

## Primary Care Setting to Care Asthma

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### ABSTRACT

Chronic asthma is primarily distinguished by episodes of wheezing, coughing, and shortness of breath brought on by inflammation and hyperresponsiveness of the airways. It is one of the most prevalent chronic pulmonary illnesses in the US, affecting 20 million adults, or 8% of the adult population.<sup>1,2</sup>

As a result, primary care offices commonly meet cases of asthma. Most asthmatics are anticipated to acquire good control, and the generalist manages asthma very successfully most of the time. The epidemiology, diagnosis, and chronic and acute therapy of asthma from a primary care perspective are all summarized in this article.

**KEYWORDS:** Asthma; Review; Outpatient; Ambulatory; Treatment; Diagnosis

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### EPIDEMIOLOGY

Asthma is substantially more common in women (10.4%) than in men (6.2%), in people who live in poverty (11.8%), and in people who identify as coming from a racial or ethnic minority, particularly those of the black race (10.2%) and Puerto Rican Hispanic ancestry (14.9 percent). Geographic prevalence also varies greatly, ranging from 4.9 to 12.7% by state. Nearly half of adults with asthma report having one or more attacks in the previous year despite the availability of a variety of treatment choices, emphasizing the significance of symptom management and disease control.<sup>3</sup>

Traditionally, asthma has been seen as a condition that first affects young people. Although asthma is most frequently first identified in children, it can show clinical signs at any age. Asthma is estimated to affect 7 percent of adults over the age of 65, which is comparable to the overall prevalence. A national survey suggests that the rate of first diagnoses for those older than 65 (3.1 percent per year) is not significantly different from that for those between 18 and 34 (4.0 percent per year).<sup>4</sup> Adult-onset asthma can be brought on by a history of prematurity, early lung infections, rhinitis, smoking, and obesity.<sup>5-7</sup> Consequently, the start of a chronic cough in an older patient shouldn't deter a clinician from considering asthma.

### DIAGNOSIS

Pulmonary function testing and patient-reported symptoms must be combined for a certain diagnosis of asthma. The

elimination of diseases that mimic asthma is crucial, especially in older people who may be more prone to have other conditions because the symptoms of asthma are sometimes ambiguous and can be triggered by other disease processes. Included is a proposed diagnostic framework for asthma (Fig. 1).

### HISTORY

Wheezing, tightness in the chest, and coughing are typical signs of asthma. These symptoms can vary in severity and are frequently episodic. Changes in exposures, such as allergens, airway irritants, or respiratory illnesses, frequently correspond to variations in symptoms. Exercise-induced bronchoconstriction is a common side effect in certain people, and this might exacerbate asthma symptoms. People with unmanaged diseases could exhibit chronic symptoms while at rest. Asthma patients frequently experience concurrent rhinitis and sinusitis, and allergic rhinitis is a risk factor for incident asthma, upper airway symptoms, which are believed to be different manifestations of a common allergic pathophysiology, should be elicited.<sup>8</sup> Chest tightness is rarely the only presenting complaint and should raise suspicion for cardiac disease.<sup>9</sup>

Providers need to find out whether the patient has any exposures that make their respiratory problems worse. Specific triggers raise the likelihood that asthma is underlying.<sup>10</sup> Allergens are well-known triggers and can be

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seasonal (usually outdoor) or perennial (typically indoor). The timing and distribution of outdoor allergen exposure vary greatly across the US. Outdoor pollen from weeds, grass, and trees, which is present at different periods of the year, is the main component of most outdoor allergies. Dust mites, mice, cockroaches, mold, and pet dander are a few examples of perennial allergies. Cigarette use, exposure to secondhand smoke, allergens, perfumes or strong scents, temperature extremes, exercise, or psychosocial distress are among additional non-allergic causes. Workplace exposures can cause asthma to develop (work-induced asthma) or worsen (work-exacerbated asthma)<sup>11,12</sup>. It is crucial to ask about workplace exposures in relation to asthma diagnosis and changes in symptom severity (eg, differences in symptoms between weekdays and weekends<sup>13</sup> or during time away from work)<sup>13</sup>. Travel-related changes in respiratory symptoms are indicative of environmental sensitivity and support an asthma diagnosis.

Common asthma mimics and related symptoms are included in Table 1. Additional history assessing these conditions may be collected, depending on the patient. In particular, "cardiac asthma," wheezing caused by undiagnosed heart failure and subsequent volume overload, and chronic obstructive pulmonary disease (COPD) should be taken into consideration for the adult patient presenting with asthma like symptoms. There is also a chance that asthma and these illnesses will coexist.

### VISUAL INSPECTION

The physical examination is most helpful in determining whether any coexisting or simulating conditions exist. When a patient has asthma, a pulmonary examination is frequently unremarkable. Although it is neither sensitive nor specific for this illness, there may be expiratory wheezing. Inspiratory wheeze is unusual and could indicate another or different disease.

Similar to crackles, alternative diagnosis should be taken into account. Patients may have symptoms of postnasal drip or concomitant rhinitis. Eczema may be discovered by a skin exam.

Finally, a cardiac exam should be carried out to look for heart failure symptoms.

### DIAGNOSTIC EVALUATION

The next step is to perform spirometry before and after bronchodilator administration to evaluate for the two key criteria central to asthma diagnosis: expiratory airflow obstruction and variability in airflow limitation. This is done if the history and physical examination suggest asthma as a likely diagnosis. A diagnosis of asthma is supported by spirometry that shows both expiratory airflow blockage and complete reversal of airflow obstruction after bronchodilator treatment. Spirometry is frequently normal when asthma is adequately controlled, though, as a result of the unpredictability in symptoms and airflow restriction being a

prominent aspect of asthma. Furthermore, due to a more severe disease state at presentation or due to airway remodeling in chronically uncontrolled asthma, certain asthma patients who initially have an obstruction of the expiratory airflow may not fully recover after bronchodilator administration. These additional illnesses should be taken into account because partial reversibility is also a characteristic of COPD or asthma-COPD overlap. Spirometry is unable to reliably differentiate between asthma and COPD in such circumstances.

A ratio of the fractional exhaled volume in the first second (FEV<sub>1</sub>) to the total volume forcibly expelled (FVC) that is less than the lower limit of normal indicates the presence of airflow restriction (LLN). The LLN compensates for the anticipated reduction in FEV<sub>1</sub>/FVC that happens with aging and is preferred over adopting a set cutoff (such as 70%) because it is based on distributions from healthy normal populations. Following administration of a bronchodilator, postbronchodilator responsiveness is defined as an increase in FEV<sub>1</sub> or FVC of more than 12% and 200 mL.<sup>14</sup> These thresholds are provided by guidelines, which acknowledge that the clinical context should be taken into account when interpreting test results. For instance, despite falling short of the 12 percent and 200-mL thresholds, a patient with a 10 percent improvement in FEV<sub>1</sub> after bronchodilator and improvement in prebronchodilator FEV<sub>1</sub> after a trial of inhaled corticosteroids (ICS) would have experienced a clinically significant response that is highly consistent with an asthma diagnosis.<sup>15,16</sup>

Repeating spirometry at a different time point is crucial if spirometry is normal but there is still a clinical suspicion of asthma since at least one episode of obstruction must be documented to support the diagnosis of asthma. Serial testing with a peak flow meter can also be used to document variations in airflow limitation if they cannot be detected via reversibility on spirometry. Over a period of two weeks, the patient is instructed to record the best of three attempted peak flows twice daily (often in the morning and evening), or more frequently during times of respiratory difficulties. Variable airflow limitation can also be diagnosed by excessive fluctuation in peak flows, which is determined by a 1-week average. more than 10% when the daily average is divided by the range of measurements from highest to lowest.<sup>15</sup>

A methacholine challenge or other bronchoprovocation test for airway hyperresponsiveness has a limited specificity for asthma. This test has consequently become less used in the confirmation of asthma but retains a role in certain populations to rule out asthma due to its high negative predictive value, which has been reported to approach 100%. Airway hyperresponsiveness is present in other pulmonary conditions, including COPD, and in the normal population, where the prevalence has ranged from 4 percent to 37 percent.<sup>17</sup>

The optimal method is a staged diagnostic process that

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includes spirometry or peak flow testing to demonstrate both blockage and variable airflow limitation, unless the patient presents with severe symptoms. When individuals are on asthma drugs, it might be difficult to identify blockage caused by asthma.<sup>18,19</sup> According to a recent Canadian study, up to one-third of those with a doctor's diagnosis of asthma may not actually have it. The study's findings emphasize the importance of objective testing to support the diagnosis of asthma because these patients were less likely to have undergone formal testing for airflow limitation.<sup>20</sup>

Blood tests and radiographic examinations are typically not required throughout the diagnostic process unless there is a suspicion of a different diagnosis. Elevations in eosinophils, immunoglobulin E (IgE), or allergen-specific IgE are neither sensitive or specific for the initial diagnosis of asthma, even though they are useful in the diagnosis of allergic illness or when considering advanced therapy. Although fractional exhaled nitric oxide (FeNO) is often not required in the diagnosis of asthma, it is a sign of eosinophilic airway inflammation.

### TYPES OF ASTHMA

Cough is the primary symptom in people with cough-variant asthma.<sup>21,22</sup> It is believed that the cough is a neural response to bronchoconstriction rather than a result of mucus secretion.<sup>23</sup> These people typically do not wheeze, so the differential diagnosis must include other conditions that can cause chronic cough.

Exercise-induced asthma affects people who experience symptoms after engaging in strenuous physical activity as a result of their airways becoming overly sensitive to cold or dry air during exercise-associated hyperventilation.<sup>24</sup> These people experience typical asthma symptoms immediately following exercise and for up to an hour afterward.

Asthma that is triggered or aggravated by drugs that block cyclo-oxygenase 1, an enzyme involved in the breakdown of proinflammatory leukotrienes, is known as aspirin-exacerbated respiratory disease (AERD). The combination of asthma, aspirin sensitivity, sinus illness, and nasal polyposis is referred to as Samter's triad. Since all nonsteroidal anti-inflammatory medicines, not just aspirin, can cause a worsening of the condition, the name of the condition may be misleading. AERD is present in roughly 14% of patients with severe asthma and 7% of all asthmatics; it is often more severe and uncontrolled than other kinds of asthma.<sup>25</sup>

Despite not being an asthma variety, vocal cord dysfunction (VCD) warrants special attention because it is a common asthma mimic and may potentially be a concomitant illness. In VCD, the vocal cords paradoxically close during inspiration, resulting in wheezing and dyspnea<sup>26</sup>. Patients who experience abrupt onset wheezing that occurs mostly during inspiration, is brief in duration, and has little to no response to asthma drugs should be evaluated for VCD.

Speech therapy by a therapist skilled about VCD can be highly beneficial for persons with VCD, especially those with concurrent asthma. It's crucial to detect this illness in order to provide treatment.

### MANAGEMENT

Asthma by definition exhibits variable symptoms and airway restriction, therefore effective therapy of the condition necessitates ongoing evaluation throughout time in order to maximize disease control, treat underlying inflammation, and reduce drug side effects. Symptoms, risk of worsening, drug tolerance and adherence, and comorbidities should all be evaluated by the clinician at each appointment. Fig. For a patient with established or just diagnosed asthma, method 2 offers an unusual step-by-step approach. The majority of patients may anticipate being well controlled with excellent care.

### COMPARISON OF THE CONTROL OF ASTHMA AND THE SEVERITY OF ASTHMA

Based on lung function, the frequency of symptoms, and a history of exacerbations, the severity of the asthma may be evaluated prior to the start of medical treatment. The classification of severity as intermittent, mild persistent, moderate persistent, or severe persistent aids in directing early therapy decisions. Since it suggests that symptoms of higher severity levels cannot be intermittent, the classification of moderate intermittent is no longer advised. It is crucial to remember that asthma severity is not a static characteristic and should be reevaluated at every visit with reclassification depending on the extent of medication required to manage or relieve the condition's symptoms. Changes in asthma severity may be a sign of new environmental exposures, comorbidities, or a disease that is progressing. Asthma severity represents the intensity of the overall illness process.

A patient's asthma control, the frequency of their asthma symptoms, and any related effects should all be evaluated at every appointment. EPR-3 and GINA both recommend using four frequency questions to evaluate control over a period of two to four weeks: days with asthma symptoms, nights awake, days when asthma has limited activity, and days when a rescue inhaler was used other than before exercise.<sup>15,16</sup>

If there have been two or less days of symptoms, two or fewer days of using a rescue inhaler, and no days of nocturnal awakening or activity limitation owing to asthma over the previous two weeks, the condition is deemed well controlled. The Asthma Control Test or Asthma Control Questionnaire are two patient-completed questionnaires that evaluate asthma control. These tools can be used in clinical settings and have enhanced sensitivity to detect changes in control over time.<sup>27,28</sup>

A patient with uncontrolled asthma does not necessarily

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have severe asthma, even though both control and severity may be anticipated to alter with time.

Additionally, a number of variables, such as poor inhaler technique, obstacles to adherence, continued trigger exposure, and contributory comorbidities, may cloud assessments. All of these should be investigated in cases of subpar control. For forecasting the risk of future exacerbations, asthma management is more important than asthma severity.

### NON-MEDICAL INTERVENTIONS

Eliminating triggers is a crucial component of managing asthma. Table 2 lists typical triggers as well as responses to them. Patients are advised to stay inside and close windows during times of high pollen counts or poor outdoor air quality, respectively, if they have seasonal allergies or are sensitive to air pollution. The timing of pollen avoidance is crucially dependent on each patient's individual aeroallergen sensitization profile, which should be identified if there is a significant history of seasonal allergies and a need to refer to an allergist. The avoidance of indoor allergens, focusing on specific allergens to which the patient is exposed, is advised but challenging to implement due to challenges in attaining total allergen remediation and expense of interventions.<sup>33</sup> Secondhand smoke avoidance and smoking cessation are stressed.<sup>34,35</sup>

Treating symptomatic gastroesophageal reflux disease on the theory that acid reflux may cause bronchoconstriction is a typical strategy. The treatment of allergic rhinitis may also be tried, albeit the effect in asthma for those who are already on ICS may be minimal.<sup>36</sup> Objective evidence of efficacy in improving asthma control or severity in adults, on the other hand, is inconsistent.

Before the age of 65, adults with asthma should receive a dose of the PPSV23 vaccine.<sup>38</sup> Other than that, recommendations for adults with asthma are the same as for healthy adults.

Patients who are overweight or obese should receive advice on losing weight as part of maintaining their general health, and all patients should be urged to follow a balanced diet.

Weight loss of 10 to 15 kg has been associated with improvements in asthma control and severity, according to interventional studies.<sup>39</sup>

### PHARMACEUTICAL TREATMENT

The two main categories of pharmaceutical therapy are controller drugs and rescue medications. Guidelines for treating asthma break down medication therapy into manageable levels, with higher steps denoting more intensive controller therapy. Fig. includes a diagram of suggested drugs adapted from GINA.<sup>3</sup> The source papers provide more thorough charts with additional choices.<sup>15,16</sup>

Finally, routine prebronchodilator spirometry should be done while paying close attention to FEV1. Prebronchodilator FEV1 values below the LLN are most likely indicative of uncontrolled disease and increase the risk of a subsequent exacerbation.<sup>30,31</sup> Although adjusting asthma therapy based on sputum eosinophilia or FeNO has been linked to a decrease in exacerbations, there is not enough evidence to support doing so in clinical practice.<sup>32</sup>

### CONTROLLED SUBSTANCES

The main objectives of controller therapy are to reduce the inflammation that underlies asthma and stop the progression of permanent airway remodeling. To this goal, all patients with persistent asthma, even those with minor symptoms, are provided with controller medications. Patients should be informed that asthma is a chronic condition and that using controllers well is what causes an absence of asthma symptoms. The idea that "no symptoms, no asthma" leads to inferior outcomes is well accepted.<sup>40</sup>

The foundation of controller therapy is ICS. Oral thrush, which can be reduced by using a spacer device and cleaning the mouth after using an ICS, and dysphonia, which has been reported to be anecdotally improved by switching to a different delivery system, are examples of common adverse effects. If control is inadequate, leukotriene modifiers or long-acting beta agonists (LABA) may be added to ICS, with the former being more effective than the latter. Long-acting muscarinic antagonists, which are frequently used in COPD, do not appear to be superior to LABA as add-on therapy in asthma and are typically reserved for severe disease.<sup>43,44</sup> Importantly, there is an absolute contraindication to LABA monotherapy (i.e., without concurrent)

### RESCUING MEDICINES

All patients should have access to an albuterol rescue inhaler. When used up to four times daily, this fast-acting medicine offers prompt bronchodilation to patients with acute symptoms. Albuterol administered to an adult patient via a nebulizer, a metered-dose inhaler (MDI) without a spacer, or an MDI with a spacer is equally as effective. Patients with intermittent asthma may control their symptoms with a short-acting beta-agonist alone, whereas those with persistent asthma (i.e., use their albuterol inhaler more than twice weekly to relieve symptoms) require the addition of ICS. In practice, however, spacers and nebulizers can deliver medication more dependably.<sup>45,46</sup>

It is crucial to monitor patient adherence and inhaler technique. Videos demonstrating the proper use of an MDI and other devices are available from the US Centers for Disease Control and Prevention (CDC)<sup>49</sup> and the American Lung Association<sup>50</sup>. Verification of inhaler technique will only become more crucial as manufacturers develop increasingly specialized delivery devices. As many as two-



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thirds of patients have errors in MDI use, resulting in suboptimal medication delivery and worse asthma control.

In a similar vein, medication adherence—the percentage of prescribed doses actually taken—should also be investigated. If logistically possible, dose counters and pharmacy data are useful, unbiased sources of data on adherence. There are no consistent factors that are associated with nonadherence, aside from older age and belief in medication necessity, according to studies, which estimate average adult ICS adherence in the range of 22 percent to 63 percent.<sup>52</sup> Unfortunately, very few adherence interventions have shown improvement in asthma outcomes, highlighting the complexity of this crucial aspect of treatment.

### TREATMENT INITIATION AND MODIFICATION

Professional recommendations offer direction regarding medication initiation for the patient starting therapy based on severity assessment.<sup>15,16</sup>

Deescalation may be thought about for the patient who is well-controlled, already receiving therapy, and has been symptom-free for the past three months. The aim is to find the therapeutic "floor," allowing adequate ascertainment of disease severity, and reduce risk of adverse effects associated with unnecessarily intensive treatment. In the event that there is evidence of decreasing control, such as a decline in peak flow or an increase in symptoms, the patient should be advised to move back to the higher treatment level.

A persistent look for triggering circumstances in the uncontrolled patient who is already receiving therapy may discover environmental alterations (offering a chance for environmental counseling) or a slip in inhaler adherence (providing an opportunity to reinforce inhaler need and adherence). To restore or establish control, therapy may need to be temporarily or permanently escalated by one to two steps. A search for an alternate or overlapping diagnosis should be prompted by symptoms that worsen and don't respond to therapy escalation (see Table 1).

For technical (inability to reliably coordinate the actuation with inspiration, required for MDI) or physiological (inability to take in a rapid breath, required for dry powder inhalers) reasons, a patient may occasionally be switched to a different delivery device of the same equivalent dose of medication.

Overall, across all patients, there is no clear winner when it comes to delivery methods.

### TAKING CARE OF ONESELF AND THE ASTHMA ACTION PLAN

Self-management of asthma entails giving the patient the power to avoid triggers and change his or her treatment plan in response to alterations in symptoms or lung function.

An asthma action plan is the cornerstone of asthma self-

management. Patients are given peak flow meters, and during a period of good control, a personal best measurement for that device is established; prediction equations for peak flows do not perform well, likely because of variations in accuracy between devices and patients.<sup>54</sup> Patients check their peak flows daily or when their symptoms worsen, and depending on the value, are classified as being in the green (80 percent of personal best), yellow (50 percent -79 p.), or red (>79 p.) categories. The patient is placed in the yellow zone if they have any wheezing, coughing, or nocturnal awakenings. The patient is placed in the red zone if they have any severe symptoms, such as being unable to perform any of their regular activities or having incapacitating shortness of breath. Particularly in patients who have difficulty recognizing the progression of their symptoms, a combination of the two approaches is encouraged.

Yellow zone interventions can take a variety of forms, but they typically involve using a rescue inhaler, alerting a doctor and possibly increasing the dose of a controller medication, as well as starting an oral corticosteroid if symptoms and peak flow do not return to normal within a predetermined time frame. In the yellow zone, doubling ICS does not seem to be effective, but quadrupling

At the cost of increased dysphonia and oral thrush, use of ICS has been demonstrated to reduce risk of moving to oral corticosteroids or having an acute asthma visit by 20%.<sup>55</sup> Patients in the red zone should take their rescue inhaler right once, contact their doctor, or go to the emergency room. Doctors might think about stepping up the controller regimen in comparison to the preexacerbation regimen.

The CDC, the National Institutes of Health, and the American Lung Association all offer asthma action plan templates.<sup>56</sup> Using peak flow measurement or symptoms to guide management appears to be generally equivalent.<sup>57</sup> Self-management strategies have been shown to prevent exacerbations, decrease asthma-related health care utilization, and improve quality of life.<sup>58-60</sup>

### ALTERNATIVE THERAPIES FOR SEVERE ASTHMA

When considering more advanced therapies for severe asthma, a pulmonologist and/or an allergist-immunologist should be consulted. Additional therapeutic options may be necessary.<sup>61</sup>

With developing therapeutics under development, recent developments in biologic therapies have led to the availability of numerous novel medications for severe asthma. These drugs are often prescribed in conjunction with a subspecialist, and the indications for them are based on unique patient characteristics.

Common targets include the allergy inflammatory pathway.

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Omalizumab, an immunoglobulin antibody that targets serum IgE, interacts with mast cells, eosinophils, and basophils in the allergic cascade<sup>62</sup>. It is approved for use in people with moderate to severe asthma who have documented allergen sensitivity and whose symptoms are not controlled by inhaled corticosteroids (ICS) and is given every two to four weeks. Mepolizumab, benralizumab, and reslizumab are antibodies that target the interleukin-5 pathway, which is involved in eosinophil recruitment and activation.<sup>63-65</sup> They are given subcutaneously for mepolizumab, benralizumab, and reslizumab and intravenously for reslizumab every 4 to 8 weeks in medical settings to patients with severe asthma and persistent eosinophilia. Subcutaneous immunotherapy has been shown to lessen asthma severity, the need for systemic corticosteroids, and the need for rescue inhaler use in patients with difficult-to-control asthma and prominent allergies<sup>66</sup>. There is a small risk of anaphylaxis, but there is not enough information in the literature to comment on its magnitude and severity.

Bronchial thermoplasty (BT) is an endoscopic procedure in which radiofrequency heat energy is applied to the airways to ablate airway smooth muscle and reduce its capacity to cause bronchoconstriction.<sup>67</sup> Evidence suggests that BT reduces exacerbations, reduces asthma-related health care utilization, and improves quality of life in people with severe asthma.<sup>68</sup>

### RISK EVALUATION AND MONITORING

The likelihood of a future asthma exacerbation or unfavorable outcomes is evaluated at the end of the appointment. Major elements that are currently taken into consideration include uncontrolled disease, aberrant FEV<sub>1</sub>, unrestricted current exposure to a recognized personal trigger, and previous exacerbations necessitating hospitalization or intubation. Patients who exhibit one or more of these characteristics, including those whose therapy was modified during the current visit, should receive a short-interval follow-up, typically within two to six weeks. If therapy is being optimized and the condition is stable, patients at lower risk might have their appointments spaced out to every six months or annually. Although the ideal time between repeat lung function tests is unknown, it is generally agreed that it should be done every one to two years in patients with stable disease, paying particular attention to the development of fixed obstruction, which is a sign of chronically insufficient control.

### ACUTE ASTHMATIC EXACERBATIONS IN PATIENTS

A focused history and physical examination will easily guide care for the outpatient who presents with abrupt worsening of asthma symptoms. On the basis of history, questions should be raised regarding recent sick contacts, abrupt termination of controller therapies, and exposure to

one's own asthma triggers. The majority of acute exacerbations are brought on by viral respiratory infections, particularly rhinovirus.<sup>69</sup> The rate at which symptoms deteriorate should be recorded. Examining should assess the patient's overall respiratory health as well as any infection-related symptoms. Worrisome symptoms include hypoxemia, use of accessory muscles, inspiratory and expiratory wheezing, and absence of wheezing linked to respiratory discomfort. Serial peak flow measurements should be carried out before and after in-office albuterol if the patient can safely perform respiratory exercises and does not require immediate emergency referral. In a simple exacerbation, radiographic abnormalities are uncommon, and chest imaging is not frequently done.

The preferred method of administering albuterol appears to be 2.5-mg aliquots every 20 minutes (for nebulizers) or 3 to 5 puffs (for MDIs) every 10 minutes, up to 3 times.<sup>70</sup> Nebulizers and MDIs (with spacers) are similar when administered in the acute situation.<sup>71,72</sup> Oral corticosteroids are the basic treatment for asthma exacerbations and intervention in the underlying inflammatory response, in addition to avoiding exposure to triggers. In general, tapering is not necessary for doses of prednisone greater than 40 to 100 mg per day or longer than 5 to 10 days.<sup>73</sup> Patients may resume their green zone treatment plan if symptoms and peak flow have returned to baseline after stopping corticosteroids and the triggering factor can be avoided. If not, maintenance therapy may need to go to the next level of the treatment pyramid while waiting for a reevaluation, or in some circumstances, oral corticosteroids may be prolonged.

Despite advancements in the protocolization of asthma treatment, the decision to refer a patient to the emergency room is still made clinically, taking into account the patient's ability to manage necessary outpatient therapies as well as the patient's disease trajectory and potential future exposure to triggers. After an exacerbation, patients should be seen within two weeks to reevaluate their symptoms, lung function, and suitability for their current controller therapy.<sup>74,75</sup> Exacerbations of asthma, particularly those requiring hospitalization or emergency room care, have been linked to long-term declines in lung function, so prevention should be prioritized.

### SPECIALIST REFERRAL INDICATES

The majority of cases of asthma can be successfully managed in the primary care setting with the right training.<sup>76</sup> However, in some instances, a referral to a specialist may be necessary, particularly for patients with severe or persistently uncontrolled asthma or patients whose asthma diagnosis is ambiguous. Box 1 includes typical referral indications. Involvement of expert treatment, through either pulmonology or allergies, has been linked to better outcomes.<sup>76,77</sup>

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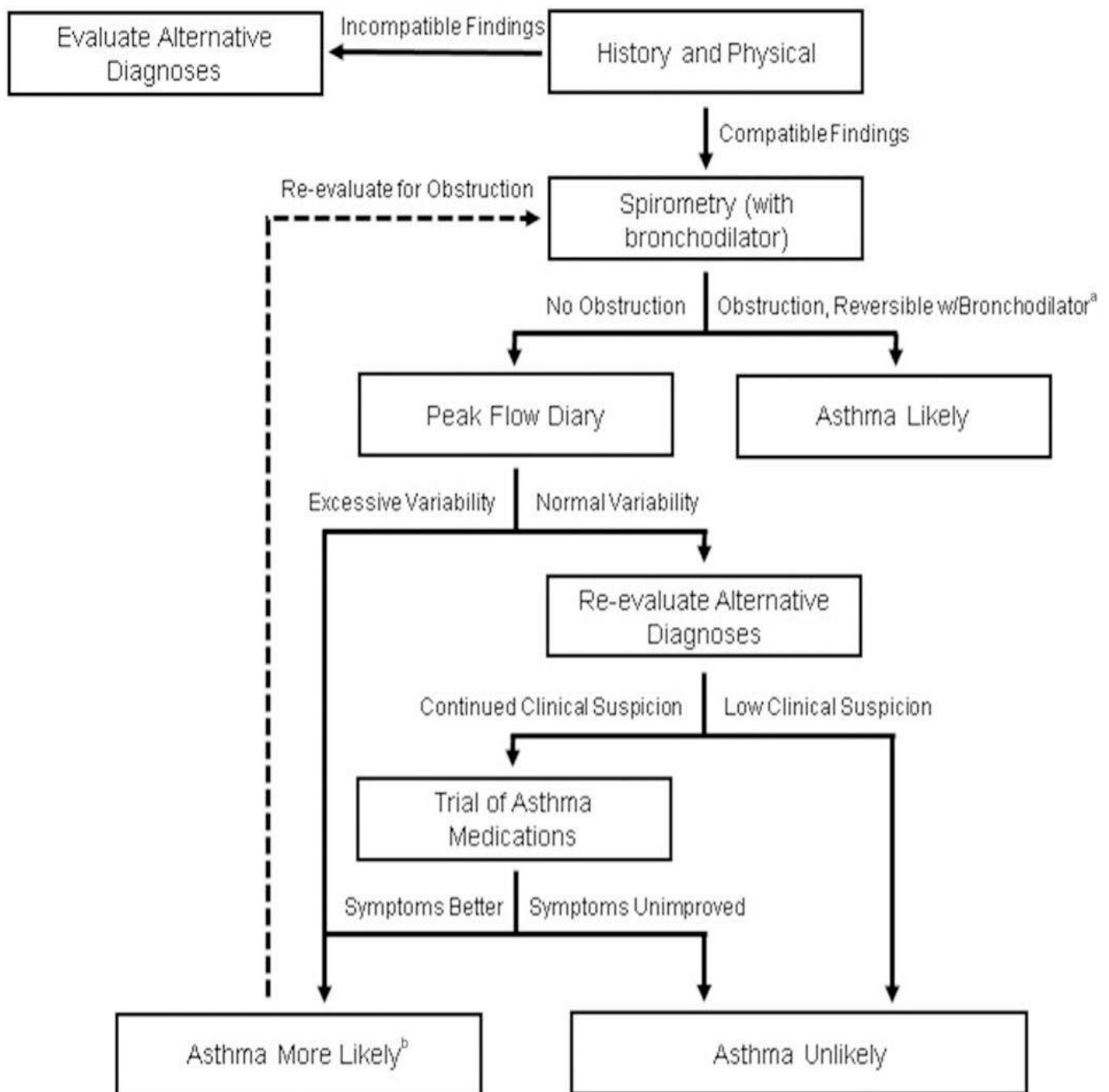
### **Common indications for specialist referral**

Alternative pulmonary diagnosis suspected  
Asthma diagnosis suspected, but confirmation elusive  
Possible occupational asthma  
Persistently uncontrolled disease  
More than 1 exacerbation in past year  
History of life-threatening exacerbation  
Difficulty with medication selection  
Difficulty managing asthma due to comorbidities  
Severe disease requiring specialized therapy

### **KEY POINTS**

- Asthma may become clinically apparent at any age, but exclusion of diseases that mimic asthma is especially important in older individuals.
- A confident diagnosis of asthma can be made with demonstration of reversible obstruction on spirometry, and the risk of misdiagnosis is higher in the absence of this objective information.
- Inhaled corticosteroids are the cornerstone of pharmacologic asthma treatment of persistent disease, with additional therapies added on the basis of inadequate disease control.
- Patients should be empowered to respond to changing symptoms through use of an asthma action plan.
- Specialist referral is indicated for individuals with severe or difficult-to-control asthma; however, most individuals with asthma are successfully managed in the primary care setting.

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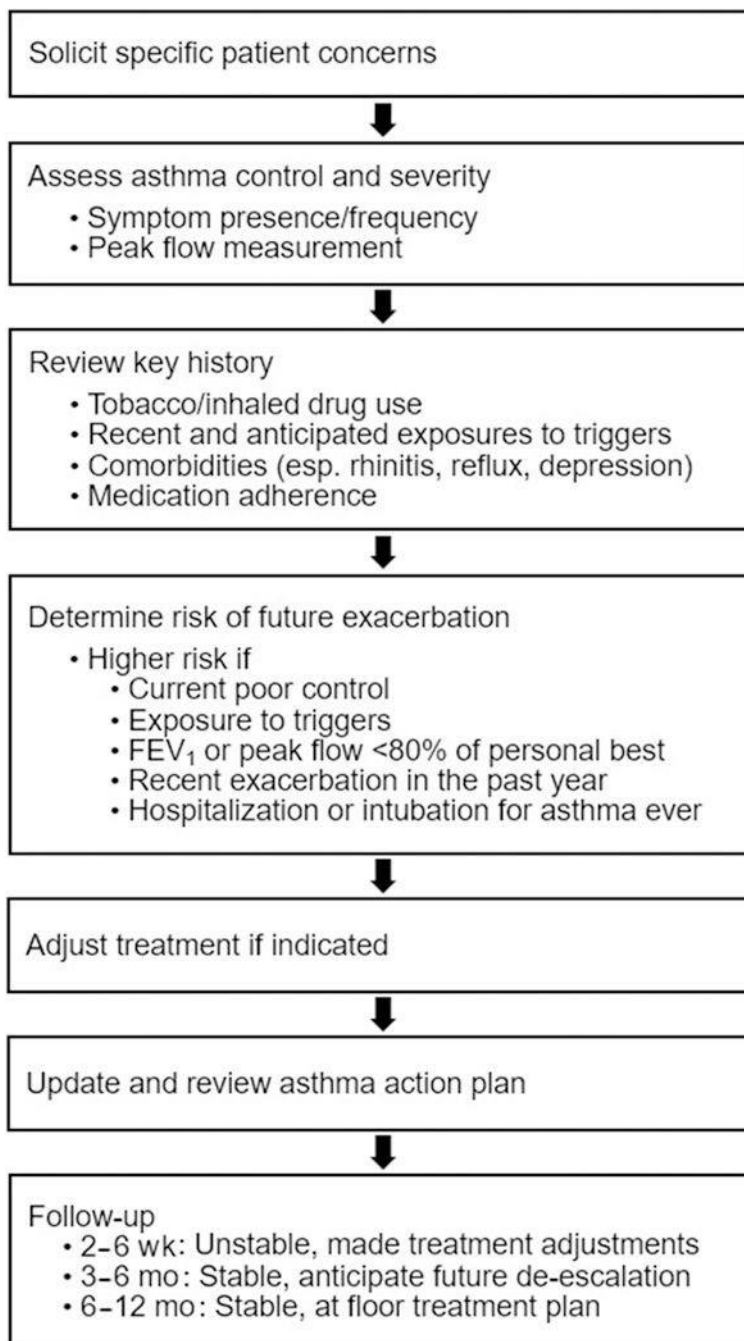
**Fig. 1.**

Iterative evaluation of a patient with suspected asthma.

<sup>a</sup>Bronchodilator responsiveness is defined as an improvement in FEV<sub>1</sub> or FVC by greater than 12% and greater than 200 mL. Patients may have improvement that does not meet this threshold and still benefit from bronchodilator therapy. Reversibility implies that spirometry improves to normal after bronchodilator. If only partially

reversible, consider possibility of COPD, asthma-COPD overlap, or severe asthma. <sup>b</sup>Probability of asthma is substantially increased with the finding of obstruction at least one time on spirometry; reevaluation should occur at regular intervals. The likelihood of identifying obstruction while already on asthma medications is lower.

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**Fig. 2.**Progression of an outpatient visit for asthma.



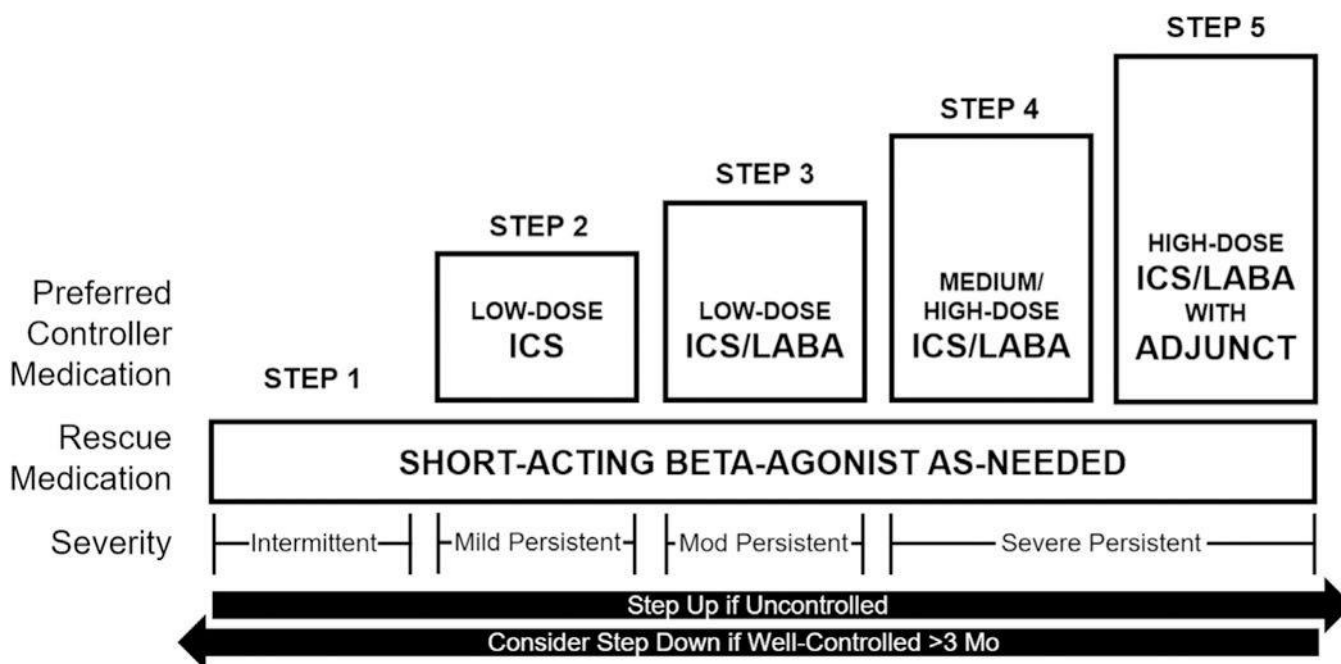


Fig. 3.

Steps of asthma pharmacologic treatment. Adjunct therapies include a long-acting muscarinic antagonist or biologic therapies in selected populations. Immune therapy may be considered for persistent asthma (steps 2–5). Leukotriene modifiers may be considered as an alternative to LABA but are generally less effective. Mod., moderate. (Adapted from Bateman ED, Hurd SS, Barnes PJ, et al. Global strategy for

asthma management and prevention: GINA executive summary. Eur Respir J 2008;31(1):157; and National Asthma Education and Prevention Program. Expert panel report 3: guidelines for the diagnosis and management of asthma. Washington (DC): US Department of Health and Human Services, National Heart, Lung, and Blood Institute; 2007. p. 343; with permission.)

**Table 1. Differential diagnoses in a patient presenting with asthmalike symptoms**

Condition	Associated Signs and Symptoms
Allergic bronchopulmonary aspergillosis	Infiltrates, mucus plugging, bronchiectasis, elevated serum total IgE, and sensitization to <i>Aspergillus</i> (either skin testing or by specific IgE)
Bronchiectasis	Productive cough, history of recurrent pulmonary infections
Carcinoid syndrome	Episodic flushing, diarrhea, emesis
COPD	History of smoking or biomass exposure (especially in those residing in rural areas), irreversible obstruction on spirometry
Congestive heart failure	Pulmonary crackles, lower extremity edema, jugular venous distension, family or personal history of cardiovascular disease
Eosinophilic bronchitis	Chronic cough, upper airway symptoms, no hyperresponsiveness
Eosinophilic granulomatosis with polyangiitis	Migratory pulmonary infiltrates, concurrent sinus disease, antineutrophil cytoplasmic antibodies
Foreign body aspiration	Localized area of wheeze, segmental atelectasis on computed tomography (CT) scan
Interstitial lung disease (ILD)	Infiltrates, reticulation, or frank fibrosis on CT scan; signs and symptoms vary with ILD type; hypersensitivity pneumonitis and cryptogenic organizing pneumonia are types of ILD with atopic association
Postnasal drip	History of rhinitis and sinusitis, but no variable airflow obstruction
Tracheal stenosis/tracheomalacia	Tracheal narrowing on CT scan, history of intubations
VCD	Sudden onset of dyspnea, prominent inspiratory wheezing, blunting of the inspiratory limb of the flow-volume loop

**Table 2. Common asthma triggers and suggested remediation strategies**

<sup>a</sup> Trigger	Strategies
Ambient air pollution	Remain indoors during poor air quality days
Certain foods	Test for food-specific allergies, avoidance
Cigarette smoke	Smoking cessation assistance, home smoking ban
Cockroaches	Sweep and vacuum regularly, use roach traps
Combustion smoke	Avoid use of wood-burning fireplaces
Dust mites	Use mattress and pillowcase covers, avoid down-filled pillows and blankets, wash bedding regularly
Emotional distress	Address comorbid depression, involve behavioral specialists
Fragrances	Avoidance
Indoor air pollution	Reduce source exposure (eg, perform maintenance to reduce NO <sub>2</sub> from appliances, such as gas stoves and gas heaters); routinely change central air filters; portable air purifiers
Molds	Address leaks, reduce home humidity
Pets	Remove or keep pets outdoors
Pollens	Remain indoors during morning through midday when specific agent is pollinating
Weather events (eg, rain, heat)	Remain indoors during weather events

<sup>a</sup>Trigger-specific strategies should only be suggested if patient is sensitive to that trigger; each patient will have different patterns of asthma triggers.