in combination with other control agents) are the inhaled corticosteroids, which improve asthma symptoms and lung function, decrease the need for short-acting bronchodilators, and reduce the risk of hospitalization and asthma-related death.

Clinicians should prescribe the least amount of medication required to achieve control as assessed by a validated tool and spirometry.

The daily use of a low-dose inhaled corticosteroid is preferred treatment for patients with mild persistent asthma. Moderate persistent asthma is generally treated with a medium-dose inhaled corticosteroid or a low-dose inhaled corticosteroid combined with a long-acting β2-adrenergic agonist. Alternatively, a leukotriene receptor antagonist (also called a leukotriene modifier) or theophylline (Uniphyl and others) can be prescribed in addition to an inhaled corticosteroid to help the patient achieve adequate control. Patients with severe persistent asthma require high doses of an inhaled corticosteroid combined with a long-acting β2-adrenergic agonist, often in combination with other control medications. Those with refractory symptoms may require daily oral corticosteroids to achieve control.

Clinicians should prescribe the least amount of medication required to achieve control as assessed by a validated tool and spirometry, but tapering of medications shouldn’t be attempted until control has been achieved for at least three months. Patients

Differential Diagnosis of Asthma
- Vocal cord dysfunction
- Chronic obstructive pulmonary disease
- Alpha-1 antitrypsin deficiency
- Allergic bronchopulmonary aspergillosis
- Laryngotracheomalacia and tracheal stenosis
- Foreign body aspiration
- Viral or obliterative bronchiolitis
- Endobronchial obstruction (benign or malignant)
- Cystic fibrosis
- Bronchiectasis
- Lymphangioleiomyomatosis
- Churg-Strauss syndrome
- Eosinophilic pneumonia

Vocal cord dysfunction, Chronic obstructive pulmonary disease, Alpha-1 antitrypsin deficiency, Allergic bronchopulmonary aspergillosis, Laryngotracheomalacia and tracheal stenosis, Foreign body aspiration, Viral or obliterative bronchiolitis, Endobronchial obstruction (benign or malignant), Cystic fibrosis, Bronchiectasis, Lymphangioleiomyomatosis, Churg-Strauss syndrome, Eosinophilic pneumonia.
should be monitored closely after reducing medications to ensure continued control.

When choosing a pharmacologic regimen, consider adverse effects. Because of their sympathomimetic properties, β₂-adrenergic agonists and theophylline should be used with caution in patients with cardiovascular disorders, particularly those with tachycardia and tachyarrhythmias. Long-acting β₂-agonists may increase the risk of severe symptom exacerbation, hospitalization, and asthma-related death. For these reasons, the Food and Drug Administration recently issued a warning that long-acting β₂-agonists should be used only

- for the shortest period of time required to achieve symptom control.
- in patients whose asthma symptoms are inadequately managed by a control medication.
- in combination products containing an inhaled corticosteroid, if the patient is a child or adolescent (to ensure adherence to the inhaled corticosteroid).

Long-acting β₂-adrenergic agonists provide neither rescue therapy nor adequate treatment for airway wall inflammation. Their use is contraindicated except in conjunction with an asthma control medication, such as an inhaled corticosteroid.

The inhaled corticosteroids are associated with oral candidiasis, the potential for suppressed or delayed growth, and reduced bone mineral density. Long-term use of inhaled corticosteroids has also been associated with cataracts and glaucoma. Recent reports suggest a possible link between leukotriene receptor antagonists and neuropsychiatric events, including depression and suicidal ideation.

**OTHER TREATMENT CONSIDERATIONS**

Evaluating and treating comorbid conditions such as gastroesophageal reflux disease, rhinosinusitis, and nasal polyposis improve asthma symptoms, as does weight loss in obese or overweight patients. Obesity, in fact, increases a patient’s risk of obstructive sleep apnea, which may impede asthma management. Patients with poorly controlled asthma should also be evaluated for stress and depression.

Address preventive health care measures such as yearly influenza vaccination, optimal weight maintenance, exercise, good handwashing techniques, avoiding contact with those who are sick, and—for patients taking corticosteroids—bone mineral density measurement and calcium and vitamin D supplementation. Other bone protective or restorative therapies may be considered in patients with osteopenia or osteoporosis.

**PATIENT EDUCATION**

Asthma education is an ongoing process that’s critical to achieving control, improving outcomes, and...
Key components of an asthma education program should include essential facts about asthma pathophysiology, the role of asthma medications, inhaler technique, the importance of asthma control, signs and symptoms of reduced control, measures for reducing exposure to environmental irritants, and self-management skills such as peak flow monitoring.3

Basic asthma pathophysiology, with instruction

Table 1. Medications for Short- and Long-Term Control of Asthma2,21

<table>
<thead>
<tr>
<th>Type of Medication</th>
<th>Comments</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-term control medications (taken on a daily basis to treat and prevent symptoms)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inhaled corticosteroids</td>
<td>Most effective</td>
<td>Fluticasone (Flovent)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Budesonide (Pulmicort)</td>
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<tr>
<td></td>
<td></td>
<td>Triamcinolone acetonide (Azmacort)</td>
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<tr>
<td></td>
<td></td>
<td>Flunisolide (Aerobid)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beclomethasone (QVAR)</td>
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<tr>
<td></td>
<td></td>
<td>Mometasone (Asmanex)</td>
</tr>
<tr>
<td>Long-acting β2-adrenergic agonists</td>
<td>Always used with an inhaled corticosteroid</td>
<td>Salmeterol (Serevent)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Formoterol (Foradil)</td>
</tr>
<tr>
<td>Combination treatment with an inhaled corticosteroid and a long-acting β2-adrenergic agonist</td>
<td></td>
<td>Fluticasone–salmeterol (Advair)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Budesonide–formoterol (Symbicort)</td>
</tr>
<tr>
<td>Leukotriene receptor antagonists</td>
<td></td>
<td>Montelukast (Singulair)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zafirlukast (Accolate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zileuton (Zyflon)</td>
</tr>
<tr>
<td>Mast cell stabilizers</td>
<td>May soon be unavailable</td>
<td>Cromolyn (Intal and others)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nedocromil (Tilade)</td>
</tr>
<tr>
<td>Methylxanthines</td>
<td></td>
<td>Theophylline (Uniphyl and others)</td>
</tr>
<tr>
<td>Immunomodulators</td>
<td></td>
<td>Omalizumab (Xolair)</td>
</tr>
<tr>
<td>Systemic corticosteroids (oral)</td>
<td></td>
<td>Methylprednisolone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prednisolone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prednisone</td>
</tr>
<tr>
<td><strong>Short-acting rescue medications (taken on an as-needed basis to treat symptoms or prevent exercise-induced symptoms)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-acting β2-adrenergic agonists</td>
<td></td>
<td>Albuterol (Proventil and others)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Levalbuterol (Xopenex)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pirbuterol (Maxair)</td>
</tr>
<tr>
<td>Anticholinergics</td>
<td>Usually reserved for asthma exacerbations, not for routine outpatient use</td>
<td>Ipratropium (Atrovent)</td>
</tr>
<tr>
<td>Systemic corticosteroids (oral, intravenous, subcutaneous, intramuscular)</td>
<td>Although oral systemic corticosteroids are not short-acting drugs, they are used adjunctively with short-acting β2-adrenergic agonists to hasten recovery</td>
<td>Methylprednisolone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prednisolone</td>
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<tr>
<td></td>
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<td>Prednisone</td>
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</table>
tailored to the patient’s and the family’s learning style, motivation, cognitive level, cultural beliefs, and asthma management practice, reinforces the need for a daily, long-term antiinflammatory medication. Teaching patients about how asthma—and asthma medications—affects their airways helps them recognize the importance of their medications, environmental control, and self monitoring. The pathophysiology can be explained as simply as follows: “Asthma is a chronic lung disease in which the airways become inflamed, or swollen, narrow, and sensitive to certain substances, which we call triggers. Exposure to these triggers tightens muscles surrounding the airways, causing further narrowing. Swollen, constricted airways, which are often filled with mucus, make breathing increasingly difficult, causing the symptoms of wheezing, chest tightness, shortness of breath, and coughing.”

Medication education should focus on differences between control and rescue medications. Patients can be offered the following simple explanation: “Control medications are used to prevent symptoms, usually by reducing the inflammation that underlies asthma. They must be taken every day, even when you are feeling well. They’re not for quick relief. Rescue medications, on the other hand, relax the muscles around the airways to relieve symptoms quickly. They don’t treat asthma inflammation and, therefore, can’t provide long-term control. If you find yourself needing your rescue medication with increasing frequency, then your asthma is not well controlled.”

When discussing medication, be sure to address potential adverse effects. Patients who use inhaled corticosteroids, for example, should be instructed to rinse the mouth with water and spit after each use to prevent oral candidiasis and throat irritation. Because these drugs are usually prescribed for use twice daily, you might suggest that patients use them immediately before morning and nighttime toothbrushing. Patients who use a metered dose inhaler might also use a spacer to reduce the amount of medication swallowed and absorbed.

Parents may express concern over the safety of inhaled corticosteroid use in children and the potential for subsequent delayed growth. It may be helpful to inform them that current asthma guidelines from the National Heart, Lung, and Blood Institute say that the efficacy of inhaled corticosteroids for establishing asthma control outweighs concerns about growth or systemic effects.3 In addition, poorly controlled asthma delays growth in children. Explain that inhaled corticosteroids are titrated to the lowest

<table>
<thead>
<tr>
<th>Components of Severity</th>
<th>Classification of Asthma Severity ≥12 years of age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermittent</td>
</tr>
<tr>
<td><strong>Impairment</strong></td>
<td></td>
</tr>
<tr>
<td>Normal FEV₁/FVC:</td>
<td></td>
</tr>
<tr>
<td>8–19 yr</td>
<td></td>
</tr>
<tr>
<td>85%</td>
<td></td>
</tr>
<tr>
<td>20–39 yr</td>
<td></td>
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<tr>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>40–59 yr</td>
<td></td>
</tr>
<tr>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>60–80 yr</td>
<td></td>
</tr>
<tr>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>≥2x/month</td>
</tr>
<tr>
<td>Short-acting beta₂-agonist use for symptom control (not prevention of EB)</td>
<td>≤2 days/week</td>
</tr>
<tr>
<td>Interference with normal activity</td>
<td>None</td>
</tr>
<tr>
<td>Lung function</td>
<td></td>
</tr>
<tr>
<td>Normal FEV₁, between exacerbations</td>
<td>FEV₁ &gt;80% predicted</td>
</tr>
<tr>
<td>Risk</td>
<td></td>
</tr>
<tr>
<td>Exacerbations requiring oral systemic corticosteroids</td>
<td>0–1/year</td>
</tr>
<tr>
<td>Frequency and severity may fluctuate over time for patients in any severity category.</td>
<td></td>
</tr>
<tr>
<td>Recommended Step for Initiating Treatment</td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td>Step 2</td>
</tr>
<tr>
<td>In 2–6 weeks, evaluate level of asthma control that is achieved and adjust therapy accordingly.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3. Classifying Asthma Severity

EIB = exercise-induced bronchospasm; FEV₁ = forced expiratory volume in 1 second; FVC = forced vital capacity.
possible dose needed to maintain control and that proper inhaler technique reduces systemic absorption of the drug. **Inhaler technique** should be reassessed at every clinical visit. Poor asthma control in a patient who has been prescribed a control medication should raise questions about whether the patient is using proper technique and adhering to the prescribed regimen.

Repetitive teaching with return demonstrations improves technique, medication delivery, and asthma control.

**The importance of asthma control and signs of reduced control** must be clearly communicated to patients. They need to recognize that increased use of a rescue bronchodilator, nighttime awakenings, worsening symptoms, or diminishing peak flow measurements signal a decline in control.

**Identifying environmental irritants and reducing exposure** to them can dramatically improve asthma control and may allow medication dosages to be reduced. Review asthma symptom triggers at each visit. Teach patients about the role of such irritants, their effect on the inflammation of asthma, and how to minimize exposure in the home (see Reducing Allergen Exposure in the Home3, 25).

**Peak flow monitoring** allows patients with possible occupational asthma to monitor symptoms in the workplace as well as at home. In addition to helping patients and clinicians assess control, peak flow measurements are valuable in predicting exacerbations because values tend to drop before symptoms appear. Peak flow meters are inexpensive and easy to use (see How to Use a Peak Flow Meter3). They measure how quickly and forcefully a person can exhale. The maximum expiratory flow achieved is called the peak expiratory flow rate (PEFR). Predicted normal PEFR values are based on a population without asthma and vary with age, sex, and height. What’s “normal” for your patients, however, is their personal best PEFR, which is the highest peak flow measurement they record when measuring PEFR twice daily (morning and night) over a two-week period in which they are well and their asthma is controlled. Comparing predicted normal PEFR values to a patient’s personal best PEFR provides an objective measure of the patient’s airway narrowing, whereas evaluating trends in a patient’s PEFR values over time may be useful in assessing response to treatment.

**THE ASTHMA ACTION PLAN**

Individualized written asthma action plans, developed in collaboration with patients, have been shown to enhance patient–provider communication and improve outcomes3, 26. Recommended for all patients as part of an overall asthma education program, written action plans are particularly valuable to patients with

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**Reducing Allergen Exposure in the Home**

**Ways to limit patients’ exposure to environmental irritants.**

**Dust mites**
- Encase mattress and pillows in allergen-impermeable covers.
- Wash all sheets, bedding, and blankets once a week in hot (>130°F) water.
- Use a dehumidifier or air conditioner to reduce indoor humidity to <60% (ideally, between 30% and 50%).
- Remove stuffed animals from the bedroom or wash weekly (in hot water or in cooler water with soap and bleach) or place in a dryer or freeze once a week.
- Remove carpet from the bedroom.

**Animal dander**
- Keep furry pets out of the home.
- If you can’t keep them outdoors, don’t allow them in the bedroom.
- Don’t allow pets on any carpet or cloth-covered furniture in the home.

**Indoor mold**
- Fix any leaky faucets or toilets.
- Clean moldy surfaces.
- Dehumidify basements.

**Animal dander**
- Keep furry pets out of the home.
- If you can’t keep them outdoors, don’t allow them in the bedroom.
- Don’t allow pets on any carpet or cloth-covered furniture in the home.

**Cockroach allergen**
- Keep food in closed containers and out of the bedroom.
- Keep garbage in closed containers.
- Use traps or a professional exterminator.

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moderate or severe persistent asthma, a history of exacerbations, or poorly controlled asthma. Action plans, which provide instruction for daily management and outline how to recognize and respond to worsening asthma, can be based on either symptoms or peak flow measurements. Patients who find it difficult to assess their asthma symptoms (for example, those with a history of near fatal asthma or prior intubation) may derive the most benefit from an action plan based on peak flow.

Action plans should be simple and easy to use. Many use a traffic light analogy, describing green, yellow, and red zones for which specific actions are prescribed. In the green (“go”) zone, patients’ PEFR is 80% to 100% of their personal best and they have no symptoms. These patients can continue using their daily medications and taking steps to limit exposure to triggers, as described in their plan. When patients’ PEFR is 50% to 80% of their personal best and they have symptoms, they’ve entered the yellow (“caution”) zone, and practitioners may consider prescribing alternative antiinflammatory medications and, possibly, a higher dose or more frequent use of the rescue medication. Patients whose PEFR drops below 50% of their personal best and whose symptoms fail to improve significantly with prescribed rescue medications are in the red (“danger–stop”) zone. They should increase medication as indicated in their action plan and call their health care provider immediately. If unable to reach their provider, they should stop what they’re doing and go directly to the nearest ED.

Numerous sample asthma action plans are available online (for example, see http://bit.ly/hM4s0) and in the asthma guidelines. Effective plans specify the frequency and dose of all prescribed medications and provide clear instructions about when to call the health care provider. Clinicians should review action plans with their patients at every clinical visit, making updates as necessary.

**FOLLOW-UP**

When the patient in our opening scenario returns for follow-up in a month, the NP assesses her asthma control using the Asthma Control Test, spirometry, and physical examination. The patient isn’t in acute distress, but end-expiratory wheezing remains evident on auscultation. Again, spirometry demonstrates expiratory airflow obstruction, and the patient’s Asthma Control Test score is 19, indicating insufficient control.

The patient reports that she’s been using her inhaled corticosteroid as prescribed, and she’s able to demonstrate its proper use. She’s also taking the nasal

---

**Figure 4. Stepwise Approach for Managing Asthma**

EIB = exercise-induced bronchospasm; ICS = inhaled corticosteroid; LABA = inhaled long-acting β2-agonist; LTRA = leukotriene receptor antagonist; SABA = inhaled short-acting β2-agonist.
Steroid as prescribed and her nasal symptoms have improved. She hasn’t been recording her PEFR. The patient acknowledges that she still has a cat, which she allows on her bed. The NP prescribes a step-up in medication and reiterates that a complete separation from the cat would be advisable. She suggests, however, that if complete separation is unacceptable to the patient, she should at least keep the cat out of the bedroom. Based on guidelines, the preferred next step is to prescribe a higher (medium-dose) inhaled corticosteroid or a long-acting $\beta_2$-adrenergic agonist to use in conjunction with the previously prescribed low-dose inhaled corticosteroid. (Alternatively she could consider adding a leukotriene modifier or theophylline to the initial regimen.) However, the NP chooses to keep the patient’s inhaled corticosteroid at the same low dose and prescribes a long-acting $\beta_2$-adrenergic agonist to use along with it.

The NP in this scenario followed current guidelines. She accurately assessed asthma severity at presentation, initiated appropriate pharmacotherapy, and provided thorough patient teaching. She correctly asked the patient to return for reassessment in a month, recognized that the patient’s asthma remained poorly controlled when she returned, stepped up therapy as recommended, and reinforced patient education, which must continue at every clinical visit.

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How to Use a Peak Flow Meter

In acute asthma episodes, peak flow monitoring may be helpful in assessing response to treatment. Long-term monitoring provides useful information in determining the need for medication changes and dose adjustments. In conjunction with an asthma action plan, both uses help patients stay in the zone of effective control. A patient with well-controlled asthma (one for whom medications may be tapered) will have high peak flow measurements and minimal peak flow variability from day to day and from morning to night. Because peak flow measurements are effort- and technique-dependent, however, it’s helpful for patients to review instructions for peak flow meter use regularly, bring peak flow meters to all clinic visits, and perform return demonstrations in the presence of their health care provider.

1. Stand.
2. Be sure the peak flow meter is at zero.
3. Take as deep a breath as possible.
4. Place the meter in your mouth and wrap your lips around the mouthpiece.
5. Blow out as hard and fast as possible.
6. If you cough, spit, or block the mouthpiece with your tongue, disregard the reading.
7. Repeat the procedure two more times.
8. Record the highest reading.

REFERENCES