An overview of asthma management

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INTRODUCTION — This overview topic presents the components and goals of asthma management. It is applicable to both children and adults. The information herein is consistent with "The National Asthma Education and Prevention Program: Expert Panel Report 3, Guidelines for the Diagnosis and Management of Asthma – Full Report 2007" [1]. Similar guidelines have been published by the Global Initiative for Asthma (GINA) [2].

The diagnosis of asthma and more detailed management issues are reviewed elsewhere. (See "Diagnosis of asthma in adolescents and adults" and "Asthma in children younger than 12 years: Initial evaluation and diagnosis" and "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications" and "Treatment of intermittent and mild persistent asthma in adolescents and adults" and "Treatment of moderate persistent asthma in adolescents and adults".)

COMPONENTS OF ASTHMA MANAGEMENT — The successful management of patients with asthma includes four essential components:

- Routine monitoring of symptoms and lung function
- Patient education to create a partnership between clinician and patient
- Controlling environmental factors (trigger factors) and comorbid conditions that contribute to asthma severity
- Pharmacologic therapy

GOALS OF ASTHMA TREATMENT — The goals of chronic asthma management may be divided into two domains: reduction in impairment and reduction of risk [1].

Reduce impairment — Impairment refers to the intensity and frequency of asthma symptoms and the degree to which the patient is limited by these symptoms. Specific goals for reducing impairment include:

- Freedom from frequent or troublesome symptoms of asthma (cough, chest tightness, wheezing, or shortness of breath)
- Minimal need (≤2 days per week) of inhaled short acting beta agonists (SABAs) to relieve symptoms
- Few night-time awakenings (<2 nights per month) due to asthma
- Optimization of lung function
- Maintenance of normal daily activities, including work or school attendance and participation in athletics and exercise
- Satisfaction with asthma care on the part of patients and families

Reduce risk — The 2007 NAEPP guidelines introduced the concept of risk to encompass the various adverse outcomes associated with asthma and its treatment [1]. These include asthma exacerbations, suboptimal lung development (children), loss of lung function over time (adults), and adverse effects from asthma medications. Proper asthma

management attempts to minimize the patient's likelihood of experiencing these outcomes. Specific goals for reducing risk include:

- Prevention of recurrent exacerbations and need for emergency department or hospital care
- Prevention of reduced lung growth in children, and loss of lung function in adults
- Optimization of pharmacotherapy with minimal or no adverse effects

MONITORING PATIENTS WITH ASTHMA — Currently, the majority of medical visits for asthma are for urgent care. Effective asthma management, however, requires a proactive, preventative approach, similar to the treatment of hypertension or diabetes. Routine follow-up visits for patients with active asthma are recommended, at a frequency of every one to six months, depending upon the severity of asthma. These visits should be used to assess multiple aspects of the patient's asthma [3]. The aspects of the patient's asthma that should be assessed at each visit include the following: signs and symptoms, pulmonary function, quality of life, exacerbations, adherence with treatment, medication side effects, and patient satisfaction with care.

Well-controlled asthma is characterized by daytime symptoms no more than twice per week and nighttime symptoms no more than twice per month. SABAs for relief of asthma symptoms should be needed less often than twice weekly, and there should be no interference with normal activity (preventative use of a SABA, such as prior to exercise, is acceptable even if used in this way on a daily basis). Peak flow should remain normal or near-normal. Oral glucocorticoid courses and/or urgent care visits should be needed no more than once per year [4]. Assessment of control in patients of different ages is summarized in the tables (table 1A-C).

Symptom assessment — Symptoms over the past two to four weeks should be assessed at each visit. Assessment should address daytime symptoms, nighttime symptoms, use of short acting inhaled beta agonists to relieve symptoms, and difficulty in performing normal activities and exercise. Several quick and validated questionnaires, like the Asthma Control Test, have been published (form 1 and figure 1) [5-15].

Assessment of impairment — The following questions are representative of those used in validated questionnaires to assess asthma control:

- Has your asthma awakened you at night or in the early morning?
- How often have you been needing to use your quick-acting relief medication to relieve symptoms of cough, shortness of breath, or chest tightness?
- Have you needed any unscheduled care for your asthma, including calling in, an office visit, or an emergency department visit?
- Have you been able to participate in school/work and recreational activities as desired?
- If you are measuring your peak flow, has it been lower than your personal best? Home monitoring of peak flow measurements is reviewed in detail separately. (See "Peak expiratory flow rate monitoring in asthma".)
- Have you had any side effects from your asthma medications?

Assessment of risk — The following questions address the most important risk factors for future exacerbations [1]. A discussion of the risk factors for fatal and near-fatal asthma is provided separately. (See "Identifying patients at risk for fatal asthma", section on 'Identifying high-risk patients'.)

- Have you taken oral glucocorticoids ("steroids") for your asthma in the past year?
- Have you been hospitalized for your asthma? If yes, how many times have you been hospitalized in the past year?
- Have you been admitted to the intensive care unit or been intubated because of your asthma? If yes, did this occur

within the past five years?

- Do you currently smoke cigarettes?
- Have you ever noticed an increase in asthma symptoms after taking aspirin or a nonsteroidal antiinflammatory agent (NSAID)?

Monitoring pulmonary function — Peak expiratory flow rate (PEFR) (performed in the office and/or at home) and spirometry (performed in the office) are the two most commonly employed modalities for monitoring pulmonary function in children older than five years of age and in adults. The 2007 NAEPP guidelines state a preference for use of spirometry in medical offices, when available [1]. Children older than five years of age are usually able to perform the peak flow or spirometric maneuver.

Office monitoring — Measurement of PEFR can be a useful indicator of airflow obstruction, the hallmark finding of asthma. PEFR can be measured with handheld peak flow meters in settings not equipped with a spirometer. Average normal values for men, women, and children are listed in the tables (table 2A-C). Adolescents have values closer to children than to adults [1].

It is important to understand the limitations of PEFR. A reduced peak flow is not synonymous with airway obstruction; spirometry is needed to distinguish conclusively an obstructive from restrictive abnormality [16]. Also, the accuracy of a single peak flow measurement to detect the presence of airflow obstruction is limited, given the large variability of PEFR among healthy individuals of the same age, height, and gender (±20 percent) [17-19]. Nonetheless, repeated measurements of PEFR in an individual patient are useful for determining relative changes or trends in asthma control [17,20-24]. PEFR monitoring is best used in patients in whom the diagnosis of asthma has been previously established with a more complete evaluation. The use of PEFR monitoring and its limitations are presented in more detail elsewhere. (See "Peak expiratory flow rate monitoring in asthma".)

Spirometry, which additionally measures forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC), can be used to document airflow obstruction (by demonstration of a reduced FEV_1/FVC ratio) and provides additional information that is useful in monitoring asthma, such as risk for exacerbations [16,25]. Spirometry has greater sensitivity for detecting airflow obstruction in the presence of a normal peak expiratory flow. As mentioned previously, the 2007 NAEPP guidelines recommend the use of spirometry in practices that are regularly caring for patients with asthma. (See "Office spirometry".)

Home monitoring — Home monitoring of the peak expiratory flow rate (PEFR) may be helpful in patients with moderate to severe asthma. It is also useful in patients who poorly perceive limitations in airflow. These individuals cannot be easily identified at the outset of care, although over time they display a lack of awareness of increasing impairment, and typically seek care for exacerbations only after symptoms have become severe [26,27].

Peak flow meters for individual use are widely available, inexpensive (approximately $20), and easy to use. However, the resulting measurements are highly dependent upon the patient's technique. It is therefore important that the clinician periodically checks the patient's use of the meter, and corrects any mistakes in technique. Instructions for patients are provided. (See "Patient information: How to use a peak flow meter (Beyond the Basics)".)

The patient should be instructed in how to establish a baseline measure of peak flow when feeling entirely well: the "personal best" peak flow value. The personal best PEFR is then used to determine the normal PEFR range, which is between 80 and 100 percent of the patient's personal best. Readings below this normal range indicate airway narrowing, a change that may occur before symptoms are perceived by the patient. (See 'Asthma action plan' below.)

Novel forms of monitoring — Measurements of lung function such as peak flow and spirometry assess asthma control based on airway diameter. However, it would also be desirable to measure airway inflammation directly. Quantitative analysis of expectorated sputum for eosinophilia and concentration of nitric oxide in exhaled breath are two modalities

currently being explored for this purpose. Studies have reached conflicting conclusions about whether regularly measuring these markers could help optimize asthma management. Neither technique is currently in routine use outside of investigational settings. The use of expectorated sputum eosinophilia and exhaled nitric oxide analysis in the management of asthma are discussed in more detail separately. (See "Evaluation of severe asthma in adolescents and adults", section on 'Airway inflammation' and "Exhaled nitric oxide analysis and applications".)

PATIENT EDUCATION — Clinicians should enable patients to become active partners in managing their asthma. Ideally, this would occur through direct education in the office, as well as adjunctive education through other members of the health care team, emergency department providers, pharmacists, and organized programs [3]. The effectiveness of direct one-on-one education by the primary clinician, in particular, is well supported by evidence [1].

Patient education decreases hospitalizations due to asthma, improves daily function, and improves patient satisfaction [28-30]. A well-informed and motivated patient can assume a large measure of control over his or her asthma care.

Patients must learn how to monitor their symptoms and pulmonary function; they must understand what triggers their asthma attacks and how to avoid or decrease exposure to these triggers; and they must understand what medicine to take and how to use inhalers properly (table 3 and table 4 and table 5 and table 6). If they have difficulty taking the medications regularly, they need help devising methods to improve compliance. The specific information that should be conveyed to the patient is reviewed in detail separately. (See "What do patients need to know about their asthma?".)

Asthma action plan — The patient's normal PEFR value can be used to construct a personalized "asthma action plan" (form 2). Symptom-based plans appear to be equally effective. The asthma action plan provides specific directions for daily management and for adjusting medications in response to increasing symptoms or decreasing PEFR. Instructions and forms for asthma action plans are presented elsewhere. (See "What do patients need to know about their asthma?".)

CONTROLLING TRIGGERS AND CONTRIBUTING CONDITIONS — The identification and avoidance of asthma "triggers" is a critical component of successful asthma management, and successful avoidance or remediation may reduce the patient's need for medications. Directed questions can identify specific triggers and contributing conditions (table 7).

Adults should be questioned about symptoms not only in the home, but also in the workplace, as asthma can be exacerbated by both irritant and allergen exposures in occupational settings. Patterns of symptoms that suggest occupational triggers are presented in the table (table 8) [1]. (See "Occupational asthma: Definitions, epidemiology, causes, and risk factors".)

Some triggers are mostly unavoidable, such as upper respiratory tract illnesses, physical exertion, hormonal fluctuations, and extreme emotion, and patients should be taught to adjust their management accordingly.

Other triggers, however, should be identified and specifically addressed or treated [5,31]:

- Inhaled allergens – The patient should be questioned about symptoms triggered by common inhaled allergens, at home, daycare, school, or work (table 7 and table 8). Indoor allergens, such as dust mites, animal danders, molds, mice, and cockroaches, are of particular importance. Food allergy rarely causes isolated asthma symptoms, although wheezing and cough can be symptoms of food-induced anaphylaxis.

  If the history suggests the patient has allergic triggers, basic avoidance measures can be advised, and evaluation by an allergy specialist should be considered. The assessment and management of allergen exposure in patients with asthma are reviewed in detail separately. (See "Allergen avoidance in the treatment of asthma and allergic rhinitis".)

- Respiratory irritants – Inhaled irritants include tobacco smoke, wood smoke from stoves or fireplaces, strong

perfumes and odors, chlorine-based cleaning products, and air pollutants. Patients should be cognizant of avoiding irritants, and avoid exertion outdoors on days when levels of air pollution are elevated. (See "Trigger control to enhance asthma management".)

Smoking cessation and avoidance of environmental tobacco smoke are reviewed in detail elsewhere. (See "Control of secondhand smoke exposure" and "Secondhand smoke exposure: Effects in adults" and "Secondhand smoke exposure: Effects in children" and "Overview of smoking cessation management in adults".)

- Comorbid conditions – Clinicians should be vigilant for comorbid conditions in patients with poorly-controlled asthma. In adults, these conditions include chronic obstructive pulmonary disease/emphysema (COPD), allergic bronchopulmonary aspergillosis, gastroesophageal reflux, obesity, obstructive sleep apnea, rhinitis/sinusitis, vocal cord dysfunction, and depression/chronic stress. These conditions are reviewed separately. (See "Allergic bronchopulmonary aspergillosis" and "Gastroesophageal reflux and asthma" and "Clinical presentation and diagnosis of obstructive sleep apnea in adults" and "An overview of rhinitis" and "Chronic rhinosinusitis: Clinical manifestations, pathophysiology, and diagnosis".)

  In young children, potential alternative or comorbid conditions include respiratory syncytial virus infection, foreign body aspiration, bronchopulmonary dysplasia, cystic fibrosis, and obesity [1].

- Medications – Non-selective beta-blockers can trigger severe asthmatic attacks, even in the minuscule amounts that are absorbed systemically from topical ophthalmic solutions. Selective beta-1 blockers can also aggravate asthma in some patients, especially at higher doses. (See "Treatment of hypertension in asthma and COPD".)

  Aspirin and non-steroidal anti-inflammatory drugs can trigger asthma symptoms in approximately 3 to 5 percent of adult asthmatic patients. The incidence of aspirin-exacerbated respiratory disease is higher among asthmatic patients with nasal polyposis (constituting "triad asthma" or Samter's triad). Aspirin-sensitive asthma is uncommon in children. (See "Aspirin-exacerbated respiratory disease".)

- Complications of influenza – Annual administration of influenza vaccine is recommended for patients with asthma because they are particularly at risk for complications of influenza infection. However, vaccination does not reduce the number or severity of asthma exacerbations during the influenza season, and providers should ensure that patients understand this distinction. Indications for vaccination against influenza are reviewed separately. (See "Seasonal influenza vaccination in adults" and "Seasonal influenza in children: Prevention with vaccines", section on 'Indications'.)

- Complications of pneumococcal infection – Administration of pneumococcal vaccination is recommended for adults whose asthma is severe enough to require controller medication and for children with asthma who require chronic oral glucocorticoid therapy (table 9 and table 10) [32]. (See "Pneumococcal (Streptococcus pneumoniae) conjugate vaccines in children", section on 'Indications' and "Pneumococcal (Streptococcus pneumoniae) polysaccharide vaccines in children", section on 'Indications' and "Pneumococcal vaccination in adults", section on 'Indications'.)

- Dietary sulfites – Sulfite compounds are used in the food industry to prevent discoloration. As many as 5 percent of patients with asthma may note significant and reproducible exacerbations following ingestion of sulfite-treated foods and beverages, such as beer, wine, processed potatoes, dried fruit, sauerkraut, or shrimp.

PHARMACOLOGIC TREATMENT — Pharmacologic treatment is the mainstay of management in most patients with asthma [33]. The 2007 National Asthma Education and Prevention Program (NAEPP) Expert Panel Report presented a stepwise approach to pharmacologic therapy, which is reflected in this review [1]. These guidelines were intended to support, rather than dictate, care that is based upon the clinician's clinical judgment.

The stepwise approach to pharmacotherapy is based on increasing medications until asthma is controlled, and decreasing medications when possible to minimize side effects. The patient's management should be adjusted, if needed, at every visit.

The first step in determining appropriate therapy for patients who are not already on a controller medication is classifying the severity of the patient's asthma. For patients already taking one or more controller medications, treatment options are guided by an assessment of asthma control rather than asthma severity.

Categories of asthma severity — Asthma severity is determined by considering the following factors [1]:

- Reported symptoms over the previous two to four weeks
- Current level of lung function (FEV_1 and FEV_1/FVC values)
- Number of exacerbations requiring oral glucocorticoids per year

The use of these three elements to determine severity in adolescents over the age of 12 years and in adults is graphically presented in the figure (table 11).

The classification of severity in children aged 5 to 11 years is similar to that in adults (table 12). Severity in children under the age of four years, however, is classified somewhat differently (table 13). Initiating long-term controller medications in children under the age of 12 years is reviewed separately. (See "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications".)

Intermittent — Intermittent asthma is characterized by the following (table 11). The criteria for adolescents and adults are utilized in this discussion [1]:

- Daytime asthma symptoms occurring two or fewer days per week
- Two or fewer nocturnal awakenings per month
- Use of short-acting beta agonists to relieve symptoms fewer than two times a week
- No interference with normal activities between exacerbations
- FEV_1 measurements between exacerbations that are consistently within the normal range (ie, ≥80 percent of predicted normal)
- FEV_1/FVC ratio between exacerbations that is normal (based on age-adjusted values)
- One or no exacerbations requiring oral glucocorticoids per year

If any of the features of a patient's asthma is more severe than those listed here, their asthma should be categorized as having persistent asthma, with its severity based on the most severe element. Patients experiencing two or more exacerbations of asthma requiring oral glucocorticoids in the past year are considered to have persistent asthma.

In addition, a person using a SABA to prevent exercise-induced asthmatic symptoms might fit into this category of intermittent asthma even if exercising more than twice per week. Others in whom asthmatic symptoms arise only under certain infrequently occurring circumstances (eg, upon encountering a cat or during viral respiratory tract infections) are also considered to have intermittent asthma. (See "Exercise-induced bronchoconstriction".)

Equivalent schema for classifying asthma in children 0 to 4 years and 5 to 11 years are provided (table 13 and table 12).

Mild persistent — Mild persistent asthma is characterized by the following (table 11):

- Symptoms more than twice weekly (although less than daily)
- Approximately three to four nocturnal awakenings per month due to asthma (but fewer than every week)
- Use of short-acting beta agonists to relieve symptoms more than two times a week (but not daily)
- Minor interference with normal activities

- FEV_1 measurements within normal range (≥80 percent of predicted normal) and normal FEV_1/FVC ratio (based on age-adjusted values)
- Two or more exacerbations requiring oral glucocorticoids per year

If any of the features of a patient's asthma is more severe than those listed here, their asthma should be categorized according to the most severe element.

Equivalent figures for asthma in children 0 to 4 years and 5 to 11 years are provided (table 13 and table 12).

Moderate persistent — The presence of any of the following is considered an indication of moderate disease severity (table 11):

- Daily symptoms of asthma
- Nocturnal awakenings more than once per week
- Daily need for short-acting beta agonists for symptom relief
- Some limitation in normal activity
- FEV_1 between 60 and 80 percent of predicted and FEV_1/FVC below normal (based on age-adjusted values)

Equivalent figures for asthma in children 0 to 4 years and 5 to 11 years are provided (table 13 and table 12).

Severe persistent — Patients with severe persistent asthma experience one or more of the following (table 11):

- Symptoms of asthma throughout the day
- Nocturnal awakenings nightly
- Need for short-acting beta agonists for symptom relief several times per day
- Extreme limitation in normal activity
- FEV_1 <60 percent of predicted and FEV_1/FVC below normal (based on age-adjusted values)

Equivalent figures for asthma in children 0 to 4 years and 5 to 11 years are provided (table 13 and table 12).

Initiating therapy during an acute exacerbation — Patients with acute exacerbations of asthma often require systemic glucocorticoids. Treatment of asthma exacerbations is reviewed separately. (See "Treatment of acute exacerbations of asthma in adults" and "Acute asthma exacerbations in children: Emergency department management".)

Initiating therapy in previously untreated patients — The initiation of asthma therapy in a stable patient who is not already receiving medications is based upon the severity of the individual's asthma.

Initiating long-term controller medications in young children is reviewed separately. (See "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications".)

Intermittent (Step 1) — Patients with mild intermittent asthma are best treated with a quick-acting inhaled beta-2-selective adrenergic agonist, taken as needed for relief of symptoms (figure 2 and figure 3 and figure 4) [34-36]. Patients for whom triggering of asthmatic symptoms can be predicted (eg, exercise-induced bronchoconstriction) are encouraged to use their inhaled beta agonist approximately 10 minutes prior to exposure in order to prevent the onset of symptoms. (See "Beta agonists in asthma: Acute administration and prophylactic use" and "Exercise-induced bronchoconstriction".)

The pharmacologic management of mild intermittent asthma is discussed in more detail separately. (See "Treatment of intermittent and mild persistent asthma in adolescents and adults" and "Asthma in children younger than 12 years: Rescue treatment for acute symptoms".)

Mild persistent (Step 2) — The distinction between intermittent and mild persistent asthma is important, because current guidelines for mild persistent asthma call for initiation of daily long-term controller medication. For mild persistent

asthma, the preferred long-term controller is a low dose inhaled glucocorticoid (GC) (figure 2 and figure 3 and figure 4). Regular use of inhaled glucocorticoids reduces the frequency of symptoms (and the need for SABAs for symptom relief), improves the overall quality of life, and decreases the risk of serious exacerbations [37-39]. Regular use of inhaled glucocorticoids has not been shown to prevent progressive loss of lung function over time.

Alternative strategies for treatment of mild persistent asthma include leukotriene receptor antagonists, theophylline, and cromoglycates (figure 2). Among these alternatives, we favor the leukotriene blockers. Patients receiving long-term controller therapy should continue to use their short-acting beta agonist as needed for relief of symptoms and prior to exposure to known triggers of their symptoms.

The pharmacologic management of mild persistent asthma is presented in greater detail elsewhere. (See "Treatment of intermittent and mild persistent asthma in adolescents and adults" and "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications".)

Moderate persistent (Step 3) — For moderate persistent asthma, the preferred therapies are either low-doses of an inhaled glucocorticoid plus a long-acting inhaled beta agonist, or medium doses of an inhaled glucocorticoid (figure 2 and figure 3 and figure 4). The former combination has proven more effective in controlling asthmatic symptoms than an increased dose of inhaled GCs, although it entails the potential risk of adverse outcomes that have been reported in association with long-acting inhaled beta agonists [40,41]. (See "Beta agonists in asthma: Controversy regarding chronic use", section on 'Long-acting beta-agonists'.)

Alternative strategies include adding a leukotriene modifier (leukotriene receptor antagonist or lipoxygenase inhibitor) or theophylline to low-dose inhaled GCs. The pharmacologic management of moderate asthma is presented in more detail elsewhere. (See "Treatment of moderate persistent asthma in adolescents and adults".)

Severe persistent (Step 4 or 5) — For severe persistent asthma, the preferred treatments are medium (Step 4) or high (Step 5) doses of an inhaled glucocorticoid, in combination with a long-acting inhaled beta-agonist (figure 2 and figure 3 and figure 4).

In addition, for patients who are inadequately controlled on high-dose inhaled GCs and LABAs, the anti-IgE therapy omalizumab may be considered if there is objective evidence of sensitivity to a perennial allergen (by allergy skin tests or in vitro measurements of allergen-specific IgE) and if the serum IgE level is within the established target range. (See "Anti-IgE therapy".)

Step 6 therapy for the management of severe asthma involves the addition of oral glucocorticoids on a daily or alternate-day basis. Severe asthma is reviewed in more detail elsewhere. (See "Treatment of severe asthma in adolescents and adults".)

Assessing control to adjust therapy — Assessment of asthma control rather than severity is used to adjust therapy in returning patients, or in patients being evaluated for the first time who are already taking a long-term controller medication. Control is assessed based on impairment over the past two to four weeks (as determined by history or a validated questionnaire), current FEV_1 or peak flow, and estimates of risk (table 14) [1,42]. Adjusting therapy in children younger than 12 years is reviewed in more detail separately. (See 'Monitoring patients with asthma' above and "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications".)

Using the information gathered, the clinician should determine whether the patient's asthma is well-controlled or not. If the asthma is not well-controlled, therapy should be "stepped-up." If the asthma is well-controlled, therapy can be continued or possibly "stepped-down" to minimize medication side effects. Therapy should be reassessed at each visit, because asthma is an inherently variable condition, and the management of asthma is a dynamic process that changes in accordance with the patient's needs over time.

EFFICACY OF ASTHMA MANAGEMENT — A prospective, randomized trial applied the management

recommendations of previous NAEPP guidelines to approximately 1500 patients with all severities of asthma over the course of one year [43]. Guideline-based management resulted in significant improvement in health-related quality of life in most patients, regardless of disease severity. In this study, subjects who required inhaled GCs were randomly assigned to receive either fluticasone propionate (FP) alone or the combination of fluticasone propionate and salmeterol (FP + S). Subjects were evaluated every three months and medications were stepped up as needed (although the protocol did not allow for stepping down of therapy). With both treatments, the majority of patients achieved well-controlled or totally-controlled asthma; control was slightly better with FP + S. The greatest improvements occurred in the first few months of therapy. This study validated a stepwise approach to asthma management as effective in reducing symptoms and improving health-related quality of life. The current guidelines have expanded upon this same basic approach [1,2].

WHEN TO REFER — Both pulmonologists and allergists/immunologists have specialty training in asthma care. Referral for consultation or comanagement is recommended when any of the following circumstances arise [1]:

- The patient has experienced a life-threatening asthma exacerbation
- The patient has required hospitalization or more than two bursts of oral corticosteroids in a year
- The adult and pediatric patient older than five years requires step 4 care or higher or a child under five requires step 3 care or higher
- Asthma is not controlled after three to six months of active therapy and appropriate monitoring
- The patient appears unresponsive to therapy
- The diagnosis of asthma is uncertain
- Other conditions are present which complicate management (nasal polyposis, chronic sinusitis, severe rhinitis, allergic bronchopulmonary aspergillosis, COPD, vocal cord dysfunction, etc)
- Additional diagnostic tests are needed (skin testing for allergies, bronchoscopy, complete pulmonary function tests)
- Patient may be a candidate for allergen immunotherapy (see "Subcutaneous immunotherapy for allergic disease: Indications and efficacy")

Other possible indications for referral include [1]:

- The adult and pediatric patient older than five years who requires step 3 care or higher or a child under five who requires step 2 care or higher
- There appear to be occupational triggers
- Patients in whom psychosocial or psychiatric problems are interfering with asthma management and in whom referral to other appropriate specialists may be required

INFORMATION FOR PATIENTS — UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient information: How to use your child's dry powder inhaler (The Basics)" and "Patient information: Asthma in children (The Basics)" and "Patient information: How to use your child's metered dose inhaler (The Basics)" and "Patient information: Asthma and pregnancy (The Basics)" and "Patient information: How

to use your dry powder inhaler (adults) (The Basics)" and "Patient information: How to use your metered dose inhaler (adults) (The Basics)" and "Patient information: Asthma in adults (The Basics)" and "Patient information: Avoiding asthma triggers (The Basics)" and "Patient information: Medicines for asthma (The Basics)" and "Patient information: Reducing the costs of medicines (The Basics)")

- Beyond the Basics topics (see "Patient information: Asthma inhaler techniques in children (Beyond the Basics)" and "Patient information: Asthma treatment in children (Beyond the Basics)" and "Patient information: Asthma and pregnancy (Beyond the Basics)" and "Patient information: Asthma symptoms and diagnosis in children (Beyond the Basics)" and "Patient information: How to use a peak flow meter (Beyond the Basics)" and "Patient information: Asthma inhaler techniques in adults (Beyond the Basics)" and "Patient information: Asthma treatment in adolescents and adults (Beyond the Basics)" and "Patient information: Exercise-induced asthma (Beyond the Basics)" and "Patient information: Trigger avoidance in asthma (Beyond the Basics)" and "Patient information: Reducing the costs of medicines (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- The four essential components of asthma management are: routine monitoring of symptoms and lung function, patient education, control of trigger factors and amelioration of comorbid conditions, and pharmacologic therapy (See 'Components of asthma management' above.)
- The goals of asthma treatment are to reduce impairment from symptoms, minimize risk of the various adverse outcomes associated with asthma (eg, hospitalizations, loss of lung function), and minimize adverse effects from asthma medications. (See 'Goals of asthma treatment' above.)
- Effective asthma management requires a preventative approach, with regularly scheduled visits during which symptoms are assessed, pulmonary function is monitored, medications are adjusted, and ongoing education is performed. (See 'Monitoring patients with asthma' above.)
- Patients should learn to monitor asthma control at home (eg, frequency and severity of dyspnea, cough, chest tightness, and albuterol use). Patients with moderate to severe asthma and those with poor perception of increasing asthma symptoms may also benefit from assessment of their peak expiratory flow rate at home. A personalized asthma action plan should be provided with detailed instructions on how to adjust asthma medications based upon changes in symptoms and/or lung function (form 2). (See 'Patient education' above.)
- Environmental triggers and co-existing conditions that interfere with asthma management should be identified and addressed for each patient. (See 'Controlling triggers and contributing conditions' above.)
- Pharmacologic therapy varies according to asthma severity and asthma control. Asthma control can be judged, irrespective of medication use, based on the current level of symptoms, FEV_1 or PEFR values, and number of exacerbations requiring oral glucocorticoids per year (table 11 and table 12 and table 13). (See 'Categories of asthma severity' above and "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications".)
- A stepwise approach to therapy is recommended, in which the dose of medication, the number of medications, and/or the frequency of administration are increased as necessary and decreased when possible (figure 2 and figure 3 and figure 4). (See 'Initiating therapy in previously untreated patients' above.)
- At each return visit, the patient's asthma control is evaluated (table 14). If the asthma is not well-controlled, therapy should be "stepped-up." If the asthma is well-controlled, therapy can be continued or possibly "stepped-down" to minimize medication side effects. (See 'Assessing control to adjust therapy' above and "Asthma in children younger than 12 years: Treatment of persistent asthma with controller medications".)

- Guidelines for when to refer a patient to a pulmonologist or an allergist/immunologist are provided. (See 'When to refer' above.)

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Topic 547 Version 31.0

GRAPHICS

Assessing asthma control in children 0-4 years of age

Components of control		Classification of asthma control (children 0-4 years of age)		
		Well-controlled	**Not-well controlled**	**Very poorly controlled**
Impairment	Symptoms	≤2 days/week	>2 days/week	Throughout the day
	Nighttime awakenings	1x/month	>1x/month	>1x/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week	Several times per day
Risk	**Exacerbations requiring oral systemic corticosteroids**	**0-1/year**	**2-3/year**	**>3/year**
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		

The level of control is based on the most severe impairment or risk category. Assess impairment domain by caregiver's recall of previous 2-4 weeks. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether the patient's asthma is better or worse since the last visit. At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma control. In general, more frequent and intense exacerbations (eg, requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate poorer disease control. For treatment purposes, patients who had ≥2 exacerbations requiring oral systemic corticosteroids in the past year may be considered the same as patients who have not-well-controlled asthma, even in the absence of impairment levels consistent with persistent asthma.

EIB: exercise-induced bronchospasm; ICU: intensive care unit.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 52149 Version 1.0

Assessing asthma control in children 5 to 11 years of age

Components of control		Classification of asthma control (children 5 to 11 years of age)		
		Well controlled	**Not well controlled**	**Very poorly controlled**
Impairment	Symptoms	≤2 days/week, but not more than once on each day	>2 days/week or multiple times on ≤2 days/week	Throughout the day
	Nighttime awakenings	≤1 time/month	≥2 times/month	≥2 times/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week	Several times per day
	Lung function			
	FEV_1 or peak flow	>80 percent predicted/personal best	60 to 80 percent predicted/personal best	<60 percent predicted/personal best
	FEV_1/FVC	>80 percent	75 to 80 percent	<75 percent
Risk	**Exacerbations requiring oral systemic glucocorticoids**	**0 to 1/year**	**≥2/year (see footnote)**	
		Consider severity and interval since last exacerbation		
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		

The level of control is based on the most severe impairment or risk category. Assess impairment domain by patient's/caregiver's recall of previous two to four weeks and by spirometry/or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether the patient's asthma is better or worse since the last visit. At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma control. In general, more frequent and intense exacerbations (eg, requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate poorer disease control. For treatment purposes, patients who had ≥2 exacerbations requiring oral systemic glucocorticoids in the past year may be considered the same as patients who have not well-controlled asthma, even in the absence of impairment levels consistent with not well-controlled asthma.

EIB: exercise-induced bronchospasm; FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity; ICU: intensive care unit.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 73634 Version 2.0

Assessing asthma control in youths greater than or equal to 12 years of age and adults

Components of control		Classification of asthma control (youths ≥12 years of age and adults)		
		Well controlled	**Not well controlled**	**Very poorly controlled**
Impairment	Symptoms	≤2 days/week	>2 days/week	Throughout the day
	Nighttime awakenings	≤2x/month	1 to 3x/week	≥4x/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week	Several times per day
	FEV_1 or peak flow	>80 percent predicted/personal best	60 to 80 percent predicted/personal best	<60 percent predicted/personal best
	Validated questionnaires			
	ATAQ	0	1 to 2	3 to 4
	ACQ	≤0.75*	≥1.5	N/A
	ACT	≥20	16 to 19	≤15
Risk	**Exacerbations**	**0 to 1/year**	**≥2/year (see footnote)**	
		Consider severity and interval since last exacerbation		
	Progressive loss of lung function	Evaluation requires long-term follow-up care		
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		

The level of control is based on the most severe impairment or risk category. Assess impairment domain by patient's recall of previous two to four weeks and by spirometry/or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether the patient's asthma is better or worse since the last visit. At present, there are inadequate data to correspond frequencies of exacerbations with different levels of asthma control. In general, more frequent and intense exacerbations (eg, requiring urgent, unscheduled care,

hospitalization, or ICU admission) indicate poorer disease control. For treatment purposes, patients who had ≥2 exacerbations requiring oral systemic corticosteroids in the past year may be considered the same as patients who have not-well-controlled asthma, even in the absence of impairment levels consistent with not-well-controlled asthma.

EIB: exercise-induced bronchospasm; FEV_1: forced expiratory volume in 1 second; ATAQ: Asthma Therapy Assessment Questionnaire (Vollmer et al. 1999); ACQ: Asthma Control Questionnaire (Juniper et al. 1999b); ACT: Asthma Control Test (Nathan et al. 2004); N/A: not applicable.
* ACQ values of 0.76 to 1.4 are indeterminate regarding well-controlled asthma.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 65972 Version 2.0

Asthma Control Test®

This survey was designed to help you describe your asthma and how your asthma affects how you feel and what you are able to do. To complete it, please mark an X in the box that best describes your answer.

1. In the **past 4 weeks**, how much of the time did your asthma keep you from getting as much done at work or at home?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

2. During the **past 4 weeks**, how often have you had shortness of breath?

More than once a day	Once a day	3 to 6 times a week	Once or twice a week	Not at all
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

3. In the **past 4 weeks**, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

4 or more nights a week	2 to 3 nights a week	Once a week	Once or twice	Not at all
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

4. In the **past 4 weeks**, how often have you used your rescue inhaler or nebulizer medication (such as Albuterol, Ventolin®, Proventil®, Maxair®, or Primatene Mist®)?

3 or more times per day	1 or 2 times per day	2 or 3 times per week	Once a week or less	Not at all
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

5. How would you rate your asthma control during the **past 4 weeks**?

Not controlled at all	Poorly controlled	Somewhat controlled	Well controlled	Completey controlled
☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

For information on the interpretation and scoring of the Asthma Control Test® (ACT®), visit www.qualitymetric.com/act.

Graphic 50620 Version 2.0

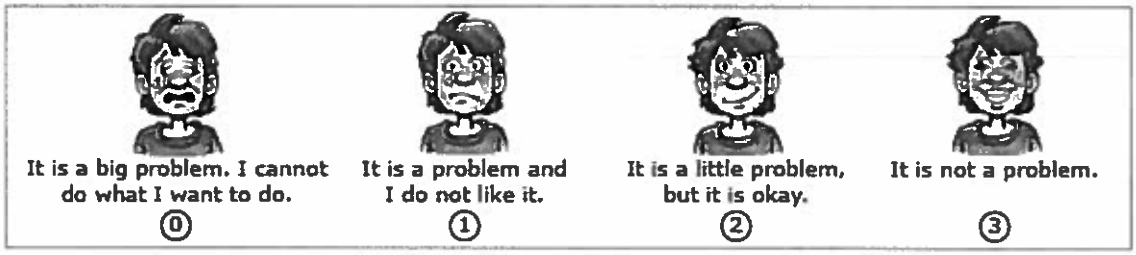
Childhood Asthma Control Test for children aged 4 to 11 years

Have your child complete these questions.

1. How is your asthma today? **SCORE**

☐

2. How much of a problem is your asthma when you run, exercise, or play sports?

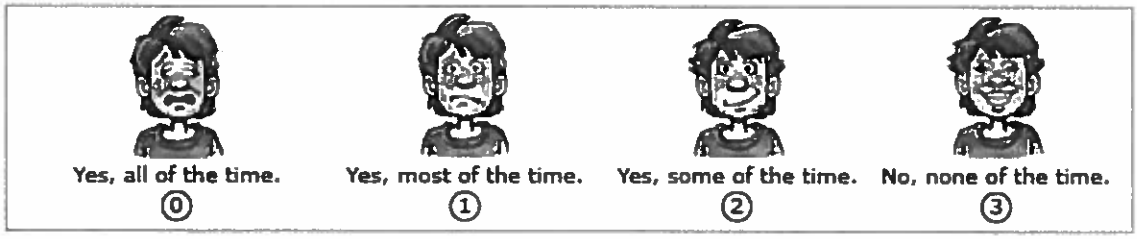


☐

3. Do you cough because of your asthma?

☐

4. Do you wake up during the night because of your asthma?



☐

Please complete the following questions on your own

5. During the *last four weeks*, how many days did your child have any daytime asthma symptoms?

5	4	3	2	1	0
Not at all	1 to 3 days	4 to 10 days	11 to 18 days	19 to 24 days	Everyday

☐

6. During the *last four weeks*, how many days did your child wheeze during the day because of asthma?

5	4	3	2	1	0
Not at all	1 to 3 days	4 to 10 days	11 to 18 days	19 to 24 days	Everyday

☐

7. During the *last four weeks*, how many days did your child wake up during the night because of asthma?

5	4	3	2	1	0
Not at all	1 to 3 days	4 to 10 days	11 to 18 days	19 to 24 days	Everyday

☐

TOTAL ☐

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Graphic 81872 Version 6.0

Predicted average peak expiratory flow for normal males (L/min)

Age	Height				
	60 inches/152 cm	65 inches/165 cm	70 inches/178 cm	75 inches/191 cm	80 inches/203 cm
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

These values represent average normal values within 100 L/min. Predicted values for African American and Hispanic minorities are approximately 10 percent lower.

Redrawn from: Leiner GC, et al, Am Rev Respir Dis 1963; 88:644.

Graphic 57257 Version 6.0

Predicted average peak expiratory flow for normal females (L/min)

Age	Height				
	55 inches/140 cm	60 inches/152 cm	65 inches/165 cm	70 inches/178 cm	75 inches/190 cm
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

These values represent average normal values within 80 L/min. Predicted values for African American and Hispanic minorities are approximately 10 percent lower.

Redrawn from: Leiner GC, et al, Am Rev Respir Dis 1963; 88:644.

Graphic 62839 Version 6.0

Predicted average peak expiratory flow rates for normal children

Height		PEFR	Height		PEFR
(inches)	(cm)	(L/min)	(inches)	(cm)	(L/min)
43	109	147	56	142	320
44	112	160	57	145	334
45	114	173	58	147	347
46	117	187	59	150	360
47	119	200	60	152	373
48	122	214	61	155	387
49	124	227	62	157	400
50	127	240	63	160	413
51	130	254	64	163	427
52	132	267	65	165	440
53	135	280	66	168	454
54	137	293	67	170	467
55	140	307			

PEFR: peak expiratory flow rate.

Graphic 64420 Version 4.0

Technique for use of a metered dose inhaler (MDI) without a spacer or chamber

Prime your inhaler if this is the first time you are using it, if you have not used it for several days, or if you have dropped it. Priming a metered dose inhaler usually involves shaking it and spraying it into the air (away from your face) a total of up to 4 times. See the information that came with your inhaler for exact instructions.
Shake MDI canister vigorously for 5 seconds.
Hold the MDI upright with your index finger on the top of the medication canister and your thumb supporting the bottom of the inhaler.
Breathe out normally.
Put the mouthpiece between your teeth and close your lips around mouthpiece or position mouthpiece about 4 cm (about width of 2 fingers) from your mouth.
Keep your tongue away from the opening of the mouthpiece.
Press down the top of the canister with the index finger to release the medication.
At the same time as the canister is pressed, breathe in deeply and slowly through your mouth until your lungs are completely filled; this should take 4 to 6 seconds.
Hold the medication in your lungs for about 5 seconds before breathing out.
If you need a second puff, wait about 15 to 30 seconds between puffs. Shake canister again before the next puff.
When finished, recap mouthpiece.
If your inhaler contains a steroid medicine (sometimes called glucocorticoid or corticosteroid), rinse your mouth and gargle with water after you use it. Then spit out the water. Do not swallow it.

These instructions do NOT apply to dry powder or soft mist inhalers. Cleaning instructions are provided separately.
More detailed information about individual medication formulations can be found at http://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm.

Graphic 72362 Version 6.0

Technique for use of a metered dose inhaler (MDI) with a spacer or chamber*

Uncap mouthpiece and check for loose objects in the device.
Prime your inhaler if this is the first time you are using it, if you have not used it for several days, or if you have dropped it. Priming a metered dose inhaler usually involves shaking it and spraying it into the air (away from your face) a total of up to 4 times. See the information that came with your inhaler for exact instructions.
Insert MDI into spacer.
Shake canister vigorously for about 5 seconds.
Hold the MDI upright with your index finger on the top of the medication canister and your thumb supporting the bottom of the inhaler. You may need to use the other hand to hold the spacer.
Breathe out normally through your mouth.
Put the mouthpiece between your teeth and close your lips tightly around mouthpiece of spacer, or, if using a mask attached to the chamber, place the mask completely over your nose and mouth.
Keep your tongue away from opening of spacer.
Press down the top of the canister with your index finger to release the medicine.
At the same time, breathe in deeply and slowly through your mouth until your lungs are completely filled; this should take 3 to 5 seconds.
Hold the medicine in your lungs for about 5 seconds. If you didn't get a full breath or can't hold your breath long enough, you can inhale a second time to fully empty the chamber, and hold your breath again for about 5 seconds.
If you need more than 1 puff, wait about 15 to 30 seconds between puffs. Shake canister again before the next puff. Do **not** load both puffs into the chamber and then empty the chamber with a single inhalation.
When finished, recap mouthpiece.
If your inhaler contains a steroid medicine (sometimes called glucocorticoid or corticosteroid), rinse your mouth and gargle with water after you use it. Then spit out the water. Do not swallow it.
You can use your spacer for more than one medication. Just remove the first MDI and insert the other one.

These instructions do NOT apply to dry powder or soft mist inhalers. Cleaning instructions are provided separately.

* We prefer to use a "valved holding chamber" for the spacer. The valve holds the medicine in the chamber. When you breathe out into the mouthpiece, your breath goes into the room and not into the chamber. This helps get the medicine into your lungs.

Graphic 93619 Version 2.0

Technique for use of various dry powder inhalers - I

Aerolizer
Remove cover and hold the base of inhaler.
Twist mouthpiece in counter-clockwise direction.
Remove capsule from foil blister immediately before use and place capsule in the base of the inhaler.
Hold the base of the inhaler and turn clockwise to close.
Simultaneously press both buttons once to pierce the capsule.
Exhale normally - do not exhale into the mouthpiece.
Tilt head back slightly, hold device horizontal with the buttons on the left and right, place mouthpiece into the mouth, and close lips around mouthpiece.
Breathe in rapidly and steadily, as deeply as possible; hold breath.
Remove device from mouth and exhale outside device.
Open chamber and examine capsule; if powder remains, repeat inhalation process.
After use, remove and discard capsule, and cover mouthpiece; store device in cool, dry place.
Diskhaler
Remove mouthpiece cover and pull tray out from device.
Place disk on wheel with numbers facing up.
Rotate disk by sliding tray out and in.
Lift back of lid until fully upright so that needle pierces both sides of blister.
Keep device level while inhaling dose with a rapid and steady flow.
Breathe in rapidly and steadily, as deeply as possible; hold breath.
Remove device from mouth and exhale outside device.
Brush off any powder remaining within device once every week; store device in cool, dry place.
Diskus
Open the device and slide the lever until it clicks.
Keep device level while inhaling dose.
Breathe in rapidly and steadily, as deeply as possible; hold breath.
Remove device from mouth and exhale outside device; store device in cool, dry place.

Graphic 69703 Version 1.0

Technique for use of various dry powder inhalers - II

HandiHaler
Capsules should be stored in sealed blisters and only removed immediately before use.
Peel back the foil using the tab until one capsule is fully visible.
Open the dust cap by pulling it upwards, then open the mouthpiece.
Place the capsule in the center chamber (it does not matter which end of the capsule is placed in the chamber).
Close the mouthpiece firmly until you hear a click, leaving the dust cap open.
Hold the HandiHaler with the mouthpiece upwards and press the piercing button completely in once and release.
Breathe out completely. Do not breathe into the mouthpiece at any time.
Close your lips tightly around the mouthpiece.
Breathe in rapidly and steadily, as deeply as possible; hold breath.
To ensure you get the full dose, repeat the inhalation from the HandiHaler as described.
After the dose, open the mouthpiece, tip out the used capsule, and dispose. Do not handle used capsules.
Close the mouthpiece and dust cap for storage; store device in cool, dry place.
Turbuhaler
Twist and remove cover.
Hold inhaler upright with mouthpiece facing up.
Turn grip right then left until it clicks.
Inhaler may be held upright or horizontal.
Breathe in rapidly and steadily, as deeply as possible; hold breath.
Remove device from mouth and exhale outside device.
Replace cover and twist to close; store device in cool, dry place.
Twisthaler
Hold the inhaler straight up with the pink portion (the base) on the bottom.
Remove the cap while it is in the upright position to make sure you get the right amount of medicine with each dose.
Hold the pink base and twist the cap in a counter-clockwise direction to remove it.
As you lift off the cap, the dose counter on the base will count down by 1. This action loads the medicine that you are now ready to inhale.
Make sure the indented arrow located on the white portion (directly above the pink base) is pointing to the dose counter.

Breathe out normally - do not exhale into the device.
Place the mouthpiece into your mouth, with the mouthpiece facing towards you, and close your lips tightly around it.
Inhale dose with a rapid and steady flow while holding the Twisthaler horizontal.
Remove the mouthpiece from your mouth and hold your breath for 5 to 10 seconds (or as long as you comfortably can).
When you exhale, be sure that you are not exhaling into the device
Immediately replace the cap and turn in a clockwise direction as you gently press down until you hear a click.
Firmly close the Twisthaler to assure that your next dose is properly loaded.
Be sure that the arrow is in line with the dose-counter window.
Store device in cool dry place.
The dose counter displays the number of doses remaining. When the unit reads 01, this indicates the last remaining dose. When the counter reads 00, the unit must then be discarded.

Graphic 80125 Version 1.0

Asthma action plan

My Asthma Action Plan

Age ≥5 years

Patient Name: _____

Medical Record #: _____

Clinician's Name: _____ DOB: _____

Clinician's Phone #: _____ Completed by: _____ Date: _____

Long-Term Control Medicines	How Much To Take	How Often	Other Instructions
		_____ times per day EVERY DAY!	
		_____ times per day EVERY DAY!	
		_____ times per day EVERY DAY!	
		_____ times per day EVERY DAY!	
Quick-Relief Medicines	**How Much To Take**	**How Often**	**Other Instructions**
		Take ONLY as needed	NOTE: If this medicine is needed frequently, call clinician to consider increasing long-term control medications.

Special instructions when I feel ◉ *good*, ○ *not good*, and ◉ *awful*.

GREEN ZONE

I feel *good*.

{My peak flow is in the GREEN zone.}

My Personal Best Peak Flow

PREVENT asthma symptoms everyday:

- ☐ Take my long-term control medicines (above) every day.
- ☐ Before exercise, take _____ puffs of _____
- ☐ Avoid things that make my asthma worse like: _____

YELLOW ZONE

I do *not* feel *good*.

{My peak flow is in the YELLOW zone.}

My symptoms may include one or more of the following:

- Wheeze
- Tight chest
- Cough
- Shortness of breath
- Waking up at night with asthma symptoms
- Decreased ability to do usual activities
- _____

50% Personal Best

CAUTION. I should continue taking my long-term control asthma medicines every day AND:

- ☐ Take _____

If I still do not feel good, or my peak flow is not back in the *Green Zone* within one hour, then I should:

- ☐ Increase _____
- ☐ Add _____
- ☐ Call _____

RED ZONE

I feel *awful*.

{My peak flow is in the RED zone.}

Warning signs may include one or more of the following:

- It is getting harder and harder to breathe
- Unable to sleep or do usual activities because of trouble breathing

50% Personal Best

Unable

Peak Flow Meter

MEDICAL ALERT! Get help!

- ☐ Take _____ until I get help immediately.
- ☐ Take _____
- ☐ Call _____

Danger! Get help immediately! Call 9-1-1 if you have trouble walking or talking due to shortness of breath or lips or fingernails are gray or blue.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 55900 Version 3.0

Assessment questions* for environmental and other factors that can make asthma worse

Inhalant allergens
Does the patient have symptoms year round? (If yes, ask the following questions. If no, see next set of questions).
Does the patient keep pets indoors? What type?
Does the patient have moisture, dampness, or a moldy odor in any room of his or her home (eg, basement)? (Suggests house dust mites, molds).
Does the patient have mold visible in any part of his or her home? (Suggests molds).
Has the patient seen cockroaches or rodents in his or her home in the past month? (Suggests significant exposure).
Assume exposure to house dust mites unless patient lives in a semiarid region. However, if a patient living in a semiarid region uses a swamp cooler, exposure to house dust mites must still be assumed.
Do symptoms get worse at certain times of the year? (If yes, ask when symptoms occur).
Early spring? (Trees).
Late spring? (Grasses).
Late summer to autumn? (Weeds).
Summer and fall? (Alternaria, Cladosporium, mites).
Cold months in temperate climates? (Suggests indoor allergens such as animal dander).
Tobacco smoke
Does the patient smoke?
Does anyone smoke at home or work?
Does anyone smoke at the child's daycare?

Workplace exposures
Does the patient cough or wheeze during the week, but not on weekends when away from work?
Do the patient's eyes and nasal passages get irritated soon after arriving at work?
Do coworkers have similar symptoms?
What substances are used in the patient's worksite? (Assess for sensitizers).
Rhinitis
Does the patient have constant or seasonal nasal congestion, runny nose, and/or postnasal drip?
Gastroesophageal reflux disease (GERD)
Does the patient have heartburn?
Does food sometimes come up into the patient's throat?
Has the patient had coughing, wheezing, or shortness of breath at night in the past four weeks?
Does the infant vomit, followed by cough, or have wheezy cough at night? Are symptoms worse after feeding?
Sulfite sensitivity¶
Does the patient have wheezing, coughing, or shortness of breath after eating shrimp, dried fruit, or processed potatoes or after drinking beer or wine?
Medication sensitivities and contraindications
What medications does the patient use now (prescription and nonprescription)?
Does the patient use eye drops¶? What type?

Indoor/outdoor pollutants and irritants
Is a wood-burning stove or fireplace used in the patient's home?
Are there unvented stoves or heaters in the patient's home?
Does the patient have contact with other smells or fumes from perfumes, cleaning agents, or sprays?
Have there been recent renovations or painting in the home?

Does the patient use any medications that contain beta-blockers or ACE inhibitors¶?
Does the patient ever take aspirin or other nonsteroidal antiinflammatory drugs?
Has the patient ever had symptoms of asthma after starting or taking any of these medications?

ACE: angiotensin-converting enzyme.
* These questions are examples and do not represent a standardized assessment or diagnostic instrument. The validity and reliability of these questions have not been assessed.
¶ Rare issue in children.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 80507 Version 9.0

Evaluation and management of work aggravated asthma and occupational asthma

Evaluation
Potential for workplace-related symptoms:
Recognized sensitizers (eg, isocyanates, plant or animal products).
Irritants* or physical stimuli (eg, cold/heat, dust, humidity).
Coworkers may have similar symptoms.
Patterns of symptoms (in relation to work exposures):
Improvement occurs during vacations or days off (may take a week or more).
Symptoms may be immediate (<1 hour), delayed (most commonly, 2-8 hours after exposure), or nocturnal.
Initial symptoms may occur after high-level exposure (eg, spill).
Documentation of work-relatedness of airflow limitation:
Serial charting for 2-3 weeks (2 weeks at work and up to 1 week off work, as needed to identify or exclude work-related changes in PEF):
Record when symptoms and exposures occur.
Record when a bronchodilator is used.
Measure and record peak flow (or FEV_1) every 2 hours while awake.
Immunologic tests.
Referral for further confirmatory evaluation (eg, bronchial challenges).
Management
Work-aggravated asthma:
Work with onsite health care providers or managers/supervisors.
Discuss avoidance, ventilation, respiratory protection, tobacco smoke-free environment.
Occupationally induced asthma:
Recommend complete cessation of exposure to initiating agent.

FEV_1: forced expiratory volume in 1 second; PEF: peak expiratory flow.
* Material Safety Data Sheets may be helpful for identifying respiratory irritants, but many sensitizers are not listed.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 69644 Version 1.0

Indications for the administration of the 13-valent pneumococcal conjugate vaccine (PCV13) and the 23-valent pneumococcal polysaccharide vaccine (PPSV23) for adults in the United States

Risk group	Underlying condition	PCV13	PPSV23	
		Recommended	Recommended	Revaccination
Immunocompetent persons	Chronic heart disease*		X	
	Chronic lung disease•		X	
	Diabetes mellitus		X	
	Cerebrospinal fluid leak	X	X	
	Cochlear implant	X	X	
	Alcoholism		X	
	Chronic liver disease, cirrhosis		X	
	Cigarette smoking		X	
	Age ≥65	X	X	Δ
Persons with functional or anatomic asplenia	Sickle cell disease/other hemaglobinopathy	X	X	X◇
	Congenital or acquired asplenia	X	X	X◇
Immunocompromised persons	Congenital or acquired immunodeficiency§	X	X	X◇
	Human immunodeficiency virus infection	X	X	X◇
	Chronic renal failure	X	X	X◇
	Nephrotic syndrome	X	X	X◇
	Leukemia	X	X	X◇
	Lymphoma	X	X	X◇
	Hodgkin disease	X	X	X◇
	Generalized malignancy	X	X	X◇

	Iatrogenic immunosuppression¥	X	X	X◇
	Solid organ transplant	X	X	X◇
	Multiple myeloma	X	X	X◇

* Including congestive heart failure and cardiomyopathies, excluding hypertension.
• Including chronic obstructive pulmonary disease, emphysema, and asthma.
Δ All adults aged ≥65 years should receive a dose of PPSV23 even if they were vaccinated when they were less than 65 years of age; however, a minimum interval of five years between PPSV23 doses should be maintained. Those who are receiving PPSV23 for the first time at or after age 65 should receive only a single dose (and do not require revaccination).
◇ Patients <65 years of age who have functional or anatomic asplenia or who are immunocompromised should be revaccinated one time five years after the initial dose, and again at or after age 65 (and at least five years after the previous dose).
§ Includes B- (humoral) or T-lymphocyte deficiency, complement deficiencies (particularly C1, C2, C3, and C4 deficiencies), and phagocytic disorders (excluding chronic granulomatous disease).
¥ Diseases requiring treatment with immunosuppressive drugs, including long-term systemic glucocorticoids and radiation therapy.

Adapted from:

1. *Tomczyk S, Bennett NM, Stoecker C, et al. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine among adults aged ≥65 years: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2014; 63:822.*
2. *Centers for Disease Control and Prevention. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine for adults with immunocompromising conditions: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2012; 61:816.*
3. *Centers for Disease Control and Prevention (CDC), Advisory Committee on Immunization Practices. Updated recommendations for prevention of invasive pneumococcal disease among adults using the 23-valent pneumococcal polysaccharide vaccine (PPSV23). MMWR Morb Mortal Wkly Rep 2010; 59:1102.*
4. *Tomblyn M, Chiller T, Einsele H, et al. Guidelines for preventing infectious complications among hematopoietic cell transplantation recipients: a global perspective. Biol Blood Marrow Transplant 2009: 15:1143.*

Graphic 86782 Version 18.0

Recommendations for pneumococcal immunization with pneumococcal conjugate vaccine (PCV13) and 23-valent pneumococcal polysaccharide vaccine (PPSV23) for children at high risk* of pneumococcal disease

Age	Previous doses	Recommendations
Any high risk condition*		
≤23 months	None	PCV13 per schedule for healthy children
24 through 71 months	4 doses of PCV13	1 dose of PPSV23, at least 8 weeks after last dose of PCV13
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
	4 doses of PCV7	1 dose of PCV13, at least 8 weeks after the last dose of PCV7
		1 dose of PPSV23, at least 8 weeks after last dose of PCV13
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
	Any incomplete schedule of 3 doses of PCV7 or PCV13	1 dose of PCV13, at least 8 weeks after last dose of PCV7 or PCV13
		1 dose of PPSV23, 8 weeks after the last dose of PCV13
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
	Unvaccinated or any incomplete schedule of PCV7 or PCV13 and no doses of PPSV23	2 doses of PCV13, 8 weeks apart, beginning at least 8 weeks after the last dose of PCV7 or PCV13
		1 dose of PPSV23, 8 weeks after the last dose of PCV13
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
	1 dose of PPSV23	2 doses of PCV13, 8 weeks apart, beginning at least 8 weeks after first dose of PPSV23
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
Anatomic or functional asplenia (including sickle cell disease), immunocompromising condition (including HIV, chronic renal failure, nephrotic syndrome), cochlear implant, or cerebrospinal fluid leak		

6 through 18 years	No doses of PPSV23 or PCV13 (0 to 4 doses of PCV7)	1 dose of PCV13
		1 dose of PPSV23, at least 8 weeks after PCV13
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
	1 dose of PPSV23 and no doses of PCV13 (0 to 4 doses of PCV7)	1 dose of PCV13, at least 8 weeks after first dose of PPSV23
		Second dose• of PPSV23, 5 years after the first, for children who are immunocompromised, have sickle cell disease, or have functional or anatomic asplenia[Δ]
	2 doses of PPSV23 and no doses of PCV13 (0 to 4 doses of PCV7)	1 dose of PCV13, at least 8 weeks after second dose• of PPSV23
Chronic heart disease, chronic lung disease, diabetes mellitus		
6 through 18 years	No doses of PPSV23 or PCV13 (0 to 4 doses of PCV7)	1 dose of PPSV23, at least 8 weeks after last dose of PCV7
	1 dose of PPSV23 and no doses of PCV13 (0 to 4 doses of PCV7)	No additional immunization

PCV7: 7-valent pneumococcal conjugate vaccine; PCV13: 13-valent pneumococcal conjugate vaccine; PPSV23: 23-valent pneumococcal polysaccharide vaccine; HIV: human immunodeficiency virus.
* High-risk children include those with sickle cell disease, asplenia, immunodeficiency, chronic heart or lung disease, cerebrospinal fluid leaks, diabetes mellitus, and cochlear implants[Δ].
• No more than two doses of PPSV23 are recommended.
Δ A second dose of PPSV23 is **not** recommended for immunocompetent children with cochlear implants or chronic illness, including chronic heart disease, chronic lung disease, diabetes mellitus, or cerebrospinal fluid leaks.

Based on recommendations from:

1. *Pneumococcal infections. In: Red Book: 2012 Report of the Committee on Infectious Diseases (29th ed), Pickering LK (Ed), American Academy of Pediatrics, Elk Grove Village, IL 2012. p.571.*
2. *Updated recommendation from the Advisory Committee on Immunization Practices (ACIP) for use of 7-valent pneumococcal conjugate vaccine (PCV7) in children aged 24-59 months who are not completely vaccinated. MMWR Morb Mortal Wkly Rep 2008; 57:343.*
3. *Nuorti JP, Whitney CG, Centers for Disease Control and Prevention (CDC). Prevention of pneumococcal disease among infants and children - use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine - recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2010; 59:1.*
4. *Centers for Disease Control and Prevention (CDC). Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine among children aged 6-18 years with*

immunocompromising conditions: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2013; 62:521.

Graphic 62519 Version 19.0

Classifying asthma severity and initiating treatment in youths greater than or equal to 12 years of age and adults

Components of severity		Classification of asthma severity (≥12 years of age)			
		Intermittent	Persistent		
			Mild	Moderate	Severe
Impairment Normal FEV_1/FVC: 8 to 19 years 85 percent 20 to 39 years 80 percent 40 to 59 years 75 percent 60 to 80 years 70 percent	Symptoms	≤2 days/week	>2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	≤2x/month	3 to 4x/month	>1x/week but not nightly	Often 7x/week
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week but not daily, and not more than 1x on any day	Daily	Several times per day
	Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
	Lung function	• Normal FEV_1 between exacerbations • FEV_1 >80 percent predicted • FEV_1/FVC normal	• FEV_1 ≥80 percent predicted • FEV_1/FVC normal	• FEV_1 >60 but <80 percent predicted • FEV_1/FVC reduced 5 percent	• FEV_1 <60 percent predicted • FEV_1/FVC reduced >5 percent
Risk	**Exacerbations requiring oral systemic glucocorticoids**	**0 to 1/year (see footnote)**	**≥2/year (see footnote)**		
		Consider severity and interval since last exacerbation			
		Frequency and severity may fluctuate over time for patients in any severity category			
		Relative annual risk of exacerbations may be related to FEV_1			
Recommended step for initiating treatment		Step 1	Step 2	Step 3 And consider short course of	Step 4 or 5

			oral systemic glucocorticoids
	In two to six weeks, evaluate level of asthma control that is achieved and adjust therapy accordingly.		

Assessing severity and initiating treatment for patients who are not currently taking long-term control medications. The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. Level of severity is determined by assessment of both impairment and risk. Assess impairment domain by patient's/caregiver's recall of previous two to four weeks and spirometry. Assign severity to the most severe category in which any feature occurs. At present, data are inadequate to correlate frequencies of exacerbations with different levels of asthma severity. In general, more frequent and intense exacerbations (eg, requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate greater underlying disease severity. For treatment purposes, patients who had ≥2 exacerbations requiring oral systemic glucocorticoids in the past year may be considered the same as patients who have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.

FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; ICU: intensive care unit.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 58247 Version 3.0

Classifying asthma severity and initiating treatment in children 5 to 11 years of age

Components of severity		Classification of asthma severity (5 to 11 years of age)			
		Intermittent	Persistent		
			Mild	Moderate	Severe
Impairment	Symptoms	≤2 days/week	>2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	≤2 times/month	3 to 4 times/month	>1 time/week but not nightly	Often 7 times/week
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week but not daily	Daily	Several times per day
	Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
	Lung function	▪ Normal FEV_1 between exacerbations ▪ FEV_1 >80 percent predicted ▪ FEV_1/FVC >85 percent	▪ FEV_1 ≥80 percent predicted ▪ FEV_1/FVC >80 percent	▪ FEV_1 = 60 to 80 percent predicted ▪ FEV_1/FVC = 75 to 80 percent	▪ FEV_1 <60 percent predicted ▪ FEV_1/FVC <75 percent
Risk	**Exacerbations requiring oral systemic glucocorticoids**	**0 to 1/year (see footnote)**	**≥2/year (see footnote)**		
		Consider severity and interval since last exacerbation			
		Frequency and severity may fluctuate over time for patients in any severity category			
		Relative annual risk of exacerbations may be related to FEV_1			
Recommended step for initiating treatment		Step 1	Step 2	Step 3, medium dose-inhaled glucocorticoids option	Step 3, medium dose-inhaled glucocorticoids option, or Step

				4
			And consider short course of oral systemic glucocorticoids	
	In two to six weeks, evaluate level of asthma control that is achieved, and adjust therapy accordingly			

Assessing severity and initiating therapy in children who are not currently taking long-term control medication. The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. Level of severity is determined by both impairment and risk. Assess impairment domain by patient's/caregiver's recall of the previous two to four weeks and spirometry. Assign severity to the most severe category in which any feature occurs. At present, data are inadequate to correlate frequencies of exacerbations with different levels of asthma severity. In general, more frequent and intense exacerbations (eg, requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate greater underlying disease severity. For treatment purposes, patients who had ≥2 exacerbations requiring oral systemic glucocorticoids in the past year may be considered the same as patients who have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.

EIB: exercise-induced bronchospasm; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; ICU: intensive care unit.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 71181 Version 7.0

Classifying asthma severity and initiating treatment in children 0 to 4 years of age

Components of severity		Classification of asthma severity (0 to 4 years of age)			
		Intermittent	Persistent		
			Mild	Moderate	Severe
Impairment	Symptoms	≤2 days/week	>2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	0	1 to 2 times/month	3 to 4 times/month	>1 time/week
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week but not daily	Daily	Several times per day
	Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
Risk	**Exacerbations requiring oral systemic glucocorticoids**	**0 to 1/year**	**≥2 exacerbations in six months requiring oral systemic glucocorticoids, or ≥4 wheezing episodes/one year lasting >1 day AND risk factors for persistent asthma**		
		Consider severity and interval since last exacerbation			
		Frequency and severity may fluctuate over time			
		Exacerbations of any severity may occur in patients in any severity category			
Recommended step for initiating treatment		Step 1	Step 2	Step 3 and consider short course of oral systemic glucocorticoids	
		In two to six weeks, depending on severity, evaluate level of asthma control that is achieved. If no clear benefit is observed in four to six weeks, consider adjusting therapy or alternative diagnoses.			

Assessing severity and initiating therapy in children who are not currently taking long-term control medication. The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. Level of severity is determined by both impairment and risk. Assess impairment domain by patient's/caregiver's recall of previous two to four weeks. Symptom assessment for longer periods should reflect a global assessment, such as

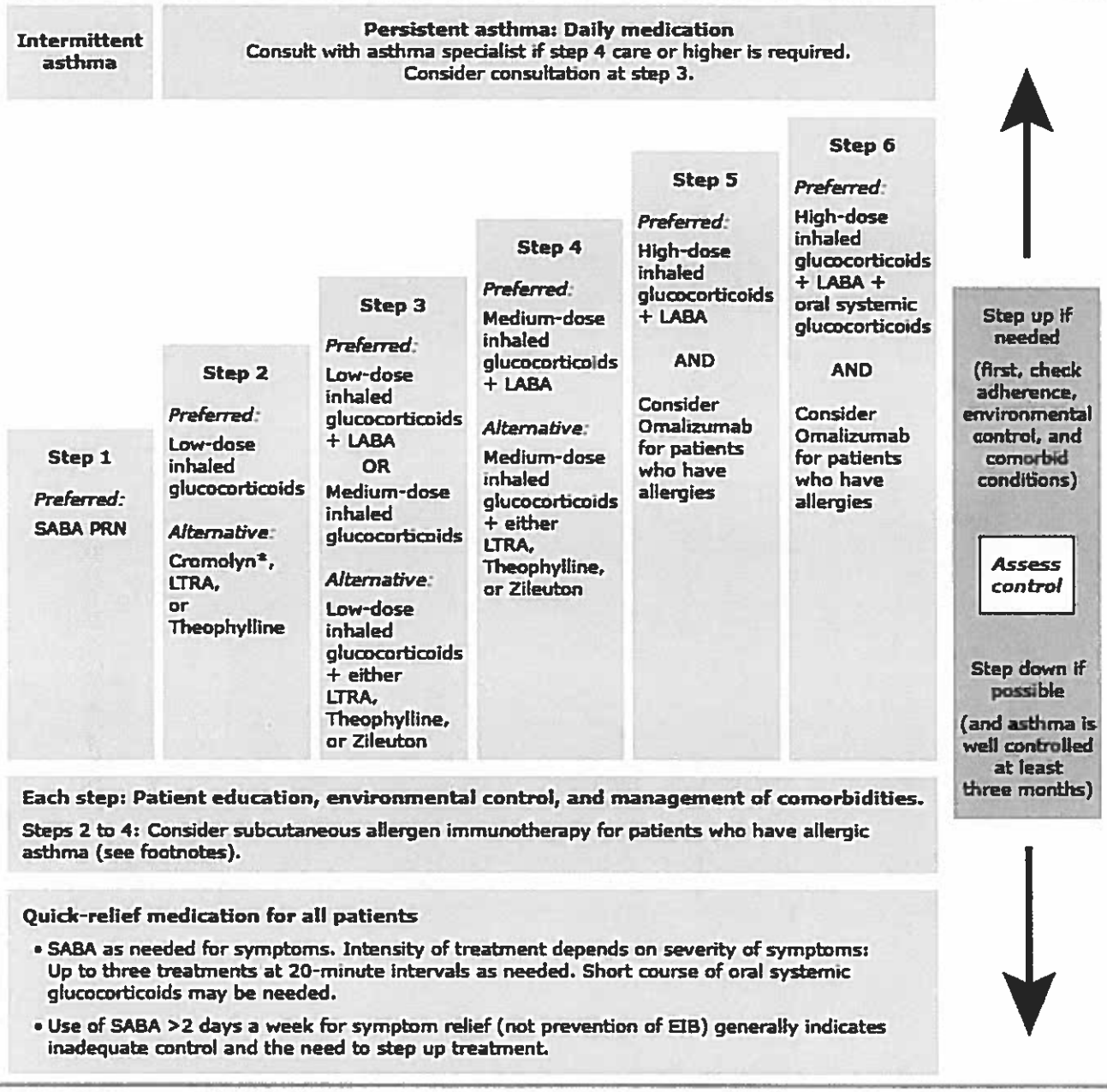
inquiring whether the patient's asthma is better or worse since the last visit. Assign severity to the most severe category in which any feature occurs. At present, data are inadequate to correlate frequencies of exacerbations with different levels of asthma severity. For treatment purposes, patients who had ≥2 exacerbations requiring oral systemic glucocorticoids in the past six months, or ≥4 wheezing episodes in the past year, and who have risk factors for persistent asthma may be considered the same as patients who have persistent asthma, even in the absence of impairment levels consistent with persistent asthma.

EIB: exercise-induced bronchospasm.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 80908 Version 6.0

Stepwise approach for managing asthma in youths greater than or equal to 12 years of age and adults



The stepwise approach is meant to assist, not replace, the clinical decisionmaking required to meet individual patient needs. If alternative treatment is used and response is inadequate, discontinue it and use the preferred treatment before stepping up. Zileuton is a less desirable alternative due to limited studies as adjunctive therapy and the need to monitor liver function. Theophylline requires monitoring of serum concentration levels. In step 6, before oral systemic glucocorticoids are introduced, a trial of high-dose ICS + LABA + either LTRA, theophylline, or zileuton may be considered, although this approach has not been studied in clinical trials. Step 1, 2, and 3 preferred therapies are based on evidence A; step 3 alternative therapy is based on evidence A for LTRA, evidence B for theophylline, and evidence D for zileuton. Step 4 preferred

therapy is based on evidence B, and alternative therapy is based on evidence B for LTRA and theophylline and evidence D for zileuton. Step 5 preferred therapy is based on evidence B. Step 6 preferred therapy is based on (EPR-2 1997) and evidence B for omalizumab. Immunotherapy for steps 2 to 4 is based on evidence B for house dust mites, animal danders, and pollens; evidence is weak or lacking for molds and cockroaches. Evidence is strongest for immunotherapy with single allergens. The role of allergy in asthma is greater in children than in adults. Clinicians who administer immunotherapy or omalizumab should be prepared and equipped to identify and treat anaphylaxis that may occur.

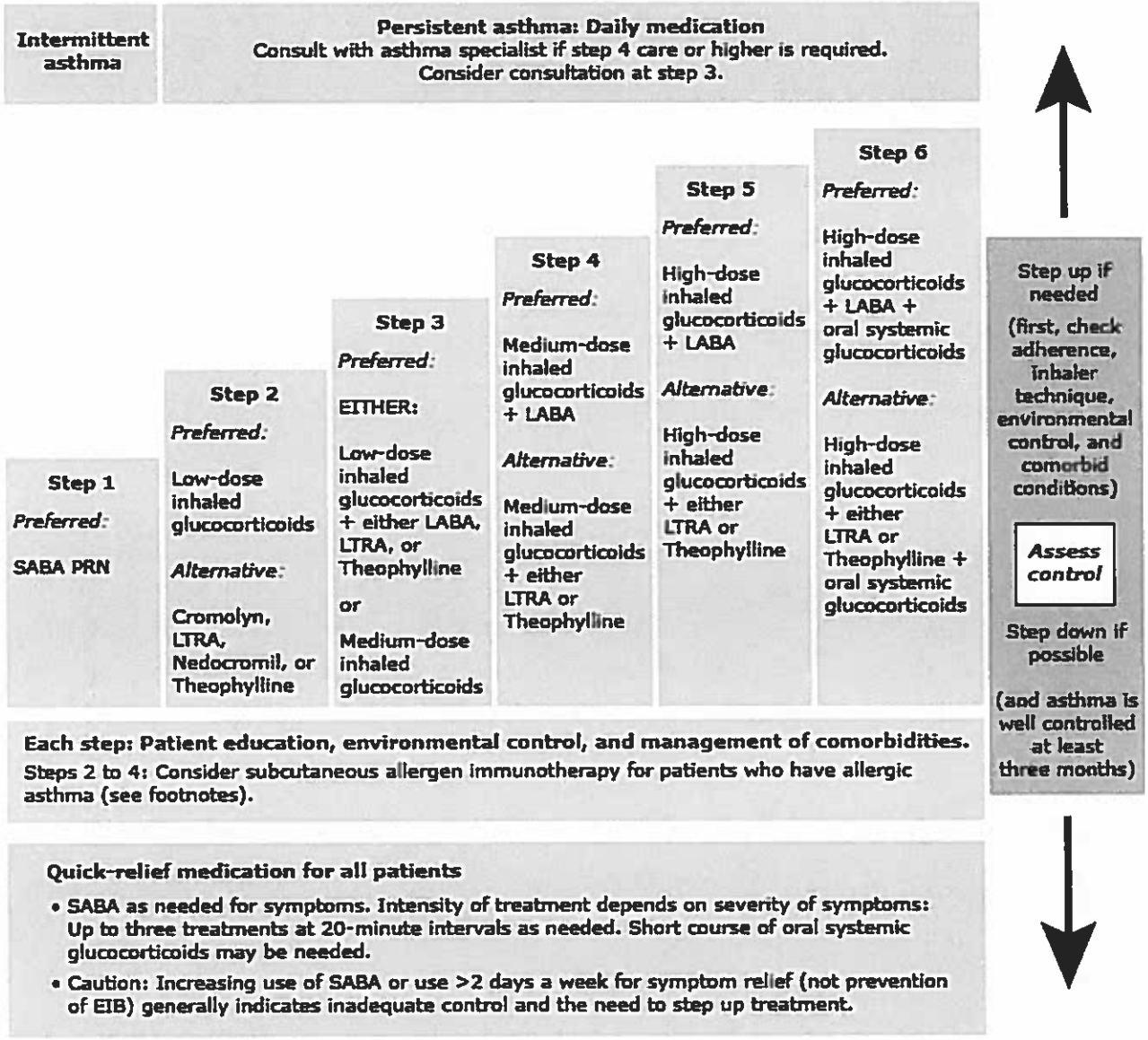
Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy.

SABA: inhaled short-acting beta$_2$-agonist; PRN: "as needed"; LTRA: leukotriene receptor antagonist; LABA: long-acting inhaled beta$_2$-agonist; EIB: exercise-induced bronchospasm.
* Cromolyn has limited availability.

Updated and reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 56729 Version 5.0

Stepwise approach for managing asthma in children 5 to 11 years of age



The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. If alternative treatment is used and response is inadequate, discontinue it and use the preferred treatment before stepping up. Theophylline is a less desirable alternative due to the need to monitor serum concentration levels. Step 1 and step 2 medications are based on evidence A. Step 3 inhaled glucocorticoids + adjunctive therapy and inhaled glucocorticoids are based on evidence B for efficacy of each treatment and extrapolation from comparator trials in older children and adults. Comparator trials are not available for this age group. Steps 4 to 6 are based on expert opinion and extrapolation from studies in older children and adults. Immunotherapy for steps 2 to 4 is based on evidence B for house dust mites, animal danders, and pollens. Evidence is weak or lacking for molds and cockroaches. Evidence is strongest for immunotherapy with single allergens. The role of allergy

in asthma is greater in children than in adults. Clinicians who administer immunotherapy should be prepared and equipped to identify and treat anaphylaxis that may occur.

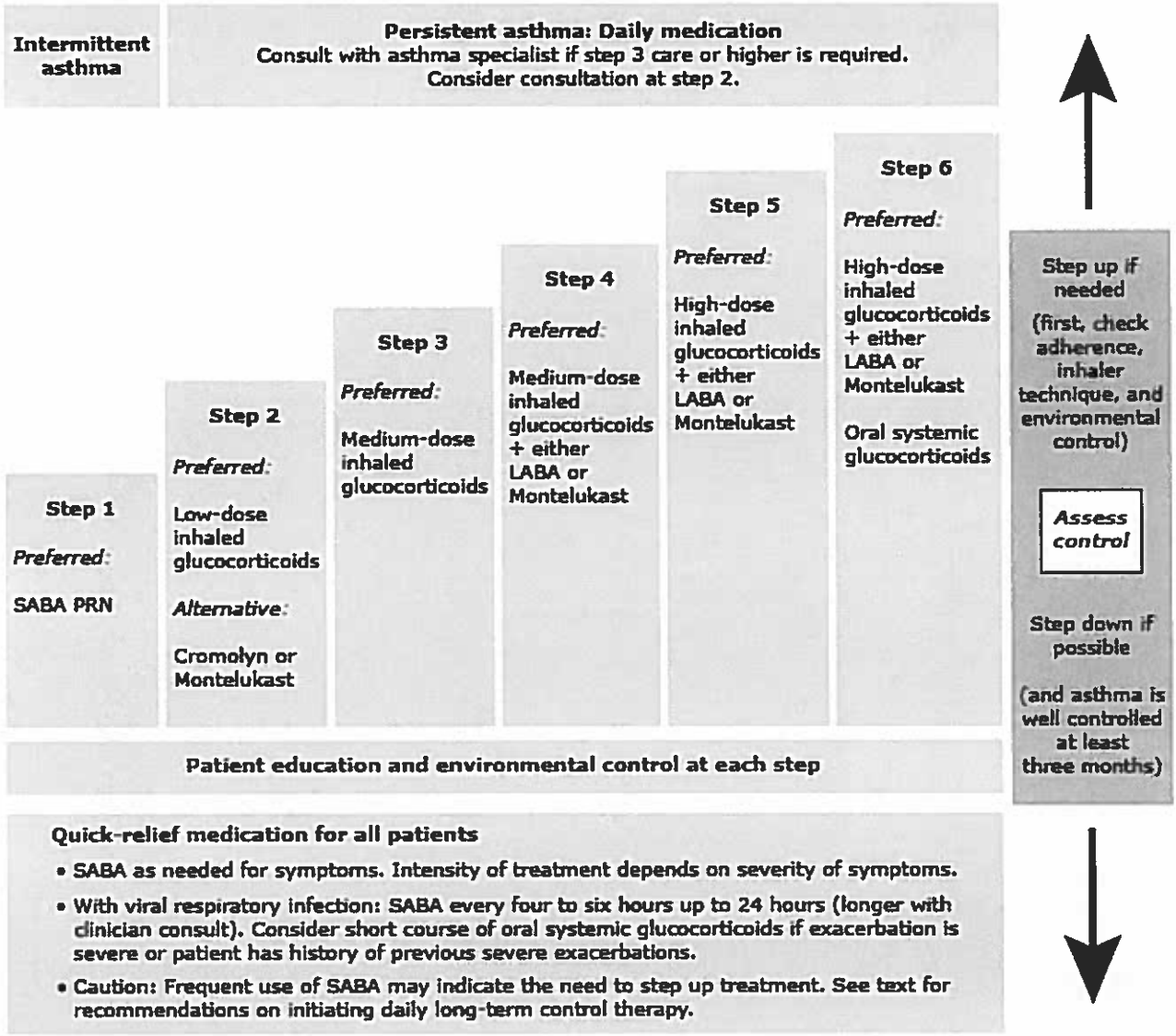
Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy.

SABA: inhaled short-acting beta$_2$-agonist; PRN: "as needed"; LTRA: leukotriene receptor antagonist; LABA: long-acting inhaled beta$_2$-agonist; EIB: exercise-induced bronchospasm.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 67459 Version 8.0

Stepwise approach for managing asthma in children 0 to 4 years of age



The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. If alternative treatment is used and response is inadequate, discontinue it and use the preferred treatment before stepping up. If clear benefit is not observed within four to six weeks and patient/family medication technique and adherence are satisfactory, consider adjusting therapy or alternative diagnosis. Studies on children 0 to 4 years of age are limited. Step 2 preferred therapy is based on evidence A. All other recommendations are based on expert opinion and extrapolation from studies in older children.
Alphabetical order is used when more than one treatment option is listed within either preferred or alternative therapy.

SABA: inhaled short-acting beta$_2$-agonist; PRN: "as needed"; LABA: inhaled long-acting beta$_2$-agonist.

Reproduced from: National Heart, Blood, and Lung Institute Expert Panel Report 3 (EPR 3): Guidelines

for the Diagnosis and Management of Asthma. NIH Publication no. 08-4051, 2007.

Graphic 76669 Version 8.0

Assessing asthma control and adjusting therapy in youths greater than or equal to 12 years of age and adults

Components of control		Classification of asthma control (≥12 years of age)		
		Well-controlled	**Not-well controlled**	**Very poorly controlled**
Impairment	Symptoms	≤2 days/week	>2 days/week	Throughout the day
	Nighttime awakenings	≤2x/month	1 to 3x/week	≥4x/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting $beta_2$-agonist use for symptom control (not prevention of EIB)	≤2 days/week	>2 days/week	Several times per day
	FEV_1 or peak flow	>80 percent predicted/personal best	60 to 80 percent predicted/personal best	<60 percent predicted/personal best
	Validated questionnaires			
	ATAQ	0	1 to 2	3 to 4
	ACQ	≤0.75*	≥1.5	N/A
	ACT	≥20	16-19	≤15
Risk	**Exacerbations requiring oral systemic glucocorticoids**	**0 to 1/year**	**≥2/year (see footnote)**	
		Consider severity and interval since last exacerbation		
	Progressive loss of lung function	Evaluation requires long-term followup care		
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		
Recommended action for treatment		• Maintain current step • Regular followups every	• Step up 1 step and • Reevaluate in two to six weeks	• Consider short course of oral systemic glucocorticoids,

	one to six months to maintain control • Consider step down if well controlled for at least three months	• For side effects, consider alternative treatment options	• Step up 1 to 2 steps, and • Reevaluate in two weeks • For side effects, consider alternative treatment options

The stepwise approach is meant to assist, not replace, the clinical decision-making required to meet individual patient needs. The level of control is based on the most severe impairment or risk category. Assess impairment domain by patient's recall of previous two to four weeks and by spirometry/or peak flow measures. Symptom assessment for longer periods should reflect a global assessment, such as inquiring whether the patient's asthma is better or worse since the last visit. At present, data are inadequate to correlate frequencies of exacerbations with different levels of asthma control. In general, more frequent and intense exacerbations (eg, requiring urgent, unscheduled care, hospitalization, or ICU admission) indicate poorer disease control. For treatment purposes, patients who had >2 exacerbations requiring oral systemic glucocorticoids in the past year may be considered the same as patients who have not-well-controlled asthma even in the absence of impairment levels consistent with not-well-controlled asthma.

Validated questionnaires for the impairment domain (the questionnaires do not assess lung function or the risk domain):

- ATAQ: Asthma Therapy Assessment Questionnaire
- ACQ: Asthma Control Questionnaire (user package may be obtained at www.qoltech.co.uk or juniper@qoltech.co.uk)
- ACT: Asthma Control Test

Minimal important difference: 1.0 for the ATAQ; 0.5 for the ACQ; not determined for the ACT.

Before step up in therapy:

- Review adherence to medication, inhaler technique, environmental control, and comorbid conditions.
- If an alternative treatment option was used in a step, discontinue and use the preferred treatment for that step.

EIB: exercise-induced bronchospasm; FEV_1: forced expiratory volume in one second; ICU: intensive care unit; N/A: not applicable.

* ACQ values of 0.76 to 1.4 are indeterminate regarding well-controlled asthma.

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