

OR

- Establish control with medium-dose inhaled corticosteroids, then lower the dose (but still within the medium-dose range) and add nedocromil. Nedocromil has a notable safety profile, and some studies (Lai et al. 1993; O'Hickey and Rees 1994; Svendsen and Jorgensen 1991) have shown that it has some, albeit modest, inhaled corticosteroid-sparing effects in adults. Other studies (e.g., Wong et al. 1993) did not demonstrate this. Therefore, this treatment option is not preferred. Furthermore, adding another inhaler into the patient's medication schedule may affect patient adherence. It will also affect the total cost of care.

If the patient's asthma is not optimally controlled with initial step 3 therapy, and medications are used correctly, additional step 3 therapy is recommended.

- Increase daily long-term-control medications to a high dose of inhaled corticosteroids,

AND

- Add a long-acting bronchodilator, especially to control nocturnal symptoms. The long-acting bronchodilator can be either long-acting inhaled beta₂-agonist or sustained-release theophylline. An evening dose of either bronchodilator may alleviate and prevent nocturnal symptoms and thus improve adherence to the overall therapeutic regimen.

Step 4: Severe Persistent Asthma. Patients whose asthma is not controlled on high doses of inhaled corticosteroids and the addition of long-acting bronchodilators will also need oral systemic corticosteroids on a regularly scheduled, long-term basis. For patients who require long-term systemic corticosteroids:

- Use the lowest possible dose (single dose daily or on alternate days).
- Monitor patients closely for corticosteroid adverse side effects (see component 3-Medications).
- When control of asthma is achieved, make persistent attempts to reduce systemic corticosteroids. High doses of inhaled corticosteroids are preferable to systemic corticosteroids because inhaled corticosteroids have fewer systemic effects.

- Consultation with an asthma specialist is recommended.

SPECIAL CONSIDERATIONS FOR MANAGING ASTHMA IN DIFFERENT AGE GROUPS

Infants and Young Children (5 Years of Age and Younger)

KEY RECOMMENDATIONS FOR MANAGING ASTHMA IN INFANTS AND YOUNG CHILDREN

- Diagnosing asthma in infants is often difficult, yet underdiagnosis and undertreatment are key problems in this age group. Thus, a diagnostic trial of inhaled bronchodilators and anti-inflammatory medications may be helpful.
- In general, infants and young children consistently requiring symptomatic treatment more than two times per week should be given daily anti-inflammatory therapy.
- When initiating daily anti-inflammatory therapy, a trial of cromolyn or nedocromil is often given due to the safety profile of these medications.
- Response to therapy should be carefully monitored. Once control of asthma symptoms is established and sustained, a careful step down in therapy should be attempted. If clear benefit is not observed, alternative therapies or diagnoses should be considered.

Diagnosis

Several studies show that as many as 50 to 80 percent of children with asthma develop symptoms before their fifth birthday. Diagnosis can be difficult in this age group and has important implications. On the one hand, asthma in early childhood is frequently underdiagnosed (receiving such labels as chronic bronchitis, wheezy bronchitis, recurrent pneumonia, gastroesophageal reflux, and recurrent upper respiratory tract infections), and thus many infants and young children do not receive adequate therapy. On the other hand, not all wheeze and cough are caused by asthma, and caution is needed to avoid giving infants and young children inappropriately prolonged asthma therapy. Episodic or

chronic wheeze, cough, and breathlessness also may be seen in other less common conditions, including cystic fibrosis, vascular ring, tracheomalacia, primary immunodeficiency, congenital heart disease, parasitic disease, and foreign body aspiration.

Among children 5 years of age and younger, the most common cause of asthma symptoms is viral respiratory infection. At present, the relative contributions of airway inflammation, bronchial smooth muscle abnormalities, or other structural factors in producing wheeze with acute viral upper respiratory infections are unknown. There appear to be two general patterns of illness in infants and children who have wheezing with acute viral upper respiratory infections: a remission of symptoms in the preschool years and persistence of asthma throughout childhood. There are no clear markers to predict the prognosis for an individual child; however, the factors more strongly associated with continuing asthma are allergy, a family history of allergy or asthma, and perinatal exposure to passive smoke and aeroallergens (Pullan and Hey 1982; Sporik et al. 1991; Martinez et al. 1995; Martinez 1995).

Diagnosis is complicated by the difficulty in obtaining objective measurements of lung function in this age group. Essential elements in the evaluation include the history, symptoms, physical examination, and assessment of quality of life. A therapeutic trial with medications listed in figure 3-5d will also aid in the diagnosis.

Treatment

Figure 3-6 illustrates the Expert Panel's recommendations for a stepwise approach to managing acute and chronic asthma symptoms, regardless of the prognosis for the wheezing infant or young child.

It is the opinion of the Expert Panel that, in general, infants and young children consistently requiring symptomatic treatment more than two times per week should be given daily anti-inflammatory medication.

At present there are few studies of medications in children younger than 3 years of age. A therapeutic trial of anti-inflammatory medications should be monitored carefully. Treatment should be stopped if a clear beneficial effect is not obvious. Although only inhaled corticosteroids have been shown to be effective in long-term clinical studies with infants

(Ilangoan et al. 1993; Gleeson and Price 1988; Bisgaard et al. 1990), cromolyn has demonstrated symptom control and reduced airway hyperresponsiveness in a number of pediatric studies (Geller-Bernstein and Sneh 1980; Hilman et al. 1987; Miraglia del Giudice et al. 1982; Shapiro and Konig 1985; Silverman et al. 1972; Bertelsen et al. 1986; Glass et al. 1981). Fewer studies are available on nedocromil, but benefit has been demonstrated (Brogden and Sorkin 1993). Sustained-release theophylline, an alternative long-term-control medication for older children, may have particular risks of adverse side effects in infants, who frequently have febrile illnesses which increase theophylline concentrations. Theophylline should be considered only if serum concentration levels will be carefully monitored.

In deciding when to initiate daily long-term-control therapy, the clinician must weigh the possible long-term effects of inadequately controlled asthma vs. the possible adverse effects of medications given over prolonged periods. A preliminary study suggests that appropriate control of childhood asthma may prevent more serious asthma or irreversible obstruction in later years (Agertoft and Pedersen 1994). There is evidence that anti-inflammatory treatment can reduce morbidity from wheezing in early childhood (Connett et al. 1993). Studies in older children suggest that the potential but small risk of delayed growth from the use of inhaled corticosteroids is balanced by their efficacy (see component 3-Medications). Furthermore, there are options (cromolyn and nedocromil) for initiating anti-inflammatory therapy.

Recommendations for treating infants and young children at different steps of care include:

- The patient's response to therapy should be monitored carefully. When benefits are sustained, a step down in therapy should be attempted. If there are no clear benefits, treatment should be stopped and alternative therapies or diagnoses should be considered.
- Daily long-term-control therapy often begins with cromolyn or nedocromil.
- When inhaled corticosteroids are introduced in step 2 care, doses may range from 100 to 400 mcg/day; this generally translates to a dose of 15 mcg/kg up to 400 mcg/day beclomethasone (Allen and Lemanske 1993). See figures 3-5b and 3-5c for discussion of equivalency among preparations.

FIGURE 3-6. STEPWISE APPROACH FOR MANAGING INFANTS AND YOUNG CHILDREN (5 YEARS OF AGE AND YOUNGER) WITH ACUTE OR CHRONIC ASTHMA SYMPTOMS

	Long-Term Control	Quick Relief
<p>STEP 4 Severe Persistent</p>	<ul style="list-style-type: none"> ■ Daily anti-inflammatory medicine <ul style="list-style-type: none"> — High-dose inhaled corticosteroid with spacer/holding chamber and face mask — If needed, add systemic corticosteroids 2 mg/kg/day and reduce to lowest daily or alternate-day dose that stabilizes symptoms 	<ul style="list-style-type: none"> ■ Bronchodilator as needed for symptoms (see step 1) up to 3 times a day
<p>STEP 3 Moderate Persistent</p>	<ul style="list-style-type: none"> ■ Daily anti-inflammatory medication. Either: <ul style="list-style-type: none"> — Medium-dose inhaled corticosteroid with spacer/holding chamber and face mask OR, once control is established: <ul style="list-style-type: none"> — Medium-dose inhaled corticosteroid and nedocromil OR <ul style="list-style-type: none"> — Medium-dose inhaled corticosteroid and long-acting bronchodilator (theophylline) 	<ul style="list-style-type: none"> ■ Bronchodilator as needed for symptoms (see step 1) up to 3 times a day
<p>STEP 2 Mild Persistent</p>	<ul style="list-style-type: none"> ■ Daily anti-inflammatory medication. Either: <ul style="list-style-type: none"> — Cromolyn (nebulizer is preferred; or MDI) or nedocromil (MDI only) — Infants and young children usually begin with a trial of cromolyn or nedocromil OR <ul style="list-style-type: none"> — Low-dose inhaled corticosteroid with spacer/holding chamber and face mask 	<ul style="list-style-type: none"> ■ Bronchodilator as needed for symptoms (see step 1)
<p>STEP 1 Mild Intermittent</p>	<ul style="list-style-type: none"> ■ No daily medication needed. 	<ul style="list-style-type: none"> ■ Bronchodilator as needed for symptoms ≤ 2 times a week. Intensity of treatment will depend upon severity of exacerbation (see component 3-Managing Exacerbations). Either: <ul style="list-style-type: none"> — Inhaled short-acting β_2-agonist by nebulizer or face mask and spacer/holding chamber OR <ul style="list-style-type: none"> — Oral β_2-agonist for symptoms ■ With viral respiratory infection <ul style="list-style-type: none"> — Bronchodilator q 4-6 hours up to 24 hours (longer with physician consult) but, in general, repeat no more than once every 6 weeks — Consider systemic corticosteroid if <ul style="list-style-type: none"> • Current exacerbation is severe OR <ul style="list-style-type: none"> • Patient has history of previous severe exacerbations
<p>Step down Review treatment every 1 to 6 months. If control is sustained for at least 3 months, a gradual stepwise reduction in treatment may be possible.</p>	<p>↑</p>	<p>Step up If control is not achieved, consider step up. But first: review patient medication technique, adherence, and environmental control (avoidance of allergens or other precipitant factors).</p>
<p>NOTE:</p> <ul style="list-style-type: none"> ■ The stepwise approach presents guidelines to assist clinical decisionmaking. Asthma is highly variable; clinicians should tailor specific medication plans to the needs and circumstances of individual patients. ■ Gain control as quickly as possible; then decrease treatment to the least medication necessary to maintain control. Gaining control may be accomplished by either starting treatment at the step most appropriate to the initial severity of their condition or by starting at a higher level of therapy (e.g., a course of systemic corticosteroids or higher dose of inhaled corticosteroids). ■ A rescue course of systemic corticosteroid (prednisolone) may be needed at any time and step. ■ In general, use of short-acting β_2-agonist on a daily basis indicates the need for additional long-term-control therapy. ■ It is important to remember that there are very few studies on asthma therapy for infants. ■ Consultation with an asthma specialist is <i>recommended</i> for patients with moderate or severe persistent asthma in this age group. Consultation should be <i>considered</i> for all patients with mild persistent asthma. 		

- When step 3 care is required, it is the opinion of the Expert Panel that control should be established promptly with higher doses of inhaled corticosteroid and then therapy should be stepped down after 2 to 3 months to maintain control (Pedersen and Hansen 1995). For some patients, control of asthma may be maintained by using a lower dose of inhaled corticosteroid (e.g., the minimum dose in the medium-dose range) along with the addition of either nedocromil or theophylline. Some, but not all, studies with nedocromil in adults have demonstrated its potential corticosteroid-sparing effect. There are no studies demonstrating this effect with cromolyn. Studies in infants and young children are necessary. Some clinicians prefer gradually increasing medication to establish control—for example, adding nedocromil or theophylline before increasing the dose of inhaled corticosteroid beyond low-dose therapy.
- Exacerbations caused by viral respiratory infections may be intermittent yet severe. Consider systemic corticosteroids if the exacerbation is moderate to severe or at the onset of a viral respiratory infection if the patient has a history of severe exacerbations.
- Consultation with an asthma specialist should be *considered* for infants and young children requiring step 2 care; consultation is *recommended* for those requiring step 3 or step 4 care.
- Several delivery devices are available for infants and young children. The dose received may vary considerably among devices and age groups. (See figure 3-3 for a summary of therapeutic issues regarding aerosol delivery devices.) The child's caregivers must be instructed in the proper use of appropriately sized face masks, spacers/holding chambers with face masks, and spacers/holding chambers for medication delivery to be effective and efficient. For children younger than 2 years of age, nebulizer therapy may be preferred for administering cromolyn and for high doses of beta₂-agonists during exacerbations. Children between 3 and 5 years may begin therapy with MDI and spacer/holding chamber alone, but if the desired therapeutic effects are not achieved, they may require a nebulizer or an MDI plus spacer/holding chamber and face mask.

School-Age Children (Older Than 5 Years of Age) and Adolescents

KEY RECOMMENDATIONS FOR MANAGING ASTHMA IN SCHOOL-AGE CHILDREN AND ADOLESCENTS

- Pulmonary function testing should use appropriate reference populations. Adolescents compare better to childhood than to adult predicted norms.
- When initiating daily anti-inflammatory therapy for mild-to-moderate persistent asthma, a trial of cromolyn or nedocromil is often given.
- Adolescents (and younger children as appropriate) should be directly involved in establishing goals for therapy and developing their asthma management plans.
- Active participation in physical activities, exercise, and sports should be promoted.
- A written asthma management plan should be prepared for the student's school, including plans to ensure reliable, prompt access to medications.

The pharmacologic management of school-age children and adolescents follows the same basic principles as those for adults, but the special circumstances of growth, school, and social development require special consideration.

Assessment

Pulmonary function testing should be performed using comparison data from an appropriate reference population (American Thoracic Society 1991). Adolescents generally compare better to childhood than to adult predicted norms. Testing in a laboratory or clinic specializing in children can result in higher pulmonary function values and more consistent data. Technicians who conduct pulmonary function testing for children should have special training in achieving the best possible effort from young patients.

Treatment

For children with mild or moderate persistent asthma, cromolyn or nedocromil are often effective anti-inflammatory therapies and have no known long-term systemic effects. However, for

children with severe persistent asthma, and for many children with moderate persistent asthma, cromolyn and nedocromil do not provide adequate control and thus inhaled corticosteroids are necessary for long-term therapy (see figure 3-4b).

The Expert Panel recommends that adolescents (and younger children as appropriate) be directly involved in developing their asthma management plans. Adolescents may experience more difficulties than younger children in adhering to a medication plan because they may fail to recognize the danger of poorly controlled asthma (Strunk et al. 1985), they may not accept having a chronic illness, or they may view the plan as infringing upon their emerging independence and adulthood. In teaching adolescents the same asthma self-management techniques expected of adults, the clinician should address adolescent developmental issues such as building a positive self-image and confidence, increasing personal responsibility, and gaining problem-solving skills. To accomplish this, it is often helpful to see the adolescent initially without parents present and to involve the adolescent directly in setting goals for therapy, developing an appropriate treatment plan, and reviewing the effectiveness of the plan at repeated visits. The parents can be brought in at the end of the visit to review the plan together and emphasize the parents' important role in supporting the adolescent's efforts.

School Issues

The clinician should prepare a written asthma management plan for the student's school (see figure 4-7) that includes the following information: an action plan for handling exacerbations (including the clinician's recommendation regarding self-administration of medication and plans to ensure prompt, reliable access to medications); recommendations for long-term-control medications and prevention of exercise-induced bronchospasm (EIB), if appropriate; and identification of those factors that make the student's asthma worse so the school may help the student avoid exposure.

It is preferable to schedule daily, long-term medications so that they are not taken at school, even if this results in unequal dosing intervals throughout the day. However, in school districts that have more comprehensive school nurse coverage, children who would benefit from close supervision to promote adherence may be given medications at school. In this way, daily medication can be administered and patient education can be supplemented most days of the week.

Students with asthma often require medication during school to treat acute symptoms or to prevent EIB that may develop during physical education class, school recess, or organized sports. Reliable, prompt access to medication is essential, but it may be difficult because of school rules that preclude the child from carrying medications. The National Asthma Education and Prevention Program and several member organizations have adopted resolutions that endorse allowing students to carry and self-administer medications when the physician and parent consider this appropriate. It may be helpful for some children to have a compressor-driven nebulizer available at the school.

Sports

Physical activity at play or in organized sports is an essential part of a child's life, and full participation in physical activities should be encouraged. Many children with asthma experience cough, wheeze, or excessive fatigue when they exercise. Treatment immediately prior to vigorous activity or exercise usually prevents EIB. If symptoms occur during usual play activities, a step up in long-term therapy is warranted. Poor endurance or EIB can be an indication of poorly controlled persistent asthma; appropriate use of long-term-control medication can reduce EIB (see Exercise-Induced Bronchospasm, page 100). Activity should be limited or curtailed only as a last resort.

Older Adults

KEY RECOMMENDATIONS FOR MANAGING ASTHMA IN OLDER ADULTS

- Chronic bronchitis/emphysema may coexist with asthma. A trial of systemic corticosteroids will determine the presence of reversibility and the extent of therapeutic benefit.
- Asthma medications may aggravate coexisting medical conditions (e.g., cardiac disease, osteoporosis); adjustments in the medication plan may need to be made.
- Be aware of increased potential for adverse drug/disease interaction (e.g., aspirin, beta-blockers).
- Review of patient technique in using medications and devices is essential.

Because of the high prevalence of other obstructive lung disease (e.g., chronic bronchitis, emphysema) among the elderly, it is important to determine the extent of reversible airflow obstruction. Careful evaluation is required because the precise cause of severe airflow obstruction can be difficult to identify in older patients with asthma. A 2- to 3-week trial of therapy with systemic corticosteroids can help detect the presence of significant reversibility of the airway disease. Long-term-control asthma medication can then be offered.

Asthma medications may have increased adverse effects in the elderly patient; adjustments in the medication plan may be necessary.

- Airway response to *bronchodilators* may change with age, although this is not clearly established. Older patients, especially those with preexisting ischemic heart disease, may also be more sensitive to beta₂-agonist side effects, including tremor and tachycardia. Concomitant use of anticholinergics and beta₂-agonists may be beneficial to the older patient (Ullah et al. 1981; Barros and Rees 1990; Gross et al. 1989).
- *Theophylline* clearance is reduced in the elderly patient (Nielsen-Kudsk et al. 1988), causing increased blood levels of theophylline. In addition, age is an independent risk factor for developing life-threatening events from iatrogenic chronic theophylline overdose (patients 75 years of age or older have a 16-fold greater risk of death from theophylline overdose than do 25-year-olds) (Shannon and Lovejoy 1990). The potential for drug interaction—especially with antibiotics and H₂-histamine antagonists such as cimetidine—is greater because of the increased use of medications in this age group. Theophylline and epinephrine may exacerbate underlying heart conditions.
- *Systemic corticosteroids* can provoke confusion, agitation, and changes in glucose metabolism.
- A dose-dependent reduction in bone mineral content may be associated with *inhaled corticosteroid* use, although low or medium doses appear to have no major adverse effect. Elderly patients may be more at risk due to preexisting osteoporosis, changes in estrogen levels that affect calcium utilization, and a sedentary lifestyle. However, the risk of not adequately controlling asthma may unnecessarily limit the patient's mobility and activities. Concurrent treatment with calcium

supplements and vitamin D, and estrogen replacement when appropriate, are recommended. At the present time, the optimal approach for identifying patients at risk for accelerated bone loss from high-dose corticosteroid therapy is to conduct bone densitometry when treatment begins and again 6 months later (NHLBI 1996), although the benefits of this approach have not yet been evaluated in clinical trials.

Medications employed for other diseases may exacerbate asthma; adjustments may need to be made. Nonsteroidal anti-inflammatory agents for treating arthritis, nonselective beta-blockers for treating hypertension, or beta-blockers found in some eye drops used to treat glaucoma may exacerbate asthma. See component 2 for more details on drugs that can complicate asthma management.

For more information on asthma in older patients, see *NAEPP Working Group Report: Considerations for Diagnosing and Managing Asthma in the Elderly* (NHLBI 1996).

MANAGING SPECIAL SITUATIONS IN ASTHMA

Seasonal Asthma

Some patients experience asthma symptoms only in relationship to certain pollens and molds. Such seasonal asthma should be treated according to the stepwise approach to long-term management of asthma. If the patient has seasonal asthma on a predictable basis, daily, long-term anti-inflammatory therapy (inhaled corticosteroids, cromolyn, or nedocromil) should be initiated prior to the anticipated onset of symptoms and continued through the season.

Cough Variant Asthma

Cough variant asthma is seen especially in young children. Cough is the principal symptom; because this frequently occurs at night, examinations during the day may be normal. Monitoring of morning and afternoon PEF variability and/or therapeutic trials with anti-inflammatory or bronchodilator medication may be helpful in diagnosis. Once the diagnosis is established, treat according to the stepwise approach to long-term management of asthma.

Exercise-Induced Bronchospasm

Exercise-induced bronchospasm—which untreated can limit and disrupt otherwise normal lives—should be anticipated in all asthma patients. EIB is a bronchospastic event that is caused by a loss of heat, water, or both from the lung during exercise because of hyperventilation of air that is cooler and dryer than that of the respiratory tree (Anderson 1985; Godfrey 1986; McFadden and Gilbert 1994). EIB usually occurs during or minutes after vigorous activity, reaches its peak 5 to 10 minutes after stopping the activity, and usually resolves in another 20 to 30 minutes.

Exercise may be the only precipitant of asthma symptoms for some patients. These patients should be monitored regularly to ensure that they have no symptoms of asthma or reductions in PEF in the absence of exercise, because EIB is often a marker of inadequate asthma management and responds well to regular anti-inflammatory therapy.

Diagnosis

A history of cough, shortness of breath, chest pain or tightness, wheezing, or endurance problems during exercise suggests EIB. An exercise challenge can be used to establish the diagnosis. This can be performed in a formal laboratory setting or as a free-run challenge sufficiently strenuous to increase the baseline heart rate to 80 percent of maximum for 4 to 6 minutes. Alternatively, the patient may simply undertake the task that previously caused the symptoms. A 15 percent decrease in PEF or FEV₁ (measurements taken before and after exercise at 5-minute intervals for 20 to 30 minutes) is compatible with EIB.

Management Strategies

One goal of management is to enable patients to participate in any activity they choose without experiencing asthma symptoms. EIB should not limit either participation or success in vigorous activities.

Recommended treatments include:

- **Beta₂-agonists** will prevent EIB in more than 80 percent of patients.
 - Short-acting inhaled beta₂-agonists used shortly before exercise (or as close to exercise as possible) may be helpful for 2 to 3 hours.

— Salmeterol has been shown to prevent EIB for 10 to 12 hours (Kemp et al. 1994).

- **Cromolyn and nedocromil**, taken shortly before exercise, are also acceptable for preventing EIB (Tullett et al. 1985; Woolley et al. 1990; Albazzaz et al. 1989; de Benedictis et al. 1995).
- A lengthy warmup period before exercise may benefit patients who can tolerate continuous exercise with minimal symptoms. The warmup may preclude a need for repeated medications.
- **Long-term-control therapy**, if appropriate. There is evidence that appropriate long-term control of asthma with anti-inflammatory medication will reduce airway responsiveness, and this is associated with a reduction in the frequency and severity of EIB (Vathenen et al. 1991).

Teachers and coaches need to be notified that a child has EIB, should be able to participate in activities, and may need inhaled medication before activity. Individuals involved in competitive athletics need to be aware that their medication use should be disclosed and should adhere to standards set by the U.S. Olympic Committee (Nastasi et al. 1995). The U.S. Olympic Committee's Drug Control Hotline is 1-800-233-0393.

Surgery and Asthma

Asthma patients are at risk for specific complications during and after surgery: acute bronchoconstriction triggered by intubation, hypoxemia and possible hypercapnia, impaired effectiveness of cough, atelectasis and respiratory infection (Kingston and Hirshman 1984), and latex exposure (Slater 1994; Sussman and Beezhold 1995). The likelihood of these complications depends on the severity of the patient's airway hyperresponsiveness, airflow obstruction, mucus hypersecretions, and latex sensitivity.

Recommended actions include:

- Patients with asthma should have an evaluation before surgery that includes a review of symptoms, medication use (particularly the use of systemic corticosteroids for longer than 2 weeks in the past 6 months), and measurement of pulmonary function.

- If possible, attempts should be made to improve lung function (FEV₁ or PEF) to their predicted values or their personal best level. A short course of systemic corticosteroids may be necessary to optimize pulmonary function.
- For patients who have received systemic corticosteroids during the past 6 months, give 100 mg hydrocortisone every 8 hours intravenously during the surgical period and reduce dose rapidly within 24 hours following surgery.

Pregnancy and Asthma

Maintaining sufficient lung function and blood oxygenation to ensure adequate oxygen supply to the fetus is essential. Poorly controlled asthma during pregnancy can result in increased perinatal mortality, increased prematurity, and low birth weight (Nelson and Weber 1988). For most drugs used to treat asthma and rhinitis, with the exception of brompheniramine, epinephrine, and alpha-adrenergic compounds (other than pseudoephedrine), there is little to suggest an increased risk to the fetus (Schatz et al. 1988; *Federal Register* 1979; Briggs et al. 1986). Other classes of drugs with some possibility of risk to the fetus include decongestants (other than pseudoephedrine), antibiotics (tetracycline, sulfonamides, and ciprofloxacin), live virus vaccines, immunotherapy (if doses are increased), and iodides.

For more information on asthma and pregnancy, see *Executive Summary: Management of Asthma During Pregnancy* (NHLBI 1992).

Stress and Asthma

The role of stress and psychological factors in asthma is important but not fully defined. There is emerging evidence that stress can play an important role in precipitating exacerbations of asthma and possibly act as a risk factor for an increase in prevalence of asthma (Busse et al. 1995). The mechanisms involved in this process have yet to be fully established and may involve enhanced generation of proinflammatory cytokines (Friedman et al. 1994). Equally important are psychosocial factors that are associated with poor outcome (e.g., conflict between patients and family and the medical staff, inappropriate asthma self-care, depressive symptoms, behavioral problems, emotional problems, and disregard of perceived asthma symptoms) (Strunk et al. 1985; Strunk 1993; Brush and Mathé 1993).

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Pharmacologic Therapy: Managing Exacerbations of Asthma

KEY POINTS

- Early treatment of asthma exacerbations is the best strategy for management. Important elements of early treatment include:
 - A written action plan to guide patient self-management of exacerbations at home, especially for patients with moderate-to-severe persistent asthma and any patient with a history of severe exacerbations
 - Recognition of early signs of worsening asthma
 - Appropriate intensification of therapy
 - Prompt communication between patient and clinician about any serious deterioration in symptoms or peak flow, decreased responsiveness to inhaled beta₂-agonists, or decreased duration of effect
- Management of asthma exacerbations includes:
 - Inhaled beta₂-agonist to provide prompt relief of airflow obstruction
 - Systemic corticosteroids, for moderate-to-severe exacerbations or for patients who fail to respond promptly and completely to an inhaled beta₂-agonist, to suppress and reverse airway inflammation
 - Oxygen to relieve hypoxemia for moderate-to-severe exacerbations
 - Monitoring response to therapy with serial measurements of lung function

Asthma exacerbations are acute or subacute episodes of progressively worsening shortness of breath, cough, wheezing, and chest tightness or some combination of these symptoms. Exacerbations are characterized by decreases in expiratory airflow that can be documented and quantified by simple measurement of lung function (spirometry or peak expiratory flow [PEF]). These objective measures

more reliably indicate the severity of an exacerbation than does the severity of symptoms.

GENERAL CONSIDERATIONS

The Expert Panel recommends that clinicians consider the following general principles and goals for managing asthma exacerbations, based on the scientific literature and the opinion of the Panel.

- Early treatment is the best strategy for management of asthma exacerbations. Important elements of early treatment include:
 - A written action plan (see figure 4-5) to guide patient self-management, especially for patients with moderate-to-severe persistent asthma and any patient with a history of severe exacerbations
 - Recognition of early indicators of an exacerbation, including worsening FEV₁ or PEF
 - Prompt communication between patient and clinician about any serious deterioration in symptoms or peak flow, decreased responsiveness to inhaled beta₂-agonist, or decreased duration of effect
 - Appropriate intensification of therapy, often including a short course of systemic corticosteroids
 - Removal of or withdrawal from allergic or irritant precipitants in the environment that may be contributing to the exacerbation

- Patients at high risk of asthma-related death require special attention—particularly intensive education, monitoring, and care. They should be counseled to seek medical care early during an exacerbation and instructed about the availability of ambulance services. Such patients include those with identifiable risk factors (see figure 3-7a).

- **Infants require special attention, especially due to their greater risk for respiratory failure (see figure 3-7b).**

TREATMENT GOALS

The principal goals for treating asthma exacerbations are:

- **Correction of significant hypoxemia by administering supplemental oxygen.** In rare instances, alveolar hypoventilation requires mechanically assisted ventilation.
- **Rapid reversal of airflow obstruction.** This is best achieved by
 - Repetitive or continuous administration of an inhaled beta₂-agonist (Brenner 1983b; Lipworth et al. 1988; McFadden 1989; Lin et al. 1993; Rudnitsky et al. 1993; Papo et al. 1993)

FIGURE 3-7a. RISK FACTORS FOR DEATH FROM ASTHMA

- Past history of sudden severe exacerbations
- Prior intubation for asthma
- Prior admission for asthma to an intensive care unit
- Two or more hospitalizations for asthma in the past year
- Three or more emergency care visits for asthma in the past year
- Hospitalization or an emergency care visit for asthma within the past month
- Use of >2 canisters per month of inhaled short-acting beta₂-agonist
- Current use of systemic corticosteroids or recent withdrawal from systemic corticosteroids
- Difficulty perceiving airflow obstruction or its severity
- Comorbidity, as from cardiovascular diseases or chronic obstructive pulmonary disease
- Serious psychiatric disease or psychosocial problems
- Low socioeconomic status and urban residence
- Illicit drug use
- Sensitivity to *Alternaria*

Sources: Kallenbach et al. 1993; Rodrigo and Rodrigo 1993; Suissa et al. 1994; Greenberger et al. 1993; O'Hollaren et al. 1991

AND

— Early in the course of treatment, administration of systemic corticosteroids to patients with moderate-to-severe exacerbations or to patients who fail to respond promptly and completely to an inhaled beta₂-agonist (Fanta et al. 1983; Littenberg and Gluck 1986; Rowe et al. 1992; Scarfone et al. 1993; Connett et al. 1994).

- **Reduction of the likelihood of recurrence of severe airflow obstruction by intensifying therapy.** Often, a short course of systemic corticosteroids is useful (Fanta et al. 1983; Littenberg and Gluck 1986; Rowe et al. 1992; Scarfone et al. 1993; Connett et al. 1994).

Achieving these goals requires close monitoring by serial measurements of lung function to quantify the severity of airflow obstruction and its response to treatment. The improvement in FEV₁

FIGURE 3-7b. SPECIAL CONSIDERATIONS FOR INFANTS

- Assessment depends on physical examination rather than objective measurements. Use of accessory muscles, paradoxical breathing, cyanosis, and a respiratory rate >60 are key signs of serious distress.
- Objective measurements such as oxygen saturation of <91 percent also indicate serious distress.
- Response to beta₂-agonist therapy can be variable and may not be a reliable predictor of satisfactory outcome. However, because infants are at greater risk for respiratory failure, a lack of response noted by either physical examination or objective measurements should be an indication for hospitalization.
- Use of oral corticosteroids early in the episode is essential but should not substitute for careful assessment by a physician.
- Most acute wheezing episodes result from viral infections and may be accompanied by fever. Antibiotics are generally not required.

after 30 minutes of treatment correlates significantly with a broad range of indices of the severity of asthma exacerbations (Rodrigo and Rodrigo 1993), and repeated measurement of airflow in the emergency department can help reduce unnecessary admissions (Taylor 1994). Use PEF or FEV₁ values to guide treatment decisions, along with the patient's history, current symptoms, and physical findings. In using PEF expressed as a percentage of personal best, it is important to consider the impact of irreversible airflow obstruction. For a patient whose best PEF is 160 L/min, for example, a fall of 40 percent represents severe, potentially life-threatening obstruction.

HOME MANAGEMENT OF ASTHMA EXACERBATIONS

Beginning treatment at home avoids treatment delays, prevents exacerbations from becoming severe, and also adds to patients' sense of control over their asthma. The degree of care provided in the home depends on the patients' (or parents') abilities and experience and on the availability of emergency care. General guidelines for managing exacerbations at home are presented in figure 3-8.

The Expert Panel recommends the following actions to prepare patients for home management of asthma exacerbations, based on scientific literature (see component 1-Periodic Assessment and Monitoring and component 4) and the opinion of the Panel.

- Teach all patients how to monitor symptoms to recognize early signs of deterioration (see component 1-Periodic Assessment and Monitoring and component 4) and how to adjust their medications accordingly.
- Teach patients with moderate-to-severe persistent asthma and those with a history of severe exacerbations how to monitor their peak flow to assess the severity of an exacerbation and the response to therapy (see component 1-Periodic Assessment and Monitoring). In the absence of PEF measurement, severity can be judged only from the presence and intensity of signs and symptoms (see figure 3-9), which correlate imperfectly with the severity of airflow obstruction. This is especially true in a subgroup of patients ("poor perceivers") who do not sense airway narrowing until it is far advanced (Kikuchi et al. 1994).

- Give a *written* asthma action plan to be followed in the event of an exacerbation (see figure 4-5), especially to patients with moderate-to-severe persistent asthma and any patient with a history of severe exacerbations. Children should also receive a plan appropriate to the school setting (see figure 4-7). The plan should direct the patient to adjust medications in response to particular signs, symptoms, and peak flow measurements and should state when to seek medical help. Review the plan with the patient and family. The clinician should tailor the plan to the needs of individual patients. Patients at risk for asthma death (see figure 3-7a) require especially close monitoring.

- Teach patients to seek medical help early if (1) an asthma exacerbation is severe, (2) therapy does not give rapid, sustained improvement, or (3) there is further deterioration.
- Advise patients with moderate-to-severe persistent asthma or a history of severe exacerbations to have the medication (e.g., corticosteroid tablets or liquid) and equipment (e.g., peak flow meter, compressor-driven nebulizer for young children) for treating exacerbations at home.

The Expert Panel recommends the following pharmacologic therapy, based on the scientific literature, for home management of exacerbations:

- Increase the frequency of inhaled beta₂-agonist.
- Initiate or increase corticosteroid treatment under certain circumstances. For mild exacerbations in patients already taking an inhaled corticosteroid, many experts prescribe doubling the dose until peak flow returns to predicted or personal best. Although this practice has not been proved in a clinical trial, a few studies suggest its benefit (Lahdensuo et al. 1996; Wilson and Silverman 1990). For moderate-to-severe exacerbations (see figure 3-9), and for mild exacerbations that persist despite an increased dose of inhaled corticosteroids, a course of oral corticosteroids is necessary (Chapman et al. 1991; Fiel et al. 1983; Harris et al. 1987; Deshpande and McKenzie 1986; Loren et al. 1980; Rowe et al. 1992).
- Continue more intensive treatment for several days. Recovery from an exacerbation is often gradual. Greater use of medication should be continued until symptoms and PEF are stable, but

FIGURE 3-8. MANAGEMENT OF ASTHMA EXACERBATIONS: HOME TREATMENT

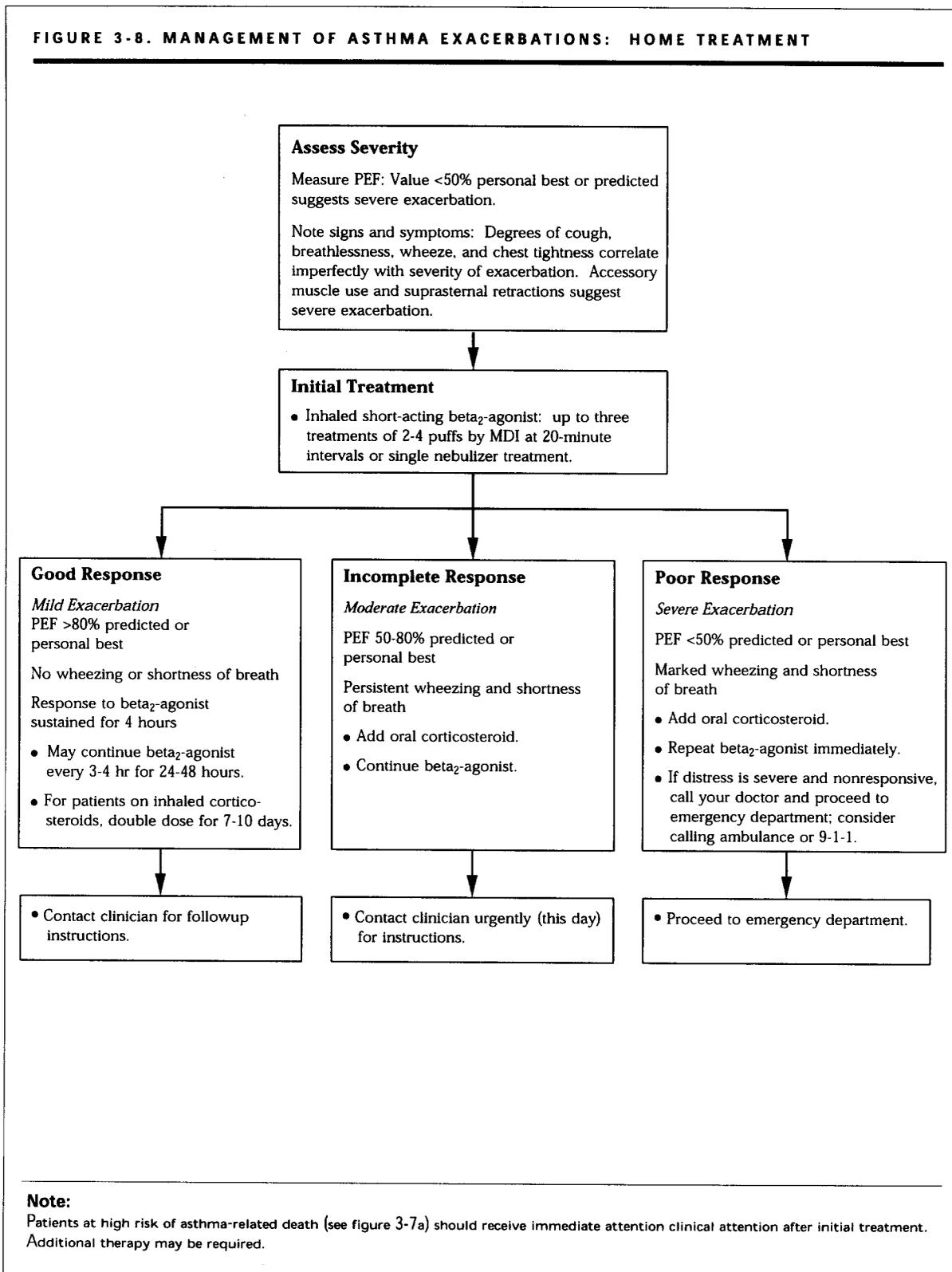


FIGURE 3-9. CLASSIFYING SEVERITY OF ASTHMA EXACERBATIONS

	Mild	Moderate	Severe	Respiratory Arrest Imminent
Symptoms				
Breathlessness	While walking	While talking (infant—softer, shorter cry; difficulty feeding)	While at rest (infant—stops feeding)	
	Can lie down	Prefers sitting	Sits upright	
Talks in	Sentences	Phrases	Words	
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Signs				
Respiratory rate	Increased	Increased	Often >30/min	
		Guide to rates of breathing in awake children: <i>Age</i> <i>Normal rate</i> <2 months <60/minute 2-12 months <50/minute 1-5 years <40/minute 6-8 years <30/minute		
Use of accessory muscles; suprasternal retractions	Usually not	Commonly	Usually	Paradoxical thoracoabdominal movement
Wheeze	Moderate, often only end expiratory	Loud; throughout exhalation	Usually loud; throughout inhalation and exhalation	Absence of wheeze
Pulse/minute	<100	100-120	>120	Bradycardia
		Guide to normal pulse rates in children: <i>Age</i> <i>Normal rate</i> 2-12 months <160/minute 1-2 years <120/minute 2-8 years <110/minute		
Pulsus paradoxus	Absent <10 mm Hg	May be present 10-25 mm Hg	Often present >25 mm Hg (adult) 20-40 mm Hg (child)	Absence suggests respiratory muscle fatigue
Functional Assessment				
PEF % predicted or % personal best	>80%	Approx. 50-80% or response lasts <2 hrs	<50% predicted or personal best	
PaO ₂ (on air) and/or	Normal (test not usually necessary)	>60 mm Hg (test not usually necessary)	<60 mm Hg: possible cyanosis	
PCO ₂	<42 mm Hg (test not usually necessary)	<42 mm Hg (test not usually necessary)	>42 mm Hg: possible respiratory failure (see text)	
SaO ₂ % (on air) at sea level	>95% (test not usually necessary)	91-95%	<91%	
Hypercapnia (hypoventilation) develops more readily in young children than in adults and adolescents.				

Note:

- The presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation.
- Many of these parameters have not been systematically studied, so they serve only as general guides.

patients should seek medical care rather than rely on bronchodilator therapy in excessive doses or for prolonged periods.

The Expert Panel does *not* recommend the following home management techniques because there are no studies demonstrating effectiveness and it is the opinion of the Panel that these techniques may delay patients from obtaining necessary care.

- Drinking large volumes of liquids or breathing warm, moist air (e.g., the mist from a hot shower).
- Using over-the-counter products such as antihistamines, cold remedies, and bronchodilators. Over-the-counter metered-dose inhalers may provide transient bronchodilation, but their use should not be permitted to delay seeking medical care.

The Expert Panel also notes that although pursed-lip and other forms of controlled breathing may help to maintain calm during respiratory distress, they do *not* bring about improvement in lung function.

PREHOSPITAL EMERGENCY MEDICINE/AMBULANCE MANAGEMENT OF ASTHMA EXACERBATIONS

The Expert Panel recommends that prehospital providers administer supplemental oxygen and inhaled short-acting bronchodilators to patients who have signs or symptoms of asthma. Prehospital administration of inhaled bronchodilators reduces airflow obstruction and relieves symptoms (Fergusson et al. 1995). Thus, advanced life support units should have available an inhaler plus spacer/holding chamber and/or nebulizer for beta₂-agonist administration (see figure 3-10 for dosages). If these are not available, subcutaneous epinephrine or terbutaline should be given for severe exacerbations (see figure 3-10) (Sly et al. 1977; Smith et al. 1977).

Ambulance services should develop prehospital protocols for the treatment of acute asthma in children and adults. Prehospital providers should receive training in how to respond to the clinical signs and symptoms of severe airway obstruction and imminent respiratory failure.

EMERGENCY DEPARTMENT AND HOSPITAL MANAGEMENT OF ASTHMA EXACERBATIONS

Severe exacerbations of asthma are potentially life threatening. Care must be prompt. Effective initial therapies (i.e., a short-acting beta₂-agonist and the means of giving it by aerosol and a source of supplemental oxygen) should be available in a physician's office. However, serious exacerbations require close observation for deterioration, frequent treatment, and repetitive measurement of lung function. Therefore, most severe exacerbations of asthma require prompt transfer to an emergency department for a complete course of therapy (Brenner 1983a). An overview of the treatment strategies in emergency departments and hospitals is presented in figure 3-11 and detailed below.

Assessment

The Expert Panel recommends that all clinicians treating asthma exacerbations be familiar with the characteristics of patients at risk for life-threatening deterioration (see figures 3-7a and 3-7b). In the emergency department, treatment should be started as soon as an asthma exacerbation is recognized and an assessment of lung function is made.

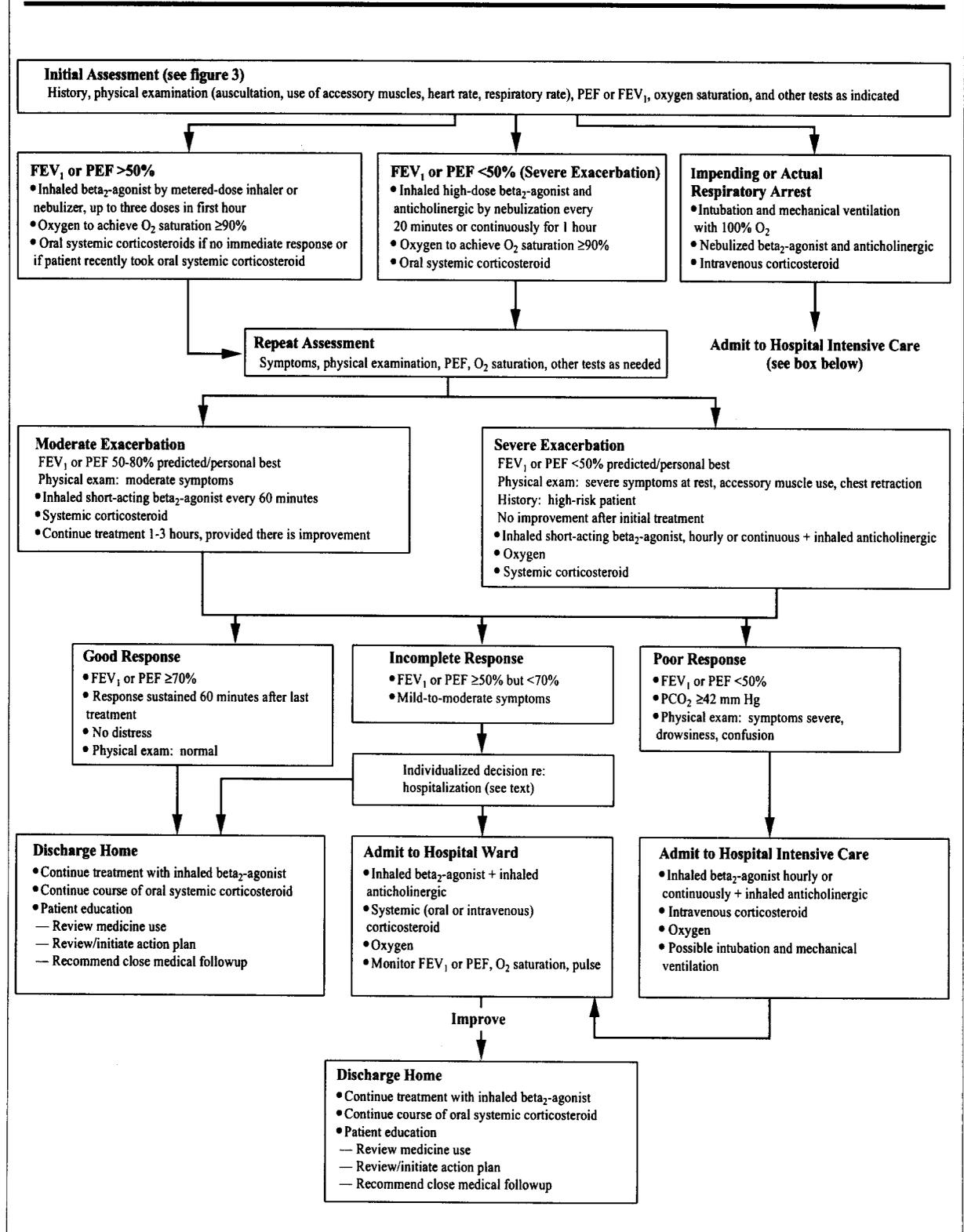
While treatment is given, obtain a brief, focused history and physical examination pertinent to the exacerbation (see figure 3-9). Take a more detailed history and complete physical examination and perform laboratory studies only after initial therapy has been completed.

- The objectives of *functional assessment* are to:
 - Obtain objective information on the severity of airflow obstruction (FEV₁ or PEF) and the patient's response to treatment. *In the emergency department*, obtain FEV₁ or PEF on presentation, after initial treatment, and at frequent intervals thereafter, depending on the patient's response to therapy. Rarely, a patient's airflow obstruction may be so severe as to prevent performance of a maximal expiratory maneuver. *In the hospital*, measure FEV₁ or PEF before and 15 to 20 minutes after bronchodilator therapy during the acute phase of the exacerbation. Thereafter, measure FEV₁ or PEF at least daily until discharge. Values <30 percent of predicted that improve by <10 percent after

FIGURE 3-10. DOSAGES OF DRUGS FOR ASTHMA EXACERBATIONS IN EMERGENCY MEDICAL CARE OR HOSPITAL

Medications	Dosages		Comments
	Adult Dose	Child Dose	
<i>Inhaled Short-Acting Beta₂-Agonists</i>			
Albuterol Nebulizer solution (5 mg/mL)	2.5-5 mg every 20 minutes for 3 doses, then 2.5-10 mg every 1-4 hours as needed, or 10-15 mg/hour continuously	0.15 mg/kg (minimum dose 2.5 mg) every 20 minutes for 3 doses, then 0.15-0.3 mg/kg up to 10 mg every 1-4 hours as needed, or 0.5 mg/kg/hour by continuous nebulization	Only selective beta ₂ -agonists are recommended. For optimal delivery, dilute aerosols to minimum of 4 mL at gas flow of 6-8 L/min.
MDI (90 mcg/puff)	4-8 puffs every 20 minutes up to 4 hours, then every 1-4 hours as needed as needed	4-8 puffs every 20 minutes for 3 doses, then every 1-4 hours inhalation maneuver. Use spacer/holding chamber.	As effective as nebulized therapy if patient is able to coordinate
Bitolterol Nebulizer solution (2 mg/mL)	See albuterol dose	See albuterol dose; thought to be half as potent as albuterol on a mg basis	Has not been studied in severe asthma exacerbations. Do not mix with other drugs.
MDI (370 mcg/puff)	See albuterol dose	See albuterol dose	Has not been studied in severe asthma exacerbations.
Pirbuterol MDI (200 mcg/puff)	See albuterol dose	See albuterol dose; thought to be half as potent as albuterol on a mg basis	Has not been studied in severe asthma exacerbations.
<i>Systemic (Injected) Beta₂-Agonists</i>			
Epinephrine 1:1000 (1 mg/mL)	0.3-0.5 mg every 20 minutes for 3 doses sq	0.01 mg/kg up to 0.3-0.5 mg every 20 minutes for 3 doses sq	No proven advantage of systemic therapy over aerosol.
Terbutaline (1 mg/mL)	0.25 mg every 20 minutes for 3 doses sq	0.01 mg/kg every 20 minutes for 3 doses then every 2-6 hours as needed sq	No proven advantage of systemic therapy over aerosol.
<i>Anticholinergics</i>			
Ipratropium bromide Nebulizer solution (.25 mg/mL)	0.5 mg every 30 minutes for 3 doses then every 2-4 hours as needed	.25 mg every 20 minutes for 3 doses, then every 2 to 4 hours	May mix in same nebulizer with albuterol. Should not be used as first-line therapy; should be added to beta ₂ -agonist therapy.
MDI (18 mcg/puff)	4-8 puffs as needed	4-8 puffs as needed	Dose delivered from MDI is low and has not been studied in asthma exacerbations.
<i>Corticosteroids</i>			
Prednisone Methylprednisolone Prednisolone	120-180 mg/day in 3 or 4 divided doses for 48 hours, then 60-80 mg/day until PEF reaches 70% of predicted or personal best	1 mg/kg every 6 hours for 48 hours then 1-2 mg/kg/day (maximum = 60 mg/day) in 2 divided doses until PEF 70% of predicted or personal best	For outpatient "burst" use 40-60 mg in single or 2 divided doses for adults (children: 1-2 mg/kg/day, maximum 60 mg/day) for 3-10 days
Note:			
<p>■ No advantage has been found for higher dose corticosteroids in severe asthma exacerbations, nor is there any advantage for intravenous administration over oral therapy provided gastrointestinal transit time or absorption is not impaired. The usual regimen is to continue the frequent multiple daily dosing until the patient achieves an FEV₁ or PEF of 50 percent of predicted or personal best and then lower the dose to twice daily. This usually occurs within 48 hours. Therapy following a hospitalization or emergency department visit may last from 3 to 10 days. If patients are then started on inhaled corticosteroids, studies indicate there is no need to taper the systemic corticosteroid dose. If the followup systemic corticosteroid therapy is to be given once daily one study indicates that it may be more clinically effective to give the dose in the afternoon at 3:00 p.m., with no increase in adrenal suppression (Beam et al. 1992).</p>			

FIGURE 3-11. MANAGEMENT OF ASTHMA EXACERBATIONS: EMERGENCY DEPARTMENT AND HOSPITAL-BASED CARE



bronchodilator therapy or that fluctuate widely over 24 hours indicate a heightened risk of life-threatening deterioration.

—In patients with severe distress or with FEV₁ or PEF < 50 percent of predicted, assess the adequacy of arterial oxygen saturation by pulse oximetry (Connett and Lenney 1993; Geelhoed et al. 1994).

■ Objectives of the *brief history* are to determine:

—Time of onset and cause of current exacerbation

—Severity of symptoms, especially compared with previous exacerbations

—All current medications and time of last dose

—Prior hospitalizations and emergency department visits for asthma, particularly within the past year

—Prior episodes of respiratory insufficiency due to asthma (loss of consciousness or intubation and mechanical ventilation)

—Other potentially complicating illness, especially other pulmonary or cardiac disease or diseases that may be aggravated by systemic corticosteroid therapy such as diabetes, peptic ulcer, hypertension, and psychosis

■ Objectives of the *physical examination* are to:

—Assess the severity of the exacerbation as indicated by the findings listed in figure 3-9.

—Assess overall patient status, including level of alertness, fluid status, and presence of cyanosis, respiratory distress, and wheezing. Wheezing can be an unreliable indicator of obstruction; in rare cases, extremely severe obstruction may be accompanied by a "silent chest" (Shim and Williams 1980).

—Identify complications (e.g., pneumonia, pneumothorax, or pneumomediastinum).

—Identify other diseases that may affect asthma (e.g., allergic rhinitis, rhinitis, sinusitis).

—Rule out upper airway obstruction. Both intrathoracic and extrathoracic central airway obstruction can cause severe dyspnea and may be diagnosed as asthma. Causes include epiglottitis, organic diseases of the larynx, vocal cord dysfunction, and extrinsic and intrinsic tracheal narrowing (see component 1-Initial Assessment and Diagnosis). Clues as to their presence include dysphonia, inspiratory stridor, monophonic wheezing loudest over the central airway, normal values for PO₂, and unexpectedly complete resolution of airflow obstruction with intubation. When upper airway obstruction is suspected, obtain further evaluation by flow-volume curves and by referral for laryngoscopy (see component 1-Initial Assessment and Diagnosis).

■ The most important objective of *laboratory studies* is detection of actual or impending respiratory failure; other objectives include detection of theophylline toxicity and of conditions that complicate the treatment of asthma exacerbations. *Do not permit these studies to delay initiation of treatment.* For example,

—Consider *arterial blood gas (ABG)* measurement for evaluating arterial carbon dioxide tension (PCO₂) in patients with suspected hypoventilation, with severe distress, or with FEV₁ or PEF 30 percent of predicted after initial treatment. (NOTE: Respiratory drive is typically increased in asthma exacerbations, so a "normal" PCO₂ of 40 mm indicates severe airflow obstruction and a heightened risk of respiratory failure.)

—*Complete blood count (CBC)* may be appropriate in patients with fever or purulent sputum; keep in mind that modest leukocytosis is common in asthma exacerbations and that corticosteroid treatment causes a further outpouring of polymorphonuclear leukocytes within 1 to 2 hours of administration.

—Measure *serum theophylline concentration* in patients taking theophylline prior to presentation.

—It may be prudent to measure *serum electrolytes* in patients who have been taking diuretics regularly and in patients with coexistent cardiovascular disease, because frequent beta₂-agonist administration can cause transient decreases in serum potassium, magnesium, and phosphate.

— *Chest radiography* is not recommended for routine assessment but should be obtained in patients suspected of a complicating cardiopulmonary process, such as pneumothorax, pneumomediastinum, pneumonia, lobar atelectasis, or congestive heart failure.

— *Electrocardiograms* need not be routinely obtained, but a baseline electrocardiogram and continual monitoring of cardiac rhythm are appropriate in patients older than 50 years of age and in those with coexistent heart disease or chronic obstructive pulmonary disease. The electrocardiogram may show a pattern of right ventricular strain that reverses promptly with treatment of airflow obstruction.

■ *Assessment considerations unique to children and infants are as follows:*

— It is often difficult for physicians and parents to determine the severity of the airway obstruction in infants and small children with asthma. However, using a combination of the subjective and objective parameters in figure 3-9 permits a fairly accurate assessment to guide initial therapy. Many of these parameters have not been systematically studied, so they serve only as general guides.

— The differences in the anatomy and physiology of the lungs of infants place them at greater risk for respiratory failure. These differences include greater peripheral airway resistance, fewer collateral channels of ventilation, further extension of airway smooth muscle into the peripheral airways, less elastic recoil, and mechanical disadvantage of the diaphragm. Viral infections, particularly respiratory syncytial virus, are the most common cause of acute wheezing illness in infants. The edematous inflammatory response in the airways leads to air trapping and hyperinflation, atelectasis, increased respiratory rate, and wheezing. This sequence of changes can rapidly progress to respiratory failure. Close monitoring is critical.

— It is particularly important to monitor O_2 saturation by pulse oximetry in infants because their ventilation/perfusion characteristics lead them to become hypoxemic more readily than adults. SaO_2 should be normal for altitude (>95 percent at sea level). Decreased oxygen

saturation is often an early sign of severe airway obstruction, and an $SaO_2 < 91$ percent on room air is a good predictor of the need for hospitalization in small infants (Connett and Lenney 1993; Geelhoed et al. 1994).

— Capillary or ABG measurements should be performed in infants suspected of respiratory failure. PCO_2 is the best measurement of ventilation in infants, as it is in adults. Children with a normal PCO_2 but in obvious respiratory distress are at high risk for respiratory failure.

Treatment

In the emergency department and hospital, tailor the intensity of treatment and surveillance to the severity of the exacerbation. The primary therapies—the administration of oxygen, inhaled beta₂-agonist, and systemic corticosteroids—are constant, but the dose and frequency with which they are given and the frequency with which the patient's response is assessed may vary. Thus, for patients presenting with a severe exacerbation, give inhaled beta₂-agonist therapy at the higher dose (figure 3-10) either repeatedly (three treatments in the first hour) or continuously (by nebulization), give systemic corticosteroids immediately, and watch closely for signs of worsening airflow obstruction or fatigue. For patients with mild exacerbations, give inhaled beta₂-agonist therapy and assess the patient's response before deciding whether additional therapy is necessary. Give supplemental oxygen to patients with significant hypoxemia and to patients with FEV_1 or PEF < 50 percent of predicted when arterial oxygen monitoring is not available.

The following recommendations are based on scientific evidence (key studies are cited) and the opinion of the Expert Panel:

- **Oxygen is recommended for most patients.** Administer supplemental oxygen (by nasal cannulae or mask, whichever is best tolerated) to maintain an $SaO_2 > 90$ percent (>95 percent in pregnant women and in patients with coexistent heart disease). Monitor oxygen saturation until a clear response to bronchodilator therapy has occurred.
- **Inhaled short-acting beta₂-agonists are recommended for all patients** (for recommended doses, see figure 3-10).

- The repetitive or continuous administration of inhaled short-acting beta₂-agonists is the most effective means of reversing airflow obstruction (Lipworth et al. 1988; Lin et al. 1993; Rudnitsky et al. 1993).
 - *In the emergency department*, three treatments of beta₂-agonists spaced every 20 to 30 minutes can be given safely as initial therapy. Thereafter, the frequency of administration varies according to the improvement in airflow obstruction and associated symptoms and the occurrence of side effects. Continuous administration of beta₂-agonists may be more effective in children and severely obstructed adults (Lin et al. 1993; Rudnitsky et al. 1993; Papo et al. 1993; Kelly and Murphy 1992).
 - Because of the risk of cardiotoxicity, use only selective beta₂-agonists (albuterol, terbutaline, pirbuterol, bitolterol) in high doses.
 - Studies show that equivalent bronchodilation can be achieved by either high doses (6 to 12 puffs) of a beta₂-agonist by MDI with a spacer/holding chamber under the supervision of trained personnel or by nebulizer therapy (Idris et al. 1993; Colacone et al. 1993; Kerem et al. 1993). However, nebulized therapy is more effective in patients who are unable to coordinate inhalation of medication from an MDI because of their age, agitation, or severity of the exacerbation.
 - The onset of action for inhaled beta₂-agonist is less than 5 minutes; repetitive administration produces incremental bronchodilation (Lipworth et al. 1988).
 - Duration of action of bronchodilation from beta₂-agonists in severe asthma exacerbations is not precisely known.
- **Anticholinergics may be considered.** Adding high doses of ipratropium bromide (0.5 mg in adults, 0.25 mg in children) to an aerosolized solution of a selective beta₂-agonist has been shown to cause additional bronchodilation, particularly in those with severe airflow obstruction (Schuh et al. 1995; Reisman et al. 1988; O'Driscoll et al. 1989; Kelly and Murphy 1991), although some studies did not demonstrate this effect (Karpel et al. 1996).
- **Systemic corticosteroids are recommended for most patients (for recommended doses, see figure 3-10).**
 - *In the emergency department*: Give systemic corticosteroids to patients who have moderate-to-severe exacerbations and patients who do not respond completely to initial beta₂-agonist therapy. These medications appear to speed the resolution of airflow obstruction and reduce the rate of relapse (Fanta et al. 1983; Rowe et al. 1992; Scarfone et al. 1993; Connett et al. 1994; Chapman et al. 1991).
 - Oral administration of prednisone has been shown to have effects equivalent to those of intravenous methylprednisolone (Harrison et al. 1986; Ratto et al. 1988) and, in the opinion of the Expert Panel, is usually preferred because it is less invasive.
 - Give supplemental doses of oral corticosteroids to patients who take them regularly, even if the exacerbation is mild.
 - In infants and children, it is especially important to give corticosteroids early in the course of an asthma exacerbation (Harris et al. 1987).
 - *In the hospital*: Give systemic corticosteroids to patients admitted to the hospital, because they speed the resolution of asthma exacerbations (Connett et al. 1994; Rowe et al. 1992; Singh and Kumar 1993).
- **Methylxanthines are not generally recommended.**
 - *In the emergency department*: Theophylline/aminophylline is not recommended because it appears to provide no additional benefit to optimal inhaled beta₂-agonist therapy and may increase adverse effects (Fanta et al. 1986; Rossing et al. 1980; Murphy et al. 1993; Rodrigo and Rodrigo 1994; Coleridge et al. 1993).
 - In patients currently taking a theophylline-containing preparation, determine serum theophylline concentration to rule out theophylline toxicity.

— *In the hospital:* Therapy with oral or intravenous methylxanthines does not benefit children hospitalized with severe asthma (Strauss et al. 1994; Carter et al. 1993; DiGiulio et al. 1993). The addition of intravenous theophylline in hospitalized adults remains controversial (Huang et al. 1993; Self et al. 1990).

- Antibiotics are *not* recommended for asthma treatment but may be necessary for comorbid conditions. Bacterial, chlamydia, and mycoplasma respiratory tract infections are thought to contribute only infrequently to exacerbations of asthma. The use of antibiotics is generally reserved for those patients with fever and purulent sputum (discolored because of polymorphonuclear leukocytes, not eosinophils) and for patients with evidence of pneumonia. When the presence of bacterial sinusitis is suspected, treat with antibiotics.
- Aggressive hydration is *not* recommended for older children and adults but may be indicated for infants and young children. Intravenous or oral administration of large volumes of fluids does *not* play a role in the management of severe asthma exacerbations. However, infants and young children may become dehydrated as a result of increased respiratory rate and decreased oral intake. In these patients, make an assessment of fluid status (urine output, urine specific gravity, mucus membrane moisture, electrolytes) and provide appropriate corrections.
- Chest physical therapy is *not* generally recommended. In general, chest physiotherapy is not beneficial and is unnecessarily stressful for the breathless asthma patient.
- Mucolytics are *not* recommended. Avoid mucolytic agents (e.g., acetylcysteine, potassium iodide) because they may worsen cough or airflow obstruction.
- Sedation is *not* recommended. Anxiolytic and hypnotic drugs are contraindicated in severely ill asthma patients because of their respiratory depressant effect.

Repeat Assessment

The Expert Panel recommends that repeat assessment of patients with severe exacerbations be

made after the initial dose of inhaled bronchodilator and that repeat assessment of all patients be made after three doses of inhaled bronchodilator (60 to 90 minutes after initiating treatment). The response to initial treatment in the emergency department is a better predictor of the need for hospitalization than is the severity of an exacerbation on presentation (Rodrigo and Rodrigo 1993). The elements to be evaluated include the patient's subjective response, physical findings, measurement of airflow, and measurement of ABG if the patient now meets the criteria described in the discussion of laboratory studies in the Assessment section, page 110.

Hospitalization

The decision to hospitalize a patient should be based on duration and severity of symptoms, severity of airflow obstruction, course and severity of prior exacerbations, medication use at the time of the exacerbation, access to medical care and medications, adequacy of support and home conditions, and presence of psychiatric illness. In general, the principles of care in the hospital resemble those for care in the emergency department and involve both treatment with oxygen, aerosolized bronchodilators, and systemic corticosteroids and frequent assessment, including clinical assessment of respiratory distress and fatigue and objective measurement of airflow (PEF or FEV₁) and oxygen saturation.

Impending Respiratory Failure

Most patients respond well to therapy. However, a small minority will show signs of worsening ventilation, whether from worsening airflow obstruction, worsening respiratory muscle fatigue, or a combination of the two. Signs of impending respiratory failure include a declining mental clarity, worsening fatigue, and a PCO₂ of > 42 mm Hg. Exactly when to intubate is based on clinical judgment; however, the Expert Panel recommends that intubation not be delayed once it is deemed necessary. Because respiratory failure can progress rapidly and can be difficult to reverse, early recognition and treatment are critically important.

Because intubation of a severely ill asthma patient is difficult, additional treatments are sometimes attempted, such as intravenous administration of magnesium sulfate (Kuitert and Kletchko 1991; Skorodin et al. 1995; Tiffany et al. 1993; Green and Rothrock 1992) and substituting a mixture of helium and

oxygen ("heliox") for oxygen-enriched air (Manthous et al. 1995; Gluck et al. 1990). Although limited observations suggest that these therapies may be effective, possibly among certain subgroups (Bloch et al. 1995), they have not yet been proven consistently effective. Intravenous administration of a beta₂-agonist also falls into this category of unproven treatment. Recent studies suggest that albuterol is more effective and has fewer side effects when it is given by aerosol than when given intravenously (Salmeron et al. 1994), but the efficacy of adding an intravenous beta₂-agonist to high-dose nebulized therapy has not been studied. Do not use intravenous isoproterenol in the treatment of asthma because of the danger of myocardial toxicity (Maguire et al. 1991).

The Expert Panel recommends the following actions regarding intubation:

- Patients presenting with apnea or coma should be intubated immediately. There are no other absolute indications for endotracheal intubation, but persistent or increasing hypercapnia, exhaustion, and depression of mental status strongly suggest the need for ventilatory support.
- Consultation with or comanagement by physicians expert in ventilator management is appropriate because mechanical ventilation of patients with severe refractory asthma is complicated and fraught with risk.
- Because intubation is difficult in asthma patients, it is best done semi-electively, before the crisis of respiratory arrest.
- Intubation should be performed in a controlled setting by a physician with extensive experience in intubation and airway management.
 - It is preferable that patients with severe exacerbations who are slowly responsive to therapy be admitted to an intensive care unit where they can be monitored closely and intubated if it is indicated.
 - Because intubation should not be delayed once it is deemed necessary, it may be performed in the emergency department or inpatient ward and the patient transferred to an intensive care unit appropriate to the patient's age.
- Children intubated for asthma should be admitted to a pediatric intensive care unit or transferred to a facility that has such a unit.
- Issues to consider at the time of intubation include the following:
 - Close attention should be given to maintaining or replacing intravascular volume, because hypotension commonly accompanies the initiation of positive pressure ventilation.
 - Once mechanical ventilation has been started, it is important to avoid high ventilator pressures and the associated risks of barotrauma.
- "Permissive hypercapnia" or "controlled hypoventilation" is the recommended ventilator strategy to provide adequate oxygenation and ventilation while minimizing high airway pressures and barotrauma (Tuxen 1994; Darioli and Perret 1984; Menitove and Goldring 1983). It involves administration of as high an FiO₂ as is necessary to maintain adequate arterial oxygenation, acceptance of hypercapnia, and treatment of respiratory acidosis with intravenous sodium bicarbonate. Adjustments are made to the tidal volume, ventilator rate, and I:E ratio to minimize airway pressures. Bronchodilators are continued, and even in ventilated patients, aerosol delivery is the route of choice (Dhand and Tobin 1996).

This ventilator strategy is not uniformly successful in critically ill asthma patients, and additional therapies are being evaluated. Their review is beyond the scope of this report.

Patient Discharge

Before discharge, provide patients with necessary medications and education in how to use them, instruction in self-assessment (e.g., by monitoring symptoms and peak flow), a followup appointment, and instruction in an action plan for managing recurrence of airflow obstruction. To ensure that these steps are taken, a discharge checklist may be useful (see example in figure 3-12).

From the Emergency Department

- Release of the patient from the emergency department depends on the patient's response to treatment.

FIGURE 3-12. HOSPITAL DISCHARGE CHECKLIST FOR PATIENTS WITH ASTHMA EXACERBATIONS

Intervention	Dose/Timing	Education/Advice	M.D./R.N. Initials
Inhaled medications (MDI + spacer/holding chamber)	Select agent, dose, and frequency (e.g., albuterol)	Teach purpose Teach technique	
Beta ₂ -agonist	2-6 puffs q 3-4 hr prn	Emphasize need for spacer/ holding chamber	
Corticosteroids	Medium dose	Check patient technique	
Oral medications	Select agent, dose, and frequency (e.g., prednisone 20 mg bid for 3-10 days)	Teach purpose Teach side effects	
Peak flow meter	Measure a.m. and p.m. PEF and record best of three tries each time	Teach purpose Teach technique Distribute peak flow diary	
Followup visit	Make appointment for followup care with primary clinician or asthma specialist	Advise patient (or caregiver) of date, time, and location of appointment within 7 days of hospital discharge	
Action plan	Before or at discharge	Instruct patient (or caregiver) on simple plan for actions to be taken when symptoms, signs, and PEF values suggest recurrent airflow obstruction	

- In general, discharge is appropriate if FEV₁ or PEF has returned to ≥70 percent of predicted or personal best and symptoms are minimal or absent. Patients with an incomplete response to therapy (FEV₁ or PEF ≥50 but <70 percent predicted or personal best) and with mild symptoms should be assessed individually for their suitability for discharge home, with consideration of factors listed in figure 3-7a.
- The Panel's opinion is that patients with a rapid response should be observed for 30 to 60 minutes after the most recent dose of bronchodilator to ensure stability of response before discharge to home.
- Extended treatment and observation in a holding area, clinical decision unit, or overnight unit to determine the need for hospitalization may be appropriate provided there is sufficient monitoring and nursing care.
- Prescribe sufficient medications for the patient to continue treatment after discharge. Patients given systemic corticosteroids should continue oral systemic corticosteroids for 3 to 10 days. The need for further corticosteroid therapy should be assessed at a followup visit. If the patient is receiving inhaled corticosteroids, it is not necessary to taper the dose gradually when the course is completed (O'Driscoll et al. 1993).
- Emphasize the need for continual, regular care in an outpatient setting. Refer the patient to a followup medical appointment. A visit to the emergency department is often an indication of inadequate long-term management of asthma or inadequate plans for handling exacerbations. Notify the patient's health care professional (or provide a referral to one if the patient does not name a source of asthma care), and instruct the patient to seek a followup medical appointment within 3 to 5 days. When possible, schedule such an appointment prior to the patient's discharge. The followup visit should include a detailed review of the patients' medications, inhaler and peak flow meter technique, and development of comprehensive daily management and action plans that will help prevent exacerbations and urgent care visits (see figures 4-4 and 4-5). Referral to an asthma specialist for consultation should be considered because this has been reported to reduce the rate of subsequent emergency department visits (Zeiger et al. 1991).

- Review written discharge medications and, whenever possible, provide patient education on avoidance of asthma triggers and correct use of an inhaler (see figure 4-3).
- Instruct the patient in a simple action plan for increasing medications or returning for care should asthma worsen.
- Consider issuing a peak flow meter and providing patient education on how to measure and record daily PEF rates.

From the Hospital

- Prior to discharge, adjust the patient's medication to an oral and/or inhaled regimen. The optimal timing of this transition is not precisely established, but the general approach is to wait until the patient is minimally symptomatic from asthma and has little wheezing on chest examination. Usually this clinical status corresponds to a PEF or FEV₁ of >70 percent of predicted or personal best. During the first 24 hours after this medication adjustment, observe the patient for possible deterioration.
- Discharge medications should include a short-acting inhaled beta₂-agonist and sufficient oral corticosteroid to complete the course of therapy or to continue therapy until the followup appointment. If the decision is made to start the patient on inhaled corticosteroids, they should be started before the course of oral corticosteroids is completed, because their onset of action is gradual (Kraan et al. 1988). Starting the inhaled corticosteroid therapy before discharge gives the patient additional time to learn and demonstrate appropriate technique.
- Provide patient education:
 - An exacerbation severe enough to require hospitalization may reflect a failure of the patient's self-management plan. Hospitalized patients may be particularly receptive to information and advice about their illness; take the opportunity to review patient understanding of the causes of asthma exacerbations, the purposes and correct uses of treatment, and the actions to be taken for worsening symptoms or peak flow values.
 - Educate patients about their discharge medications and the importance of a followup medical visit. Referral to an asthma specialist should be considered for patients with a history of life-threatening exacerbations or multiple hospitalizations (see component 1, page 23) (Mayo et al. 1990).
 - Educate patients older than 5 years of age in the use of peak flow meters to monitor their lung function at home.
 - Review or develop an action plan for management of recurrent symptoms or exacerbations. The plan should describe the signs, symptoms, and/or peak flow values that should prompt increases in self-medication, contact with a health care provider, or return for emergency care. The plan given at discharge from the emergency department may be quite simple (e.g., instructions for discharge medications and returning for care should asthma worsen). The plan developed for discharge from the hospital should be more complete (see figure 3-12). A detailed plan for comprehensive long-term management and handling exacerbations should be developed by the regular provider at a followup visit (see figure 4-5).

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COMPONENT 4: EDUCATION FOR A PARTNERSHIP IN ASTHMA CARE

KEY POINTS

- Patient education should begin at the time of diagnosis and be integrated into *every* step of clinical asthma care.
- It is essential that education be provided by *all* members of the health care team. The principal clinician should introduce the key educational messages and negotiate agreements with patients; these messages should be reinforced and expanded by all members of the health care team.
- Teach asthma self-management, tailoring the approach to the needs of each patient. Maintain a sensitivity to cultural beliefs and practices.
- Teach and reinforce at *every* opportunity:
 - Basic facts about asthma
 - Roles of medications
 - Skills: inhaler/spacer/holding chamber use, self-monitoring
 - Environmental control measures
 - When and how to take rescue actions
- Jointly develop treatment goals.
- To encourage an active partnership, provide all patients with a written daily self-management plan and an action plan for exacerbations. Action plans are especially important for patients with moderate-to-severe asthma and patients with a history of severe exacerbations. Provide appropriate patients with a daily asthma diary.
- Encourage adherence by promoting open communication; individualizing, reviewing, and adjusting plans as needed; emphasizing goals and outcomes; and encouraging family involvement.

DIFFERENCES FROM 1991 EXPERT PANEL REPORT

- Emphasis is on patient education by the principal clinician as well as other members of the health care team.
 - To enhance the delivery of education, detailed questions to elicit information and educational messages for each visit are provided in chart form. Reinforcement of key messages is emphasized.
 - Additional emphasis is placed on evaluating outcomes in terms of patient perceptions of improvement, especially quality of life and the ability to engage in desired activities.
 - Roles of written materials and formal education programs are clarified with emphasis that they can supplement but not replace education by clinicians. A list of sources for asthma education programs and materials is provided.
 - Renewed emphasis is placed on providing patients with *both* a written treatment plan for daily self-management and a written action plan for management of exacerbations. Examples are provided that are applicable to both children and adults.
 - New section on assessing and responding to cultural and language differences was added.
 - New section on patient education for non-chlorofluorocarbon inhalers was added.
-

FIGURE 4-1. KEY EDUCATIONAL MESSAGES FOR PATIENTS

Check off or document that the following key messages have been covered:

Basic Facts About Asthma

- The contrast between asthmatic and normal airways
- What happens to the airways in an asthma attack

Roles of Medications

- How medications work
 - Long-term control: medications that prevent symptoms, often by reducing inflammation
 - Quick relief: short-acting bronchodilator relaxes muscles around airways
- Stress the importance of long-term-control medications and not to expect quick relief from them.

Skills

- Inhaler use (patient demonstrate)
- Spacer/holding chamber use
- Symptom monitoring, peak flow monitoring, and recognizing early signs of deterioration

Environmental Control Measures

- Identifying and avoiding environmental precipitants or exposures

When and How To Take Rescue Actions

- Responding to changes in asthma severity (daily self-management plan and action plan)

Patient education is an essential component of successful asthma management. Current management approaches require patients and families to effectively carry out complex pharmacologic regimens, institute environmental control strategies, detect and self-treat most asthma exacerbations, and communicate appropriately with health care providers. Patient education is the mechanism through which patients learn to successfully accomplish those tasks. It is also a powerful tool for helping patients gain the motivation, skill, and confidence to control their asthma (Feldman et al. 1987; Mellins 1989). Research shows that asthma education can be cost-effective and can reduce morbidity for both adults and children,

especially among high-risk patients (Trautner et al. 1993; Bolton et al. 1991; Fireman et al. 1981; Hindi-Alexander and Cropp 1984; Lewis et al. 1984; Clark et al. 1986).

This component covers strategies for enhancing the delivery of patient education and improving the likelihood that patients will follow clinical recommendations, as well as key messages to communicate to the patient. When references are not cited, recommendations are based on the opinion of the Expert Panel.

ESTABLISH A PARTNERSHIP

Patient education should begin at the time of diagnosis and be integrated into every step of medical care, in the context of medical appointments and other clinician-patient communication. When clinicians take the time to provide education, it sends a powerful message to patients and families about the importance of being knowledgeable self-management of asthma. Specific educational messages delivered in the context of a medical care appointment clearly communicate the importance of collaboration in the treatment of asthma (Mayo et al. 1990; Ignacio-Garcia and Gonzales-Santos 1995). From the time of diagnosis, the clinician and other members of the health care team should begin to build a partnership with the patient and family. Building the partnership requires that clinicians promote open communication and ensure that patients have a basic and accurate foundation of knowledge about asthma, understand the treatment approach, and have the self-management skills necessary to monitor the disease objectively and take medication effectively (Evans et al. 1997).

When nurses, pharmacists, respiratory therapists, and other health care professionals are available to support and expand patient education (NHLBI 1995a, 1995b), a team approach should be used. The principal clinician should introduce the key educational messages (see figure 4-1) and negotiate agreements with patients (Mayo et al. 1990; Kotses et al. 1996). Different members of the health care team should reinforce and expand these messages during office visits and telephone calls or in more formal educational sessions.

Communication and coordination within the team are critical. Team members should document in the patient's record the key educational points (see figure 4-1), patient concerns, and actions the

BOX 1. PATIENT EDUCATION FOR NON-CFC INHALERS

Clinicians need to be aware that metered-dose inhalers (MDIs) containing chlorofluorocarbons (CFCs) contribute to the depletion of stratospheric ozone. As a result of the consequent health hazards, CFCs have been internationally banned. Although a temporary medical exemption has been granted, MDIs with CFC propellants will eventually have to be replaced with alternative aerosol products, including MDIs with non-CFC propellants. Other non-CFC options include multidose dry powder inhalers and hand-held mini-nebulizers.

When first prescribing any of these new alternative products to patients accustomed to a CFC-containing MDI, the Expert Panel recommends that clinicians review with the patient the appropriate inhalation technique and care of the device to ensure proper use and optimum device performance. For alternative propellant MDIs, the patient may perceive differences in the aerosol delivery compared to their CFC-containing MDI. The patient should be given the following messages about these differences:

- All FDA-approved alternative propellant inhalers will have been demonstrated to be comparably safe and effective as their usual CFC-propelled medication in clinical trials. However, individual differences in tolerability may be observed.
- Clinicians should familiarize patients with any differences in the care and use of non-CFC devices.
- The alternative propelled MDIs may taste different or feel different due to differences in the propellant and formulations. However, patients should be assured that these differences should not lead to important differences in their use or benefit.

For alternate propellant MDIs that deliver a less forceful aerosol plume, patients may believe that this less forceful spray may not reach their lungs as effectively as their CFC product. Clinicians should reassure patients that medication delivery is assured by proper inhalation technique and that a less forceful spray does not equate with less efficacy. This is an opportunity to train patients in the use of non-CFC devices.

patient agrees to take. This will enable all members of the team to be consistent and to reinforce the educational points and the progress being made.

Teach Asthma Self-Management

The Expert Panel recommends that clinicians teach patients and families the essential information, medication skills, self-monitoring techniques, and environmental control measures outlined in figure 4-2 (Bailey et al. 1990; Ignacio-Garcia and Gonzales-Santos 1995; Kotses et al. 1995, 1996; Wilson et al. 1993). These key points should be adapted to meet the individual patient's needs. Clinicians should:

- Teach basic facts about asthma so that the patient and family understand the rationale for needed actions. Give a brief verbal description of what asthma is and the intended role of each medication. Do not overwhelm the patient with too much information all at once, but repeat the important mes-

sages at each visit. Ask the patient to bring all medications to each appointment for review.

- Teach the patient necessary medication skills, such as correct use of the inhaler (see figure 4-3) and spacer/holding chamber and knowing when and how to take quick-relief medications. (Also see box 1, Patient Education for Non-CFC Inhalers.)
- Teach self-monitoring skills: symptom monitoring, peak flow monitoring as appropriate (see component 1-Periodic Assessment and Monitoring), and recognizing early signs of deterioration.
- Teach relevant environmental control/avoidance strategies (see figure 2-4). Teach how environmental precipitants or exposures can make the patient's asthma worse (e.g., allergens and irritants) at home, school, and work and how to recognize both immediate and delayed reactions.

FIGURE 4-2. DELIVERY OF ASTHMA EDUCATION BY CLINICIANS DURING PATIENT CARE VISITS

Assessment Questions	Information	Skills
Recommendations for Initial Visit		
<p>Focus on:</p> <ul style="list-style-type: none"> ■ Expectations of visit ■ Goals of treatment ■ Medications ■ Quality of life <p>"What worries you most about your asthma?"</p> <p>"What do you want to accomplish at this visit?"</p> <p>"What do you want to be able to do that you can't do now because of your asthma?"</p> <p>"What do you expect from treatment?"</p> <p>"What medicines have you tried?"</p> <p>"What other questions do you have for me today?"</p>	<p>Teach in simple language:</p> <p>What is asthma? A chronic lung disease. The airways are very sensitive. They become inflamed and narrow; breathing becomes difficult.</p> <p>Asthma treatments: two types of medicines are needed:</p> <ul style="list-style-type: none"> ■ Long-term control: medications that prevent symptoms, often by reducing inflammation ■ Quick relief: short-acting bronchodilator relaxes muscles around airways <p>Bring all medications to every appointment.</p> <p>When to seek medical advice. Provide appropriate telephone number.</p>	<p>Teach or review and demonstrate:</p> <p>Inhaler (see figure 4-3) and spacer/holding chamber use. Check performance.</p> <p>Self-monitoring skills that are tied to an action plan:</p> <ul style="list-style-type: none"> ■ Recognize intensity and frequency of asthma symptoms ■ Review the signs of deterioration and the need to reevaluate therapy: <ul style="list-style-type: none"> • Waking at night with asthma • Increased medication use • Decreased activity tolerance <p>Use of a simple, written self-management plan (see figure 4-4) and action plan (see figure 4-5)</p>
Recommendations for First Followup Visit (2 to 4 weeks or sooner as needed)		
<p>Focus on:</p> <ul style="list-style-type: none"> ■ Expectations of visit ■ Goals of treatment ■ Medications ■ Quality of life <p>Ask relevant questions from previous visit and also ask:</p> <p>"What medications are you taking?"</p> <p>"How and when are you taking them?"</p> <p>"What problems have you had using your medications?"</p> <p>"Please show me how you use your inhaled medications."</p>	<p>Teach in simple language:</p> <p>Use of two types of medications. Remind patient to bring all medications and the peak flow meter to every appointment for review.</p> <p>Self-evaluation of progress in asthma control using symptoms and peak flow as a guide.</p>	<p>Teach or review and demonstrate:</p> <p>Use of a daily self-management plan. Review and adjust as needed.</p> <p>Use of an action plan. Review and adjust as needed.</p> <p>Peak flow monitoring (see figure 1-7) and daily diary recording (see figure 1-9).</p> <p>Correct inhaler and spacer/holding chamber technique.</p>

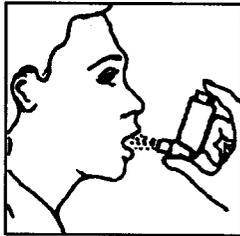
FIGURE 4-2. DELIVERY OF ASTHMA EDUCATION BY CLINICIANS DURING PATIENT CARE VISITS (CONTINUED)

Assessment Questions	Information	Skills
Recommendations for Second Followup Visit		
Focus on: <ul style="list-style-type: none"> ■ Expectations of visit ■ Goals of treatment ■ Medications ■ Quality of life 	Teach in simple language:	Teach or review and demonstrate:
Ask relevant questions from previous visits and also ask:	Relevant environmental control/avoidance strategies (see figure 2-4).	Inhaler/spacer/holding chamber technique.
"Have you noticed anything in your home, work, or school that makes your asthma worse?"	<ul style="list-style-type: none"> ■ How to identify home, work, or school exposures that can cause or worsen asthma 	Peak flow monitoring technique.
"Describe for me how you know when to call your doctor or go to the hospital for asthma care."	<ul style="list-style-type: none"> ■ How to control house-dust mites, animal exposures if applicable ■ How to avoid cigarette smoke (active and passive) 	Use of daily self-management plan. Review and adjust as needed.
"What questions do you have about the action plan?" "Can we make it easier?"	Review all medications.	Review use of action plan. Confirm that patient knows what to do if asthma gets worse.
"Are your medications causing you any problems?"	Review and interpret from daily diary: <ul style="list-style-type: none"> ■ Peak flow measure ■ Symptom scores 	
Recommendations for All Subsequent Visits		
Focus on: <ul style="list-style-type: none"> ■ Expectations of visit ■ Goals of treatment ■ Medications ■ Quality of life 	Teach in simple language:	Teach or review and demonstrate:
Ask relevant questions from previous visits and also ask:	Review and reinforce all:	Inhaler/spacer/holding chamber technique.
"How have you tried to control things that make your asthma worse?"	<ul style="list-style-type: none"> ■ Educational messages ■ Environmental control strategies at home, work, or school ■ Medications 	Peak flow monitoring technique.
"Please show me how you use your inhaled medication."	Review and interpret from daily diary: <ul style="list-style-type: none"> ■ Peak flow measures ■ Symptom scores 	Use of daily self-management plan. Review and adjust as needed.
		Review use of action plan. Confirm that patient knows what to do if asthma gets worse. Periodically review and adjust written action plan.

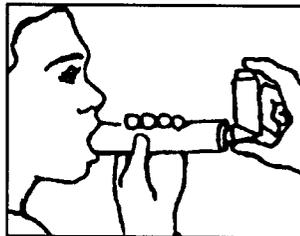
STEPS FOR USING YOUR INHALER

Please demonstrate your inhaler technique at every visit.

1. Remove the cap and hold inhaler upright.
2. Shake the inhaler.
3. Tilt your head back slightly and breathe out slowly.
4. Position the inhaler in one of the following ways (A or B is optimal, but C is acceptable for those who have difficulty with A or B. C is required for breath-activated inhalers):



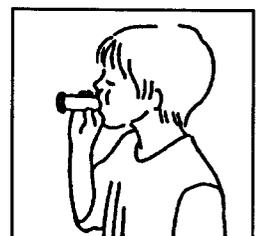
A. Open mouth with inhaler 1 to 2 inches away.



B. Use spacer/holding chamber (that is recommended especially for young children and for people using corticosteroids).



C. In the mouth. Do not use for corticosteroids.



D. NOTE: Inhaled dry powder capsules require a different inhalation technique. To use a dry powder inhaler, it is important to close the mouth tightly around the mouthpiece of the inhaler and to inhale rapidly.

5. Press down on the inhaler to release medication as you start to breathe in slowly.
6. Breathe in slowly (3 to 5 seconds).
7. Hold your breath for 10 seconds to allow the medicine to reach deeply into your lungs.
8. Repeat puff as directed. Waiting 1 minute between puffs may permit second puff to penetrate your lungs better.
9. Spacers/holding chambers are useful for all patients. They are particularly recommended for young children and older adults and for use with inhaled corticosteroids.

Avoid common inhaler mistakes. Follow these inhaler tips:

- Breathe out *before* pressing your inhaler.
- Inhale *slowly*.
- Breathe in through your mouth, not your nose.
- Press down on your inhaler at the *start* of inhalation (or within the first second of inhalation).
- Keep inhaling as you press down on inhaler.
- Press your inhaler only *once* while you are inhaling (one breath for each puff).
- Make sure you breathe in evenly and deeply.

NOTE: Other inhalers are becoming available in addition to those illustrated above. Different types of inhalers may require different techniques.

Source: *Expert Panel Report 2: Guidelines for the Diagnosis and Management of Asthma*. National Asthma Education and Prevention Program, National Heart, Lung, and Blood Institute, 1997.

Jointly Develop Treatment Goals

Fundamental to building a partnership is for clinicians and patients to jointly develop and agree on both short- and long-term treatment goals. Such agreements can encourage active participation, enhance the partnership, and improve asthma management (Schulman 1979; Clark 1989; Clark et al. 1995). It is the opinion of the Expert Panel that clinicians should:

- Determine the patient's personal treatment goals. Ask how asthma interferes with the patient's life (e.g., inability to sleep through the night, play a sport) and incorporate the responses into personal treatment goals. Asthma-specific quality-of-life instruments (Juniper et al. 1992; Marks et al. 1993) may be useful.
- Share the general goals of asthma treatment with the patient and family. Tell patients, "Our goals are to have you:
 - Be free from severe symptoms day and night, including sleeping through the night."
 - Have the best possible lung function."
 - Be able to participate fully in any activities of your choice."
 - Not miss work or school because of asthma symptoms."
 - Need fewer or no urgent care visits or hospitalizations for asthma."
 - Use medications to control asthma with as few side effects as possible."
 - Be satisfied with your asthma care."
- Agree on the goals of treatment. The clinicians, the patient, and when appropriate, the patient's family should agree on the goals of asthma management, which include both the patient's personal goals and the general goals (see list above) suggested by the clinicians.

Provide the Patient With Tools for Self-Management

It is the opinion of the Expert Panel that, at the first visit, clinicians should develop a written, individualized, daily self-management plan (see figure 4-4) in consultation with the patient. Include the recommended doses and frequencies of daily medications and the daily self-management

activities needed to achieve the agreed-on goals. Review and refine the plan at subsequent followup visits. List the treatment goals in the plan and explain how following the plan will help the patient reach those goals. Emphasizing the patient's personal goals is essential to enhancing adherence. For example, ask, "Have you had any problems taking your bronchodilator immediately before playing basketball? Has it helped you stay in the game?"

Discuss the long-term benefits of following the written, daily self-management plan (Plaut 1996). For some patients, focusing on long-term treatment goals and discussing the "big picture" of asthma control and how medications can be adjusted over time may improve adherence (Mellins 1996).

Also at the first visit, jointly develop a written action plan to help the patient manage asthma exacerbations (see figure 4-5, pages 138-143) for examples). This is especially important for patients with moderate-to-severe persistent asthma and patients with a history of severe exacerbations. Review and refine the plan at followup visits. The action plan directs the patient to adjust medicines at home in response to particular signs, symptoms, and peak flow measurements. It should also list the PEF levels and symptoms indicating the need for acute care and emergency telephone numbers for the physician, emergency department, rapid transportation, and family/friend for aid and support. A number of action plans have been published (Woolcock et al. 1988; Beasley et al. 1989; D'Souza et al. 1994; Charlton et al. 1990; Mellins and Evans, in press; NHLBI 1995d; NHLBI 1995e). Those tested in randomized clinical trials were effective in decreasing asthma exacerbations (Woolcock et al. 1988; Charlton et al. 1990). Clinicians should choose an action plan that suits their practice, patients, and style. The examples in figure 4-5 are not endorsed by the Expert Panel; rather, they are provided to demonstrate a range of possibilities and should be modified as appropriate.

It is the opinion of the Expert Panel that clinicians should provide an asthma diary to appropriate patients for self-monitoring symptoms, peak flow measurements, frequency of daily quick-relief inhaler medication use, and activity restriction (see figure 1-9).

ASTHMA DAILY SELF-MANAGEMENT PLAN (EXAMPLE 1)

ASTHMA SELF-MANAGEMENT PLAN FOR _____

(Name)

YOUR TREATMENT GOALS

- Be free from severe symptoms day and night, including sleeping through the night
- Have the best possible lung function
- Be able to participate fully in any activities of your choice
- Not miss work or school because of asthma symptoms
- Not need emergency visits or hospitalizations for asthma
- Use asthma medications to control asthma with as few side effects as possible

Add personal goals here:

YOUR DAILY MEDICATIONS

Daily Medication

How Much To Take

When To Take It

RECORD DAILY SELF-MONITORING ACTIONS in the asthma diary your doctor gives you.

Peak flow: At least every morning when you wake up, before taking your medication, measure your peak flow and record it in your diary. Bring these records to your next appointment with your doctor.

Symptoms: Note if you had asthma symptoms (shortness of breath, wheezing, chest tightness, or cough) and rate how severe they were during the day or night: mild, moderate, severe.

Use of your quick-relief inhaler (bronchodilator): Keep a record of the number of puffs you needed to use each day or night to control your symptoms.

Actual use of daily medications:

Activity restriction:

This plan is provided as an example to clinicians.

Encourage Adherence

An important part of patient education is encouraging adherence.

- **Use effective techniques to promote open communication.** Research suggests that certain clinician behaviors are associated with patient adherence and/or satisfaction with care (Clark et al. 1995). Not all are appropriate for cultural subgroups, but the items listed in figure 4-6 are general guidelines.
- **Early in each visit, elicit the patient's concerns, perceptions, and unresolved questions about his or her asthma** (see figure 4-2). A question such as "What worries you most about your asthma?" which cannot be answered yes or no, encourages patients and families to voice issues, personal beliefs, or concerns they may be apprehensive about discussing or may not think are of interest to the clinician. These potential barriers to adherence can be dealt with only if they are identified. By asking about and discussing such concerns, clinicians build trust and a sense of partnership with the patient. Most nonadherence originates in personal beliefs or concerns about asthma that have not been discussed with the clinician (Korsch et al. 1968; Janz et al. 1984). Until such fears and worries are identified and addressed, patients will not be able to adhere to the clinician's recommendations (Korsch et al. 1968).
- **Assess the patient's and family's perceptions of the severity level of the disease.** Two questions may prove useful: "How severe do you think your asthma is?" and "How much danger do you believe you are in from your asthma?" When patients are identified who are overwhelmed by fear of death, put their fears in perspective by providing them with the results of objective assessments and expert opinion. A clearly written, detailed action plan that directs the patient how to respond to worsening asthma may be extremely helpful in reducing anxiety (figure 4-5). Patients' perceptions about their disease severity and its threat to their well-being influence self-management behavior and use of the health care system (Janson-Bjerklie et al. 1992; Janz et al. 1984).
- **Assess the patient's and family's level of social support.** Ask, "Who among your family or friends can you turn to for help if your asthma worsens?" Counsel patients to identify an asthma

FIGURE 4-6. PROMOTING OPEN COMMUNICATION TO ENCOURAGE PATIENT ADHERENCE

Friendly Manner:

- Show attentiveness (eye contact, attentive listening, etc.)
- Give encouragements with nonverbal communication (nodding agreement, smiling, etc.)
- Give verbal praise for effective management strategies
- Use interactive conversation (e.g., asking open-ended questions)

Reassuring Communication:

- Elicit patient's underlying concerns about asthma
 - Allay fears with specific reassuring information
-

Adapted with permission from Clark et al. 1995.

"partner" among their family or friends who is willing to be educated and provide support. Include at least one of these individuals in follow-up appointments with the patient so that he or she can hear what is expected of the patient in following the self-management and action plans (Graham et al. 1990).

- **Encourage or enlist family involvement.** Ask patients to identify ways their family members can help them follow the plans. Ask the patient to share the plans with family members, elicit their input, and agree on actions they can help with. It may be helpful for children and parents to discuss this with a clinician present.
- **Consider referral to a psychologist, social worker, psychiatrist, or other licensed professional** when stress seems to unduly interfere with daily asthma management. As with other chronic diseases, emotional and social stress may be a confounding factor for many patients struggling with asthma control. Although stress does not cause asthma, it can play a role in precipitating asthma exacerbations (Busse et al. 1995) and can complicate an individual's attempts at self-management. Referral to a local support group may be useful.

- **Use methods to increase the chances that the patient will adhere to the written, daily self-management plan.** For instance, adherence to the self-management plan is enhanced when the plan is simplified as much as possible, when the number of medications and frequency of daily doses are minimized, when the medication doses and frequency fit into the patient's and family's daily routine (Clark et al. 1995; Haynes et al. 1979; Eisen et al. 1990; Evans 1993; Meichenbaum and Turk 1987), and when the plan considers the patient's ability to afford the medications (Hindi-Alexander and Throm 1987). Because nonadherence is difficult for clinicians to detect (Haynes et al. 1979; Charney et al. 1967; Mushlin and Appel 1977), it is prudent to explore potential barriers to adherence with every patient by asking what concerns they have about medicines (e.g., safety) or other aspects of treatment.

Tailor Education to the Needs of the Individual Patient

Assess cultural or ethnic beliefs or practices that may influence self-management activities and modify educational approaches, as needed. Cultural variables may affect patient understanding of and adherence to medical regimens (Pachter and Weller 1993; Kleinman et al. 1978). Open-ended questions such as "In your community, what does having asthma mean?" can elicit informative responses. The culturally sensitive clinician should attempt to find ways to incorporate harmless or potentially beneficial remedies with the pharmacologic plan. For example, a prevalent belief among the Latino population is that illnesses are either "hot" or "cold" (Risser and Mazur 1995). Asthma is viewed as a "cold" illness amenable to "hot" treatment. Suggesting that asthma medications be taken with hot tea or hot water incorporates this belief into the therapeutic regimen and helps build the therapeutic partnership. When harmful home remedies are being used, clinicians should discourage their use by suggesting a culturally acceptable alternative as a replacement or recommending a safer route of administration (Pachter et al. 1995). These and other strategies may be useful in working with ethnic minorities (NHLBI 1995c).

Every effort should be made to discuss asthma care, especially the self-management plan, in the patient's native language so that educational messages are fully understood. Research suggests that lack of language concordance between the clinician and the patient

affects adherence and appropriate use of health care services (Manson 1988). Language barriers also may complicate the assessment of cultural differences. If interpreters are used, they should be equally competent in both English and the patient's language and knowledgeable about medical terms (Woloshin et al. 1995).

MAINTAIN THE PARTNERSHIP

As part of ongoing care, the clinician should continue to build the partnership by being a sympathetic coach and by helping the patient follow the self-management plan and take other needed actions. Educational efforts should be continuous, because it may take up to 6 months for the impact of education to be evident (Toelle et al. 1993). Furthermore, it is necessary to periodically review information and skills covered previously because patient self-management behavior is likely to decline over time (Reis et al. 1995).

In particular, it is essential that clinicians demonstrate, review, evaluate, and correct inhaler/spacer/holding chamber technique at each visit because these skills deteriorate rapidly (Keston et al. 1993). Written instructions are helpful (see figure 4-3), but insufficient (Nimmo et al. 1993; Wilson et al. 1993). Research suggests that patients tend to make specific mistakes in using inhalers that need to be corrected (Larsen et al. 1994; Dolovich et al. 1981; Keston et al. 1993; Hanania et al. 1994). Patients especially need to be reminded to inhale slowly and to activate the inhaler only *once* for each breath (Rau et al. 1996).

Clinicians should continue to promote open communication with the patient and family by addressing the following elements (see figure 4-2) in each followup visit:

- **Continue asking patients early in each visit what concerns they have about their asthma and what they especially want addressed during the visit.**
- **Review the short-term goals agreed on in the initial visit.** Assess how well they are being achieved (e.g., was the patient's wish to engage in physical activity achieved?). Revise the goals as needed. Achievement of short-term goals should be discussed as indicators that the patient is moving toward long-term goals. Give positive verbal reinforcement for achievement of a goal and recognize the patient's success in moving closer to full control of the disease.

- **Review the daily self-management plan and the steps the patient was to take** (Clark et al. 1995). Adjust the plan as needed (e.g., the recommendations of how to use medicines if the dose or type is not working). Identify other problems the patient has in following the agreed-on steps (e.g., disguising the bad taste of medicine); treat these as areas needing more work, not as adherence failures. Write a self-management plan to help school personnel manage a child's asthma (see figure 4-7, page 144, for an example).
- **Periodically review the asthma action plan and revise as necessary.** Confirm that the patient knows what to do if his or her asthma gets worse.
- **Continue teaching and reinforcing key educational messages** (see figure 4-1). Provide information and teach skills over several visits so as not to overwhelm the patient with too much information at one time. Repeat important points often.
- **Give patients simple, brief written materials that reinforce the actions recommended and skills taught** (Morris et al. 1986; Ley 1972; Davis et al. 1990; Estey et al. 1991). Figure 4-8 (page 146) lists organizations that distribute patient education materials; many of these organizations also have some Spanish-language materials.

SUPPLEMENT PATIENT EDUCATION DELIVERED BY CLINICIANS

All patients may benefit from a *formal asthma education program* that has been evaluated and reported in the literature to be effective. These programs should be taught by qualified asthma educators who are knowledgeable about asthma and experienced in patient education. Communication among the asthma educator, the clinicians providing direct care, and the patient/family is critical. When formal programs are available in local communities, they can *supplement, but not replace*, patient education provided in the office. Individual and group programs have been developed and tested for patients of all ages, including parents of very young children (birth to 4 years) (Clark et al. 1986; Creer et al. 1988; Evans et al. 1987; Lewis et al. 1984; NHLBI 1984a, 1984b, 1984c, 1985; Taggart et al. 1991; Wilson-Pessano et al. 1987; Wilson-Pessano and McNabb 1985; Bailey et al. 1990; Kotses et al. 1995; Wilson et al. 1996; Lahdensuo et al. 1996). A list of organizations distributing programs that have been validated in the literature can be found in figure 4-8.

These patient education programs should be delivered as designed. Some validity and effectiveness may be compromised when segments of various programs are pieced together or when programs are condensed. In the interest of saving time, educators should not delete educational strategies, such as using small groups or scheduling multiple sessions spaced with "homework" assignments, because these strategies have demonstrated effectiveness in motivating individuals to make significant behavior changes (Thapar 1994; Wilson et al. 1993; Kotses et al. 1995; Bailey et al. 1990).

A variety of *other educational formats*, such as videotapes (Yoon et al. 1993) and interactive computer software (Osman et al. 1994), also may *enhance, but not replace*, education delivered by clinicians.

PROVIDE PATIENT EDUCATION IN OTHER CLINICAL SETTINGS

Patient education also should be delivered in the context of emergency department visits and hospitalizations. Asthma exacerbations may represent teachable moments when patients are more receptive to educational messages. Research on adults with asthma who are referred by emergency department providers to an asthma education program shows that education can decrease utilization of emergency services (Bolton et al. 1991). Educational programs delivered to hospitalized children and adult asthma patients show increased knowledge and use of self-management behaviors (Taggart et al. 1991), reduced length of hospital stay, and overall reduction in asthma readmissions (Mayo et al. 1996).

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ASTHMA ACTION PLAN (EXAMPLE 1)

Name _____ Date _____

It is important in managing asthma to keep track of your symptoms, medications, and peak expiratory flow (PEF).
You can use the colors of a traffic light to help learn your asthma medications:

- A. **GREEN means Go** Use preventive (anti-inflammatory) medicine
- B. **YELLOW means Caution** Use quick-relief (short-acting bronchodilator) medicine in addition to the preventive medicine.
- C. **RED means STOP!** Get help from a doctor.

A. Your **GREEN ZONE** is _____ 80 to 100% of your personal best. **GO!**
Breathing is good with no cough, wheeze, or chest tightness during work, school, exercise, or play.

ACTION:

- Continue with medications listed in your daily treatment plan.

B. Your **YELLOW ZONE** is _____ 50 to less than 80% of your personal best. **CAUTION!**

Asthma symptoms are present (cough, wheeze, chest tightness).

Your peak flow number drops below _____ or you notice:

- Increased need for inhaled quick-relief medicine
- Increased asthma symptoms upon awakening
- Awakening at night with asthma symptoms
- _____

ACTIONS:

- Take _____ puffs of your quick-relief (bronchodilator) medicine _____.
Repeat _____ times.
- Take _____ puffs of _____ (anti-inflammatory) _____ times/day.
- Begin/increase treatment with oral steroids:
Take _____ mg of _____ every a.m. _____ p.m. _____.
- Call your doctor (phone _____) or emergency room _____.

C. Your **RED ZONE** is _____ 50% or less of your best. **DANGER!!**

Your peak flow number drops below _____, or you continue to get worse after increasing treatment according to the directions above.

ACTIONS:

- Take _____ puffs of your quick-relief (bronchodilator) medicine _____, Repeat _____ times.
 - Begin/increase treatment with oral steroids. Take _____ mg now.
 - Call your doctor now (phone _____). If you cannot contact your doctor, go directly to the emergency room (phone _____).
- Other important phone numbers for transportation _____.

AT ANY TIME, CALL YOUR DOCTOR IF:

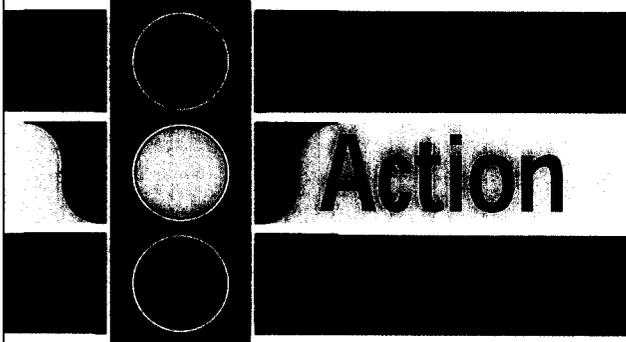
- Asthma symptoms worsen while you are taking oral steroids, or
- Inhaled bronchodilator treatments are not lasting 4 hours, or
- Your peak flow number remains or falls below _____ in spite of following the plan.

Physician Signature _____ Patient's/Family Member's Signature _____

This plan is provided as an example to clinicians.

Figure 4-5.

ASTHMA ACTION PLAN (EXAMPLE 2)

Name: _____ Doctor's Name: _____ Doctor's Phone: _____ Baseline/Personal Best Peak Flow: _____ Medicines: _____	
	

ZONE	ACTIONS
GREEN	_____ _____ _____ _____
YELLOW	_____ _____ _____ _____
RED	_____ _____ _____ _____

Adapted with permission from Cecilia Vicuna-Kneady, R.N.
This plan is provided as an example to clinicians.

ASTHMA ACTION PLAN (EXAMPLE 3)

ADULT SELF-MANAGEMENT INSTRUCTIONS FOR ASTHMA ACTION PLAN

DATE - _____

When to Monitor Peak Flow Numbers

- In the morning soon after waking up.
- Before supper.
- Before bed.
- Before and 5-15 minutes after inhaled treatments.
- With increased respiratory symptoms.
- _____

Important Peak Flow Numbers

Baseline _____

_____ % baseline _____

_____ % baseline _____

If your peak flow number drops below _____ or you notice:

- Increased use of inhaled treatments to manage asthma
- Increased asthma symptoms upon awakening
- Awakening at night with asthma symptoms
- _____

Follow these treatment steps:

- Increase inhaled steroids.
Take _____ puffs of _____ times a day.
- Begin/increase treatment with oral steroids.
Take _____ mg of _____
In the morning and /or before supper.
- _____

If your peak flow number drops below _____ or you continue to get worse after increasing treatment according to the directions above, follow these treatment steps:

- Begin/increase treatment with oral steroids.
Take _____ mg of _____
In the morning and /or before supper.
- Contact your health care provider.

Contact your health care provider if:

- Asthma symptoms worsen while you are taking oral steroids or,
- Inhaled bronchodilator treatments are not lasting 4 hours or,
- Your peak flow number falls below _____.
- If you cannot contact your health care provider go directly to the Emergency Room.

Directions for Resuming Normal Treatment:

- Continue increased treatment until symptoms and peak flow number have returned to normal, then continue increased inhaled steroids or _____ mg of oral steroids for the same number of days it took to return to normal. If your peak flow number has not returned to normal in 5 days contact your health care provider.
- Call your health care provider for specific instructions.

If you have questions please call:

- _____
- Other _____ After hours
- Your home physician.

Physician Signature _____ Date _____

Patient/Family Signature _____ Staff Signature _____

T-101 1/95

Adapted with permission from National Jewish Medical and Research Center.
This plan is provided as an example to clinicians.

ASTHMA ACTION PLAN (Peak Flow monitoring)

ZONE	LEVEL	STATUS	ACTION												
<p>Green Zone: All Clear My best peak Flow: _____ Peak Flow: _____ to _____ (100 - 80% of My Best Peak Flow)</p> <ul style="list-style-type: none"> No symptoms of an asthma episode Able to do usual activities Usual medications control asthma 	<p>1</p>	<p>DOING WELL</p>	<p>TAKE:</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Medicine</td> <td style="text-align: center;">Dose</td> <td style="text-align: center;">Max # times/day</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table>	Medicine	Dose	Max # times/day	_____	_____	_____	_____	_____	_____	_____	_____	_____
Medicine	Dose	Max # times/day													
_____	_____	_____													
_____	_____	_____													
_____	_____	_____													
<p>Yellow Zone: Caution Peak Flow: _____ to _____ (80 - 50% of My Best Peak Flow)</p> <ul style="list-style-type: none"> Increased asthma symptoms (including waking at night due to asthma) Usual activities somewhat limited Increased need for asthma medications 	<p>2</p>	<p>INCREASE IN SYMPTOMS</p>	<p>ADD:</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Medicine</td> <td style="text-align: center;">Dose</td> <td style="text-align: center;">Max # times/day</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table> <p style="text-align: center;">Return to Level 1 when symptoms improve</p>	Medicine	Dose	Max # times/day	_____	_____	_____						
Medicine	Dose	Max # times/day													
_____	_____	_____													
<p>Red Zone: Medical Alert Peak Flow: Less than _____ (50% of My Best Peak Flow)</p> <ul style="list-style-type: none"> Increased symptoms longer than 24 hrs Very short of breath Usual activities severely limited Asthma medications haven't reduced symptoms 	<p>3</p>	<p>NO IMPROVEMENT AFTER ____ HRS or EVEN MORE SYMPTOMS</p>	<p>ADD:</p> <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">Medicine</td> <td style="text-align: center;">Dose</td> </tr> <tr> <td>_____</td> <td>_____</td> </tr> </table> <p>AND CALL YOUR PROVIDER</p>	Medicine	Dose	_____	_____								
Medicine	Dose														
_____	_____														
<p>DANGER SIGNS:</p> <ul style="list-style-type: none"> • DIFFICULTY WALKING AND TALKING DUE TO SHORTNESS OF BREATH ➡ GO TO THE HOSPITAL NOW • LIPS OR FINGERNAILS ARE BLUE ➡ OR CALL 911 NOW 															

ASTHMA ACTION PLAN (EXAMPLE 4)

Adapted with permission from Kaiser Permanente Center for Health Research, Portland, OR.
 This plan is provided as an example to clinicians.

ASTHMA ACTION PLAN (Symptom monitoring)

Figure 4-5.

LEVEL		STATUS	ACTION												
<p>All Clear</p> <ul style="list-style-type: none"> No symptoms of an asthma episode Able to do usual activities Usual medications control asthma 	1	DOING WELL	<p>TAKE:</p> <table border="0"> <tr> <td style="text-align: center;">Medicine</td> <td style="text-align: center;">Dose</td> <td style="text-align: center;">Max # times/day</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table>	Medicine	Dose	Max # times/day	_____	_____	_____	_____	_____	_____	_____	_____	_____
Medicine	Dose	Max # times/day													
_____	_____	_____													
_____	_____	_____													
_____	_____	_____													
<p>Caution</p> <ul style="list-style-type: none"> Increased asthma symptoms (including waking at night due to asthma) Usual activities somewhat limited Increased need for asthma medications 	2	INCREASE IN SYMPTOMS	<p>ADD:</p> <table border="0"> <tr> <td style="text-align: center;">Medicine</td> <td style="text-align: center;">Dose</td> <td style="text-align: center;">Max # times/day</td> </tr> <tr> <td>_____</td> <td>_____</td> <td>_____</td> </tr> </table> <p>Return to Level 1 when symptoms improve</p>	Medicine	Dose	Max # times/day	_____	_____	_____						
Medicine	Dose	Max # times/day													
_____	_____	_____													
<p>Medical Alert</p> <ul style="list-style-type: none"> Increased symptoms longer than 24 hrs Very short of breath Usual activities severely limited Asthma medications haven't reduced symptoms 	3	NO IMPROVEMENT AFTER ____ HRS or EVEN MORE SYMPTOMS	<p>ADD:</p> <table border="0"> <tr> <td style="text-align: center;">Medicine</td> <td style="text-align: center;">Dose</td> </tr> <tr> <td>_____</td> <td>_____</td> </tr> </table> <p>AND CALL YOUR PROVIDER</p>	Medicine	Dose	_____	_____								
Medicine	Dose														
_____	_____														
<p>DANGER SIGNS:</p> <ul style="list-style-type: none"> DIFFICULTY WALKING AND TALKING DUE TO SHORTNESS OF BREATH LIPS OR FINGERNAILS ARE BLUE <p>➡ GO TO THE HOSPITAL NOW ➡ OR CALL 911 NOW</p>															

ASTHMA ACTION PLAN (EXAMPLE 5)

Adapted with permission from Kaiser Permanente Center for Health Research, Portland, OR. This plan is provided as an example to clinicians.

ASTHMA ACTION PLAN (EXAMPLE 6)

For adults, teens, and children age 5 and over PEAK FLOW-BASED HOME TREATMENT PLAN

Name: _____

Date: _____

Best Peak Flow: _____

Green Zone

GREEN ZONE: Peak flow between _____ and _____.

Normal activity. (Insert brand name in blanks.)

- Adrenaline-like medicine: albuterol (_____), pirbuterol (_____), or terbutaline (_____) : 1 or 2 puffs 15 minutes before exercise.
- Nedocromil (_____) or cromolyn (_____): 2 puffs before contact with cat or other allergen.

Medicine to be taken every day:

- Nedocromil (_____) or cromolyn (_____): ____ puffs ____ times a day (a total of ____ puffs daily).
- Inhaled steroid (_____): ____ puffs ____ times a day (a total of ____ puffs daily).
- Adrenaline-like medicine (see above): ____ puffs before each *nedocromil, cromolyn, or inhaled steroid* dose for the first month.
- Other:

Yellow Zone

HIGH YELLOW ZONE: Peak flow between _____ and _____.

Eliminate triggers and change medicines. No strenuous exercise.

Medicine to be taken:

- Adrenaline-like medicine: ____ puffs by holding chamber. Give three to six times in 24 hours. Continue until peak flow is in the *Green Zone* for 2 days.
- Double *inhaled steroid* to ____ puffs daily until peak flow is in the *Green Zone* for as long as it was in the *Yellow Zone*.
- Other:

LOW YELLOW ZONE: Peak flow between _____ and _____.

Follow this plan if peak flow does not reach *High Yellow Zone* within 10 minutes after taking inhaled adrenaline-like medicine, or drops back into *Low Yellow Zone* within 4 hours:

- Continue adrenaline-like medicine treatment as above.
- Add *oral steroid** ____ mg immediately. Continue each morning (8:00 a.m.) until peak flow is in the *Green Zone* for at least 24 hours.
- Please call the office before starting oral steroid.

* If your condition does not improve within 2 days after starting oral steroid, or if peak flow does not reach the *Green Zone* within 7 days of treatment, see your doctor.

Red Zone

RED ZONE: Peak flow less than _____.

Follow this plan if peak flow does not reach *Low Yellow Zone* within 10 minutes after taking inhaled adrenaline-like medicine, or drops back into *Red Zone* within 4 hours.

- ✓ Adrenaline-like medicine: ____ puffs by holding chamber.
- ✓ Give oral steroid ____ mg.
- ✓ Visit your doctor or go to the emergency room.

SCHOOL SELF-MANAGEMENT PLAN



**Asthma and Allergy
Foundation of America**
1125 15th St., N.W., Suite 502
Washington, DC 20005

STUDENT ASTHMA ACTION CARD



Name: _____ Grade: _____ Age: _____

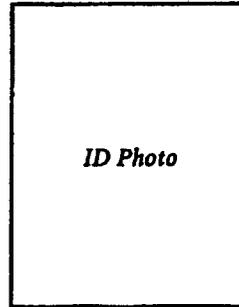
Teacher: _____ Room: _____

Parent/Guardian Name: _____ Ph: (H) _____

Address: _____ Ph: (W) _____

Parent/Guardian Name: _____ Ph: (H) _____

Address: _____ Ph: (W) _____



Emergency Phone Contact #1 _____
Name Relationship Phone

Emergency Phone Contact #2 _____
Name Relationship Phone

Physician Student Sees for Asthma: _____ Ph: _____

Other Physician: _____ Ph: _____

DAILY ASTHMA MANAGEMENT PLAN

• Identify the things which start an asthma episode (Check each that applies to the student.)

- | | | |
|---|--|--------------------------------------|
| <input type="checkbox"/> Exercise | <input type="checkbox"/> Strong odors or fumes | <input type="checkbox"/> Other _____ |
| <input type="checkbox"/> Respiratory infections | <input type="checkbox"/> Chalk dust | _____ |
| <input type="checkbox"/> Change in temperature | <input type="checkbox"/> Carpets in the room | |
| <input type="checkbox"/> Animals | <input type="checkbox"/> Pollens | |
| <input type="checkbox"/> Food _____ | <input type="checkbox"/> Molds | |

Comments _____

• **Control of School Environment**

(List any environmental control measures, pre-medications, and/or dietary restrictions that the student needs to prevent an asthma episode.)

• **Peak Flow Monitoring**

Personal Best Peak Flow number: _____

Monitoring Times: _____

• **Daily Medication Plan**

	Name	Amount	When to Use
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____

SCHOOL SELF-MANAGEMENT PLAN (CONTINUED)

EMERGENCY PLAN

Emergency action is necessary when the student has symptoms such as _____, _____, _____ or has a peak flow reading of _____.

• Steps to take during an asthma episode:

1. Give medications as listed below.
2. Have student return to classroom if _____
3. Contact parent if _____
4. Seek emergency medical care if the student has any of the following:

- ✓ No improvement 15-20 minutes after initial treatment with medication and a relative cannot be reached.
- ✓ Peak flow of _____
- ✓ Hard time breathing with:
 - Chest and neck pulled in with breathing
 - Child is hunched over
 - Child is struggling to breathe
- ✓ Trouble walking or talking
- ✓ Stops playing and can't start activity again
- ✓ Lips or fingernails are gray or blue



IF THIS HAPPENS, GET EMERGENCY HELP NOW!

• Emergency Asthma Medications

	Name	Amount	When to Use
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____

COMMENTS / SPECIAL INSTRUCTIONS

FOR INHALED MEDICATIONS

- I have instructed _____ in the proper way to use his/her medications. It is my professional opinion that _____ should be allowed to carry and use that medication by him/herself.
- It is my professional opinion that _____ should not carry his/her inhaled medication by him/herself.

Physician Signature

Date

Parent Signature

Date

FIGURE 4-8. SOURCES OF PATIENT EDUCATION PROGRAMS AND MATERIALS

Organization	Validated Program(s); Age Group	Other written and audiovisual patient education materials? (in other languages?)	Local support groups?
American Lung Association For the affiliate nearest you, call (800) LUNG-USA [800-586-4872]	Open Airways at School; 8-11 years (Evans et al. 1987)	Yes (Yes)	Yes
Asthma and Allergy Foundation of America 1125 15th Street, N.W., Suite 502 Washington, DC 20005 (800) 7-ASTHMA [800-727-8462]	Asthma Care Training for Kids (A.C.T.); 7-12 years (Lewis et al. 1984) You Can Control Asthma; 8-12 years (Taggart et al. 1991)	Yes (Yes)	Yes
National Technical Information Service 5285 Port Royal Road Springfield, VA 22161 (703) 487-4650	Air Power; 9-13 years (Wilson-Pessano and McNabb 1985; NHLBI 1984c) Air Wise; 8-13 years (McNabb et al. 1985; NHLBI 1984a) Living With Asthma; 8-13 years (Creer et al. 1988; NHLBI 1985) Open Airways; 4-12 years (Clark et al. 1986; NHLBI 1984a)	Yes (Yes)	No
National Asthma Education and Prevention Program National Heart, Lung, and Blood Institute Information Center P.O. Box 30105 Bethesda, MD 20824-0105 (301) 251-1222	Breathe Easier; adult (Wilson et al. 1993)	Yes (Yes)	No
Allergy and Asthma Network/Mothers of Asthmatics, Inc. 3554 Chain Bridge Road, Suite 200 Fairfax, VA 22030-2709 (800) 878-4403	No validated programs	Yes (Yes)	No
American Academy of Allergy, Asthma, and Immunology 611 East Wells Street Milwaukee, WI 53202 (800) 822-ASTHMA [800-822-2762]	No validated programs	Yes (No)	No
American College of Allergy, Asthma, and Immunology 85 West Algonquin Road Arlington Heights, IL 60005 (800) 842-7777	No validated programs	Yes (No)	No
National Jewish Medical and Research Center 1400 Jackson Street Denver, CO 80206 (800) 423-8891	No validated programs	Yes (No)	No

Discrimination Prohibited:
Under provisions of applicable public laws enacted by Congress since 1964, no person in the United States shall, on the grounds of race, color, national origin, handicap, or age, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity (or, on the basis of sex, with respect to any education program or activity) receiving Federal financial assistance. In addition, Executive Order 11141 prohibits discrimination on the basis of age by contractors and subcontractors in the performance of Federal contracts, and Executive Order 11246 states that no federally funded contractor may discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. Therefore, the National Heart, Lung, and Blood Institute must be operated in compliance with these laws and Executive Orders.

**U.S. DEPARTMENT OF HEALTH AND
HUMAN SERVICES**

**Public Health Service
National Institutes of Health
National Heart, Lung, and Blood Institute**

**NIH Publication No. 97-4051
July 1997**