Algorithm for the diagnosis and management of asthma: a practice parameter update

These parameters were developed by the Joint Task Force on Practice Parameters, representing the American Academy of Allergy, Asthma and Immunology, the American College of Allergy, Asthma and Immunology, and the Joint Council of Allergy, Asthma and Immunology*

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This algorithm on the diagnosis and treatment of asthma is intended to complement and update the previously published Practice Parameters for the Diagnosis and Treatment of Asthma.[1] Both documents were developed by the Joint Task Force on Practice Parameters, representing the AAAAI, ACAAI, and the JCAAI.

The authors of this asthma algorithm have attempted to include all the elements essential for the diagnosis and care of patients with asthma. Every effort was made to keep the algorithm clear and concise, yet thorough and complete (Fig 1). Each component of the algorithm is elaborated further in a brief annotation. For further discussion, the reader is referred to the more extensive Practice Parameters for the Diagnosis and Treatment of Asthma.

Ann Allergy Asthma Immunol 1998;81:415–420.

ANNOTATION 1: PRESENTATION SUGGESTIVE OF ASTHMA

Asthma is a reversible obstructive disorder of the large and small airways in which the degree of obstruction varies spontaneously and in response to therapy. Allergy is an important trigger in 60% to 90% of children and 50% of adults with asthma. Onset can be at any age. Although symptoms tend to be episodic, even in patients with mild asthma, the pathogenetic process is chronic. Persistent inflammation may lead to progressive decline in lung function which may be partly irreversible, due in part at least to airway narrowing. Early diagnosis and treatment leads to a better prognosis.

Clinical features consistent with asthma include episodic or chronic:

- wheezing
- cough
- dyspnea
- chest tightness (sometimes described as chest pain, chest congestion, inability to take a deep breath)

ANNOTATION 2: DOES THIS PATIENT HAVE ASTHMA?

Asthma symptom patterns are variable: for example, acute or chronic; episodic or constant; nocturnal and/or daytime; seasonal or perennial; with strenuous exercise or with ordinary activity. Symptoms may arise only in certain environments or after exposure to specific irritants, such as cigarette smoke, or specific allergens, such as animal allergens. In patients with occupational asthma, symptoms may be worse at work. Although wheezing is the hallmark of asthma, asthma may present with persistent cough without wheezing. Frequent chest colds ("colds go to my chest"), recurrent "bronchitis" with or without wheezing, and recurrent (especially afebrile) pneumonia also suggest the possibility of asthma. Sputum production occurs generally in small quantity in contrast to chronic bronchitis in adults. The mucus appears clear to white, sometimes with a somewhat yellow tinge, and is often tenacious and thick.

There is a high familial association between asthma and other allergic diseases, and a high personal association between asthma and atopic eczema and/or allergic rhinitis. A history of association between precipitants known to cause asthma (eg, upper respiratory infections, allergens, exercise) and asthmatic symptoms, as well as a history of therapeutic response to

* The American Academy of Allergy, Asthma and Immunology (AAAAI) and the American College of Allergy, Asthma and Immunology (ACAAI) have jointly accepted responsibility for establishing this update. Because this document incorporated the efforts of many participants, no single individual, including those who served on the Joint Task Force, is authorized to provide an official AAAAI or ACAAI interpretation of this update. Any request for information about or an interpretation of this update by the AAAAI or the ACAAI should be directed to the Executive Offices of the AAAAI, the ACAAI, and the Joint Council of Allergy, Asthma and Immunology.

† This parameter was edited by Dr Nicklas in his private capacity and not in his capacity as a medical officer with the Food and Drug Administration. No official support or endorsement by the Food and Drug Administration is intended or should be inferred.

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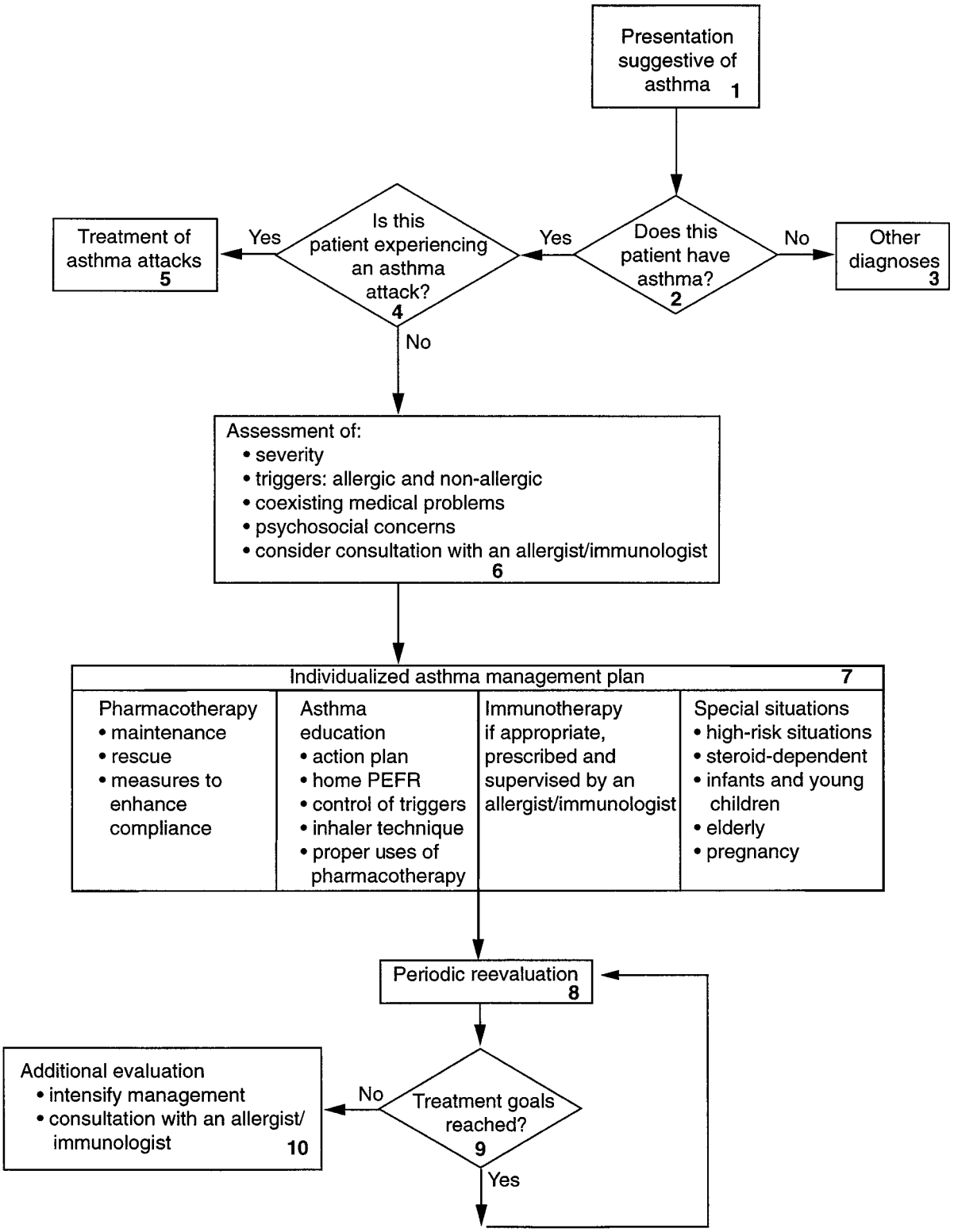
Presentation suggestive of asthma 1
Does this patient have asthma? 2
Yes
No
Other diagnoses 3
Is this patient experiencing an asthma attack? 4
Yes
No
Treatment of asthma attacks 5
Assessment of:
• severity
• triggers: allergic and non-allergic
• coexisting medical problems
• psychosocial concerns
• consider consultation with an allergist/immunologist 6
Individualized asthma management plan 7
Pharmacotherapy
• maintenance
• rescue
• measures to enhance compliance
Asthma education
• action plan
• home PEFR
• control of triggers
• inhaler technique
• proper uses of pharmacotherapy
Immunotherapy if appropriate, prescribed and supervised by an allergist/immunologist
Special situations
• high-risk situations
• steroid-dependent
• infants and young children
• elderly
• pregnancy
Periodic reevaluation 8
Treatment goals reached? 9
No
Yes
Additional evaluation
• intensify management
• consultation with an allergist/immunologist 10

a bronchodilator suggests a diagnosis of asthma.

On physical examination, patients with asthma may have wheezing, rhonchi, and/or chest hyperinflation secondary to generalized bronchial obstruction and/or diminished air exchange although the chest examination is frequently normal. Examination of the skin and upper respiratory tract for possible concomitant atopic disease is important. Clubbing is not associated with asthma; when present, it suggests an accompanying or alternative diagnosis.

Asthma is characterized by variable airflow limitation. It is important, therefore, to demonstrate that the patient has airway obstruction as well as therapeutic relief of such obstruction after bronchodilator use. Some patients with chronic obstructive pulmonary disease may also have (partially) reversible airway obstruction. In very young children, a diagnosis of asthma is usually made on the basis of symptoms, physical examination, and response to therapy. In older children and in adults, it is important that obstruction and the relief of obstruction be demonstrated objectively. *Although there is a relationship between symptoms and airflow limitation, the relationship is highly imperfect, with some patients unable to perceive airflow limitation even at half-normal airflow.* Even in the most experienced hands, the ability of a clinician to assess degree of airflow limitation on the basis of the history and physical examination is very limited. If there is sufficient chronic inflammation, a bronchodilator may not reverse airway obstruction, and treatment with corticosteroids (eg, prednisone) may be required to demonstrate improvement in pulmonary function and response to a bronchodilator. A 12% or greater improvement in FEV_1 is considered to be a bronchodilator response consistent with asthma.

ANNOTATION 3: OTHER DIAGNOSES

In adults, emphysema and chronic bronchitis, cardiac disease, pulmonary embolism, endobronchial obstructive lesions, bronchiolitis obliterans, and laryngeal dysfunction must be considered in the differential diagnosis. Chronic sinusitis with nasopharyngeal drainage may present with chronic or recurrent cough; it is not unusual for sinusitis to co-exist with asthma. In children, if asthmatic symptoms begin early in life and persist, cystic fibrosis, bronchopulmonary dysplasia, immunodeficiency syndromes, congenital cardiovascular anomalies, and foreign body aspiration must be considered.

ANNOTATION 4: IS THE PATIENT EXPERIENCING AN ACUTE ASTHMA ATTACK?

History, physical examination, and pulmonary function testing can be used to establish the presence of an acute asthma attack. A patient experiencing an acute asthma attack will have prominent symptoms (eg, dyspnea, cough, wheezing, and/or chest tightness). Establishing the rapidity of onset and progression of symptoms, as well as the response to prior treatment may help in determining the severity of the asthma attack. Concomitant medical conditions and possible differential diagnoses should also be considered, eg, left ventricular failure, pulmonary embolus, mechanical obstruction, or vocal cord dysfunction.

Physical examination may be characterized by the presence of audible wheezing, decreased airflow (especially expiratory), tachypnea, and/or signs of respiratory distress and labored breathing. Use of accessory muscles of respiration, cyanosis (as a late sign), and pulsus paradoxus greater than 10 mm Hg may be present in severe attacks. Patients may also present with restlessness, agitation, diaphoresis, signs of dehydration, and, in infants, grunting, retracting and flaring.

Measurement of peak expiratory flow rate (PEFR) or FEV_1 provides objective evidence of the extent of airway obstruction, and is often a more reliable indicator of the severity of an acute asthma attack than the patient's history or findings on physical examination. Serial measurement of FEV_1 or PEFR can be used to assess response to treatment. Peak expiratory flow rate and to a lesser extent, FEV_1 are, however, effort-dependent tests, especially in an acute setting. Pulse oximetry and/or arterial blood gas determination are helpful in assessing the degree of respiratory insufficiency.

ANNOTATION 5: TREATMENT OF ASTHMA ATTACK

Treatment of acute asthma should be directed not only at relief of bronchial obstruction and gas exchange but also at reduction of inflammation and prevention of recurrence.

Parenteral and inhaled sympathomimetic agents are effective in the management of acute asthma and nebulized or aerosol beta-2 adrenergic agonists are the treatment of choice. Depending on the severity of the attack, multiple or continuous nebulization may be indicated. If parenteral adrenergic agonists are used (ie, epinephrine or terbutaline), there may be increased risk of cardiac adverse effects, especially in patients with coronary artery disease and/or cardiac arrhythmias.

In severe attacks, oxygen administration is very important. A reasonable goal of oxygen therapy is to increase the Pa_{O_2} to at least 60 mm Hg, equivalent to an arterial oxygen saturation of 90% to 92%, which can be monitored continuously by a pulse oximeter. Systemic corticosteroids are indicated in moderate to severe attacks of acute asthma. Corticosteroids reduce airway inflammation. Although clinical studies suggest that oral corticosteroids are as effective as intravenous corticosteroids, the intravenous route is preferred for severe exacerbations.

In selected cases, theophylline may also be useful in the management of acute asthma, but its routine use is discouraged. If dehydration is present, intravenous fluids are indicated. With respiratory failure, intubation and mechanical ventilation are necessary.

Acute asthma may require treatment in an outpatient setting, emergency room, inpatient hospital setting, or intensive care unit. Prior response to treatment is often a helpful indicator of

response to current interventions. Once the acute attack resolves, adequate treatment and follow-up of the patient are very important to prevent future recurrences.

ANNOTATION 6: ASSESSMENT OF THE ASTHMATIC PATIENT

Assessment should include an evaluation of the severity of the patient's asthma, possible triggers of asthma exacerbations, and the need for consultation with an allergist/immunologist.

An evaluation of the severity of the patient's asthma should be based on the history, physical examination, and pulmonary function testing. The history should include questions about:

- the frequency and severity of symptoms;
- nocturnal symptoms;
- the degree to which symptoms interfere with the patient's and/or parent's ability to function, including loss of time from work or school;
- the patient's quality of life;
- the extent of rescue mediation use, eg, short-acting inhaled beta agonists and systemic corticosteroids;
- the number of emergency visits or hospitalizations;
- the patient's response to treatment with medications, environmental avoidance measures and allergen immunotherapy;
- a history of intubation or mechanical ventilation; and
- growth in children.

On physical examination, it may be possible to estimate asthma severity based on the extent and degree of wheezing on auscultation, the ease of air exchange, and/or the patient's general appearance, especially the degree of respiratory difficulty. Pulmonary function testing provides objective assessment of asthma severity. Since physical examination of the lungs is often normal, pulmonary function may be needed for assessment of asthma severity and is necessary for the continuing care of asthma patients by either the primary care physician or specialist. Pulmonary function testing performed during visits to the clinician is very important and can be augmented by patient measurement of morning and evening peak flow.

Asthma may be exacerbated by a number of allergic and non-allergic factors. Allergic triggers may include aeroallergens such as pollen, mold, dust mites, and animal antigens. Foods can occasionally provoke asthma, especially in children. Non-allergic triggers of asthma may include irritants such as smoke, strong odors, cold air, industrial chemicals, medications (eg, ASA and other non-steroidal anti-inflammatory drugs, beta adrenergic blocking agents), exercise, hormonal changes (eg, pregnancy), food additives (eg, sulfites), psychosocial factors and weather changes. It is important to evaluate the patient for concomitant conditions that can exacerbate asthma, such as sinusitis, rhinitis, gastroesophageal reflux, and other pulmonary disease, as well as for concomitant conditions that can increase the difficulty of treating asthma, such as hypertension or cardiac arrhythmias. Special consideration may need to be given to management of asthma in very young children and the elderly. The temporal relationship of asthma symptoms to home versus work, inside versus outside, and geographic areas should be determined.

Consultation with an allergist/immunologist should be encouraged early in the course of asthma in order to maximize effective management. Consultation with an allergist/immunologist should be strongly considered if:

- the patient's asthma is unstable; the patient's response to treatment is limited, incomplete, or very slow and continued poor control interferes with the patient's quality of life; the patient experiences sudden, severe attacks of asthma; hospitalization is required; emergency visits are required to control the patient's asthma;
- the patient is using rescue medication too frequently;
- there is a need to identify causes of the patient's asthma;
- allergen immunotherapy is being considered in the management of the patient's asthma;
- the patient needs intensive education in the role of allergens and other environmental factors; there is a need to enhance patient use of medications and/or peak flow measurements;
- the patient has a chronic cough, refractory to usual therapy;
- concomitant illnesses and/or their treatment complicate the management of asthma;
- the patient has recurrent absences from school or work due to asthma; the patient is unable to participate in normal daily activities;
- the patient experiences continuing nocturnal episodes of asthma;
- the patient requires multiple medications on a long-term basis;
- frequent bursts of oral corticosteroids or daily oral corticosteroids are required;
- the patient exhibits excessive lability of pulmonary function;
- there is concern about the potential side effects with use of corticosteroids; and
- preventive measures need to be considered for the high-risk, predisposed infant with a family history of asthma or atopy; and/or if the patient or parent asks for a consultation.

ANNOTATION 7: THE ASTHMA MANAGEMENT PLAN

No two patients with asthma are exactly alike. *The asthma management plan must be individualized based on the clinical evaluation outlined in Annotation #6.* Asthma management should be a cooperative effort between the patient/parent, the primary care physician and the allergist/immunologist.

Pharmacotherapy

Patients with mild, intermittent asthma (eg, exercise-induced asthma only, mild, daytime symptoms only once or twice a week, no history of asthma exacerbations and normal or near-normal FEV_1) can usually be managed by prophylactic and/or as-needed short-acting inhaled beta-agonists. Some physicians treat these patients with anti-inflammatory medications.

Most other asthma patients (ie, those with persistent asthma) should be treated with daily asthma maintenance medications. *Inhaled corticosteroids are generally considered the most effective maintenance treatment and may be the first choice for many patients, especially those with more severe asthma.* Inhaled cromolyn or nedocromil is often considered first in children because of the excellent safety profile of these drugs. Fewer patients respond to leukotriene antagonists than to inhaled corticosteroids and response is usually not as good. All patients with asthma should have a short-acting beta-agonist inhaler for as needed rescue therapy.

Patients whose asthma is not well-controlled by a single maintenance asthma drug may benefit from treatment with more than one maintenance asthma drug. Usually this combination would consist of an inhaled corticosteroid with a long-acting bronchodilator, such as salmeterol. Inhaled corticosteroids can also be given with theophylline, oral beta-agonists, nedocromil and/or leukotriene antagonists. In treating patients with more severe asthma, it is usually necessary to prescribe higher doses of inhaled corticosteroids (eg, greater than 800 mg/day beclomethasone). At these higher doses, there is a greater risk of systemic effects.

Patients whose asthma is not well-controlled by high dose inhaled corticosteroids or combined therapy often require oral corticosteroids for maintenance therapy. These patients should be carefully evaluated to ensure that all aspects of asthma care are optimal especially compliance and environmental control. An alternate day regimen of oral corticosteroids may reduce the systemic effects of corticosteroids. Patients who require maintenance oral corticosteroids for control of asthma should be followed closely, for clinical response and corticosteroid adverse effects, and the dose of corticosteroid adjusted as needed. The treatment goal for these patients is to establish the lowest dose of oral corticosteroid needed to achieve control of asthma.

At follow-up visits, all patients with well controlled asthma should be evaluated for a reduction (step-down) in asthma medications.

Asthma Education

All patients with asthma and if indicated, their parents, should be taught how to manage asthma (cooperative management through education). For most patients, this instruction should include (1) a basic description of the pathophysiology of asthma; (2) the indications, use, and risks of the asthma medications the patient is taking (including inhaler technique); (3) identification and environmental control of asthma triggers (eg, exercise, infections, allergens); and (4) early recognition and management of asthma attacks. Patients with asthma should receive clear instructions on (1) use of daily maintenance medications, including proper inhaler use; (2) use of rescue (as needed) and prophylactic medications (eg, pretreatment before exercise); and (3) when and what to do for an exacerbation of asthma.

A written treatment plan should be available for all patients. Patients with more severe asthma or those who have previously experienced asthma attacks should have a written asthma action plan specifying what to do for asthma attacks. Such a plan generally should include (1) a symptom, medication, and PEFR diary. Home monitoring of peak flow can help the clinician individualize treatment; in particular, the step-down (or step-up) of asthma medications; (2) clear instructions on action to be taken when signs or symptoms of an asthma attack develop (eg, increase beta-agonist inhaler use); (3) clear instructions on when to call the physician's office and when to seek immediate attention; and (4) clear instructions on when to begin oral corticosteroids and/or to increase other medications.

Immunotherapy

Clinical studies show that immunotherapy is an effective treatment for allergic asthma in selected patients. Patients with asthma triggered by allergens, who have positive tests for specific IgE antibodies (generally skin tests), may be suitable candidates for immunotherapy, which should be prescribed and supervised by an allergist/immunologist. The allergist/immunologist should correlate the clinical course with the positive skin tests. The decision to begin immunotherapy must be individualized and is a joint decision between the allergist/immunologist and the patient and/or the patient's parent(s).

Special Situations

Some patients may have asthma that is difficult to control or may present with complicating medical conditions. Evaluation and management of such patients may be best performed through consultation with an allergist/immunologist. A few selected situations are summarized here:

a. *High-Risk Asthma:* Characteristics of patients at high risk for hospitalization for asthma, near-fatal asthma, or fatal asthma include (1) severe, poorly controlled asthma; (2) previous near-fatal asthma; (3) hospitalization or emergency department visit for asthma in the past year; (4) two or more urgent visits for asthma in the past year; (5) previous rapidly developing asthma attack (3 hours or less); (6) use of more than 1 canister of short-acting beta-agonist per month; (7) advanced age; (8) poor perception of airway obstruction; (9) psychosocial disturbances; (10) poor adherence to prescribed treatment; and/or (11) smoking.

b. *Corticosteroid-Dependent Asthma:* Patients taking oral corticosteroids for maintenance treatment of asthma present special challenges. These challenges include review and optimization of control of asthma triggers, pharmacotherapy, including inhaled corticosteroids, and asthma education. Management may also include prevention, assessment, and treatment of corticosteroid-induced adverse effects (eg, osteoporosis, cataracts). A major goal in managing these patients is to administer the least amount of oral corticosteroid required for good asthma control. Some patients with severe asthma do not respond well to corticosteroids and are called corticosteroid insensitive. These patients need specialized care.

c. *Infants and Young Children:* Special challenges in this population include (1) the diagnosis of asthma in this population may be more difficult; (2) many asthma medications have not been labeled for use in infants or young children; (3) most metered dose inhalers and breath-activated devices cannot be easily used in infants or young children; (4) measurement of pulmonary function is difficult, however, it can be done in some patients as young as 5 years of age; (5) control of asthma triggers may be complex (eg, parental smoking, cockroach or dust mite exposure, exposure to viruses); and/or (6) the family or psychosocial setting may be a barrier to asthma care.

d. *Elderly:* Older patients with asthma may have co-existing disease (eg, hypertension, congestive heart failure, coronary artery disease, diabetes mellitus, glaucoma, osteoporosis, or nicotine dependence) that may complicate the diagnosis, assessment, and treatment of asthma. These patients may also be taking medications that complicate asthma management. Advanced age is a significant risk factor for asthma mortality.

e. *Pregnancy:* Management of asthma in the pregnant patient demands good asthma control with prevention or prompt treatment of asthma exacerbations. Virtually all asthma medications can be given safely in pregnant patients. Medications that are potentially harmful to the fetus should be avoided if possible, but a severe asthma attack poses the greatest risk to mother and fetus. Pregnant patients with asthma should be followed carefully and be given explanations on the risks of asthma in pregnancy and the indications and risks of treatment.

ANNOTATION 8: PERIODIC RE-EVALUATION

All asthma patients should be re-evaluated periodically. This is essential for individualization of treatment. At the follow-up visit, the clinician may (1) assess the response to treatment; (2) assess (reassess) the severity of asthma; (3) assess and improve patient adherence to the asthma management plan; (4) review and revise medication based on side effects; (5) intensify or reduce asthma medication as appropriate based on asthma control; (6) review and revise the plan for managing asthma attacks (asthma action plan); and/or (7) evaluate patient adherence, including proper use of inhaled medications and peak flow measurement.

Generally, asthma visits should include some measurement of lung function (PEFR or FEV_1). Typically, patients with well-controlled mild asthma (see Annotation #7) may need less frequent follow-ups, eg, every 6 to 12 months. Patients who require maintenance therapy should generally be followed more frequently, eg, every 1 to 6 months. Clearly, patients with more severe asthma or high risk asthma will require more frequent visits than other patients.

ANNOTATION 9: TREATMENT GOALS REACHED

At each visit, the clinician should assess whether or not treatment goals have been reached. Treatment goals should be individualized for each patient but may include those listed in Annotation #10.

If treatment goals have been reached, then the patient's asthma is well-controlled and periodic re-evaluation is recommended. If treatment goals have not been reached, further evaluation and intervention may be necessary.

ANNOTATION 10: FURTHER EVALUATION AND MANAGEMENT THAT ARE NEEDED IF TREATMENT GOALS ARE NOT REACHED

Only through cooperative interaction between the patient and/or the patient's representative(s), the primary care provider, and the allergist/immunologist is it possible to maximize the possibility of meeting the stated goals of asthma therapy. The goals of asthma therapy should include:

- individualization of assessment and treatment;
- general improvement in the patient's quality of life;
- asthma co-management by patient and care givers;
- optimal control of asthma with the use of the least amount of medication possible, administered in a manner that permits the most normal lifestyle, and with minimal side effects;
- no emergency room visits, hospitalizations, nocturnal symptoms, or time lost from work, school, and daily activities;
- physical activity appropriate for age;
- prevention of asthma in high-risk (or predisposed) persons;
- prevention of complications;
- optimization of pulmonary function; and
- insuring that the patient is confident in managing asthma day-to-day and in case of asthma attacks.

For patients who have not reached these treatment goals, consultation with an allergist/immunologist should be obtained. The allergist/immunologist has the ability to further assess the severity of the patient's asthma. This may include challenge with non-specific or specific triggers of asthma. The allergist/immunologist also has the ability, through training and experience, to define allergic and non-allergic causes of the patient's asthma within and outside of the workplace through the use of immediate hypersensitivity skin testing. The allergist/immunologist's treatment plan generally includes extensive patient education (see Annotations 6 and 7).

REFERENCE

1. Practice parameters for the diagnoses and treatment of asthma. J Allergy Clin Immunol 1995;96:707–870.