1. **ASTHMA**

Eve A. Kerr, MD, MPH and Kenneth A. Clark, MD, MPH

The general approach to developing quality indicators for asthma diagnosis and treatment was based on *Guidelines for the Diagnosis and Management of Asthma* (NAEPP, 1997). These guidelines, issued by the National Heart, Lung, and Blood Institute (NHLBI), are based on expert consensus and scientific literature review. They are updates of the original guidelines published in 1991. The guidelines are being submitted for publication as of the time of this writing. The expert panel was convened by the Coordinating Committee of the National Asthma Education and Prevention Program (NAEPP). We also reviewed the standards issued by the American Thoracic Society for the diagnosis and care of patients with chronic obstructive pulmonary disease and asthma. Further, we conducted a MEDLINE literature search to identify randomized controlled trials related to asthma and its treatment or the prevention and control of asthma exacerbations published in English between January, 1991 and April, 1997. We reviewed select articles dealing with areas where management controversy exists.

**IMPORTANCE**

NHLBI defines asthma as “a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role, in particular, mast cells, eosinophils, T lymphocytes, macrophages, neutrophils, and epithelial cells. In susceptible individuals, this inflammation causes recurrent episodes of wheezing, breathlessness, chest tightness, and cough, particularly at night and in the early morning. These episodes are usually associated with widespread but

---

1. This chapter is a revision of one written for an earlier project on quality of care for women and children (Q1). The expert panel for the current project was asked to review all of the indicators, but only rated new or revised indicators.
2. Material reviewed is current to February 24, 1997.
variable airflow obstruction that is often reversible either spontaneously or with treatment. The inflammation also causes an associated increase in the existing bronchial hyperresponsiveness to a variety of stimuli” (NAEPP, 1997). Asthma affects between 14 and 15 million Americans, and total estimated asthma-related health care expenditures for 1990 exceeded $6 billion in the United States (NAEPP, 1997; Weiss et al., 1992).

SCREENING

The reviewed literature does not support screening for asthma in asymptomatic patients.

DIAGNOSIS

The diagnosis of asthma is based on the patient's medical history, physical examination, and laboratory test results. Symptoms include cough, wheezing, shortness of breath, chest tightness, and sputum production. Precipitating and/or aggravating factors may include viral respiratory infections, exposure to environmental or occupational allergens, irritants, cold air, and drugs (e.g., aspirin), exercise, and endocrine factors. Severity of disease ranges widely, with some patients having rare symptoms and others having severe limitation of daily activity with frequent exacerbations. Consequently, the use of health care services and the impact of asthma on an individual's quality of life also vary widely.

Patients with a diagnosis of asthma should have a detailed medical history that addresses identification of possible precipitating factors such as viral respiratory infections, environmental exposures, inhalant allergens (NAEPP, 1997) (Indicator 1).

Spirometry, to document severity of airflow obstruction and establish acute bronchodilator responsiveness, should be performed for all patients in whom the diagnosis of asthma is being considered (NAEPP, 1997). The NHLBI guidelines recommend spirometry at the time of initial assessment (Indicator 2), and at least every one to two years to assess the maintenance of airway function (Indicator 3) (NAEPP, 1997). When considering alternative diagnoses, additional laboratory testing, such as chest x-rays and complete pulmonary function studies, may be
considered in some patients. Skin testing and in vitro testing, to
determine the presence of specific IgE antibodies to common allergens,
is recommended for patients with persistent asthma who require daily
therapy (NAEPP, 1997).

Measurement of peak expiratory flow (PEF) with a peak flow meter
is generally a sufficient assessment of pulmonary function, particularly
in cases of mild intermittent, mild persistent, and moderate persistent
asthma. PEF provides a simple, quantitative, and reproducible measure
of the existence and the severity of airflow obstruction. PEF meters
are designed as tools for monitoring, not for diagnosis (NAEPP, 1997).

Since different brands of peak flow meters can give significantly
different values and because lung function varies across racial and
ethnic populations, there is no universal normative standard for PEF
(NAEPP, 1997).

Peak flow monitoring can be used for short-term monitoring,
management of exacerbations, and daily long-term monitoring. Two recent
studies have shown that asthma self-management programs using peak flow
monitoring as a component achieved improvements in health outcomes
(Ignacio-Garcia and Gonzalez-Santos, 1995 and Lahdensuo et al., 1996).
To date, however, studies that have isolated comparisons between PEF and
symptom monitoring have not been sufficient to assess the relative
contributions of each to asthma management (NAEPP, 1997).

TREATMENT

According to the NHLBI, asthma therapy has several components:
patient education, control of factors contributing to severity, and
pharmacological therapy, as well as the use of objective measures to
assess the severity of disease and monitor the course of therapy (NAEPP,
1997).

Patient Education

Patient education is an essential component of successful asthma
management. It should begin at the time of diagnosis and be integrated
into every step of medical care (NAEPP, 1997). Asthma education
programs have led to improved patient outcomes, including reduced
hospitalizations and emergency room visits (Lawrence, 1995), fewer
asthma symptoms and physician visits, and improvement in asthma management skills (Kotses et al., 1995). However, the performance and adequacy of education is not easily assessed through medical record review. Therefore, the review and the indicators that follow will not focus on the patient-education component of care.

**Pharmacological Therapy**

*Corticosteroids*

Corticosteroids are the most potent and the most effective anti-inflammatory medication currently available. Inhaled forms are used for long-term control, while systemic corticosteroids are often used to obtain prompt control of the disease when beginning long-term therapy (NAEPP, 1997). Inhaled corticosteroids, at currently approved doses, are safe and effective for the treatment of asthma and are being utilized more frequently as primary therapy.

In any patient requiring chronic treatment with oral corticosteroids (i.e., exceeding one month in duration), a trial of inhaled corticosteroids should be attempted in an effort to reduce or eliminate oral steroids (Indicator 7). High doses of inhaled steroids should be used if conventional doses fail to permit oral steroid tapering. Pulmonary functions (PEF or FEV₁) should be monitored during tapering. Prolonged daily use of oral corticosteroids is reserved for patients with severe asthma despite use of high-dose inhaled corticosteroids. In patients on long-term oral corticosteroids, pulmonary function tests should be used to objectively assess efficacy.

*Cromolyn Sodium and Nedocromil*

Cromolyn sodium and nedocromil are mild-to-moderate nonsteroidal anti-inflammatory medications with a strong safety profile. Both compounds have been shown to reduce asthma symptoms, improve morning peak flow, and reduce the need for quick-relief beta₂-agonists. The clinical response to cromolyn and nedocromil is less predictable than the response to inhaled corticosteroids (NAEPP, 1997).

*Beta₂-agonists*

Inhaled short-acting beta₂-agonists are the medication of choice for the prevention of exercise-induced bronchospasm and for the
Immediate treatment of acute asthma exacerbations (Indicator 4) (NAEPP, 1997). There appears to be some consensus in the medical community that regular (i.e., four times daily) use of beta₂-agonists should be discouraged in favor of anti-inflammatory treatment (Indicator 5) (Executive Committee of the American Academy of Allergy and Immunology, 1993). One case-control study found an increased risk of death and near death from asthma associated with regular use of inhaled beta₂-agonist bronchodilators (Spitzer et al., 1992).

Inhaled long-acting beta₂-agonists are used as an adjunct to anti-inflammatory therapy for providing long-term control of symptoms, especially nocturnal symptoms, and to prevent exercise-induced bronchospasm (NAEPP, 1997). Long-acting beta₂-agonists are not to be used for exacerbations. The frequency of beta-agonist use can be a useful monitor of disease activity (NAEPP, 1997). Patient education regarding correct use is critical.

Methylxanthines

Theophylline, the methylxanthine principally used in treating asthma, provides mild-to-moderate bronchodilation. Monitoring serum theophylline concentrations is essential to ensure that therapeutic, but not toxic, doses are achieved (NAEPP, 1997). Recent evidence suggests that low serum concentrations of theophylline are mildly anti-inflammatory (Kidney, 1995). Sustained-release theophylline is mainly used as adjuvant therapy, and is particularly useful for controlling symptoms of nocturnal asthma. When there are issues concerning cost or adherence to regimens using inhaled medication, sustained-release theophylline can be considered as an alternative long-term preventive therapy, but is not preferred. Patients on chronic theophylline should have a serum theophylline determination at least once each year to decrease the risk of theophylline toxicity (NAEPP, 1997) (Indicator 8).

Leukotriene Modifiers

Leukotriene modifiers can be considered an alternative therapy to low doses of inhaled steroids or cromolyn or nedocromil for patients 12 years of age of older with mild persistent asthma. However, additional clinical experience and study are needed to establish their roles in asthma therapy (NAEPP, 1997).
Anticholinergics

Ipratropium bromide may be an alternative bronchodilator for some patients who do not tolerate inhaled beta_{2}-agonists. It may also provide some additive benefit to inhaled beta_{2}-agonists during severe exacerbations (NAEPP, 1997).

Control of Factors Affecting Severity

Allergens and irritants may play a significant role in the symptoms of asthma for some persons. Because of the importance of allergens and their control in asthma morbidity and management, the NHLBI Expert Panel recommends that patients with asthma at any level of severity be questioned about exposures to inhalant allergens (e.g., animal allergens, house-dust mites, outdoor allergens). For persons with persistent asthma who require daily therapy, the Expert Panel also recommends skin testing or in vitro testing to determine the presence of specific IgE antibodies to indoor allergens (NAEPP, 1997).

Once it is determined (through history and/or ancillary testing) that allergy plays a role in the person's asthma, allergen avoidance should be the first recommendation (NAEPP, 1997). However, when avoidance is not possible and appropriate medication fails to control symptoms of allergic asthma, immunotherapy should be considered (NAEPP, 1997). A meta-analysis of 20 randomized, placebo-controlled studies has substantiated the effectiveness of immunotherapy in asthma (Abramson, 1995). Because immunotherapy is absolutely indicated in only a small subset of asthma patients, we have not developed an indicator on this topic.

Other factors that influence asthma severity should also be considered. Intranasal corticosteroids are recommended for the treatment of chronic rhinitis in patients with persistent asthma. Adult patients with asthma should be questioned about bronchoconstriction that is precipitated by aspirin or other nonsteroidal anti-inflammatory drugs. Nonselective beta-blockers (e.g., atenol and propranolol) can cause asthma symptoms and should be avoided by patients with asthma (Indicator 6).
Treatment of Asthma by Severity

The NHLBI guidelines state that therapeutic agents to prevent or reverse airway hyperresponsiveness are considered first-line therapy. Specific asthma therapy must be selected to fit the needs of individual patients. Treatment recommendations are based on severity of disease. However, it must be recognized that grading severity is not always straightforward. Criteria for determining the severity of asthma have been suggested by the NAEPP Expert Panel. They are summarized below and are based on 1997 NHLBI guidelines. The severity classification has been changed from the chronic mild, chronic moderate, and chronic severe groupings in the 1991 NHLBI guidelines to a four step system.

Mild Intermittent Asthma

According to NHLBI, mild intermittent asthma is characterized by:

- intermittent, brief (less than 1 hour) wheezing, coughing, or dyspnea up to two times weekly;
- asymptomatic status and normal PEF between exacerbations;
- brief exacerbations (from a few hours to a few days) with variable intensity; and
- infrequent nocturnal symptoms (no more than two times a month).

For these patients, asthma symptoms often occur following exercise, exposure to irritants or allergens, or respiratory infections. For patients with mild intermittent asthma, the use of short-acting inhaled beta₂-agonists on an as-needed basis usually suffices. However, if significant symptoms recur or beta₂-agonists are required for quick relief more than two times a week (except for exacerbations caused by viral infections or exercise-induced bronchospasm), the patient should be moved to the next step of care. Patients who experience exercise-induced bronchospasm benefit from taking inhaled beta₂-agonists, cromolyn, or nedocromil shortly before exercise (NAEPP, 1997).

Mild Persistent Asthma

According to NHLBI, mild persistent asthma is characterized by:

- symptoms greater than two times a week but less than one time a day;
- exacerbations that may affect activity; and
• nocturnal symptoms more than two times a month.

The NHLBI Expert Panel recommends that patients with persistent asthma at any level of severity should receive daily long term control medication. For persons with mild persistent asthma this is inhaled corticosteroids at a low dose, cromolyn, or nedocromil. Sustained-release theophylline is an alternative, but not a preferred, long-term control therapy. Leukotriene modifiers can also be considered, but their place in therapy is not fully established. Short-acting inhaled beta$_2$-agonists should be used as needed to relieve symptoms (NAEPP, 1997).

**Moderate Persistent Asthma**

According to NHLBI, moderate persistent asthma is characterized by:

- daily symptoms;
- daily use of inhaled short-acting beta$_2$-agonists;
- exacerbations that affect activity;
- exacerbations greater than or equal to two times a week that may last days; and
- nocturnal symptoms more than once a week.

There are at least three options for patients with moderate persistent asthma. The first option is increasing inhaled corticosteroids to a medium dose. Most patients will benefit from this strategy, though infrequent adverse effects may arise. The second option is adding a long-acting bronchodilator to a low-to-medium dose of inhaled corticosteroids. The bronchodilator may be either a long-acting inhaled beta$_2$-agonist (e.g., salmeterol) or sustained-release theophylline. Long-acting beta$_2$-agonist tablets, although not preferred, may be considered. The third option is to establish control with medium-dose inhaled corticosteroids, then lower the dose and add nedocromil. The panel reviewed literature on this third option and found some benefit in three studies and no benefit in another study. Therefore, this treatment option is not preferred. If symptoms are not initially controlled with these therapy options, then daily long-term control medications should be increased to a high dose of inhaled corticosteroids and a long-acting bronchodilator should be added (NAEPP, 1997).
Severe Persistent Asthma

According to NHLBI, severe persistent asthma is characterized by:

- continual symptoms;
- limited physical activity; and
- frequent exacerbations;
- frequent nocturnal symptoms.

Patients who are not controlled on maximal doses of long-acting bronchodilators and high doses of inhaled anti-inflammatory agents will also need oral systemic corticosteroids on a routine, long-term basis. The lowest possible dose must be sought and should be administered under the supervision of an asthma specialist (NAEPP, 1997).

Other Management Measures

The U.S. Preventive Services Task Force (USPSTF) recommends pneumococcal vaccination and regular influenza vaccination for those with chronic cardiac or pulmonary disease (USPSTF, 1996). The updated NHLBI guidelines recommend annual influenza vaccinations for patients with persistent asthma, but their earlier support for pneumococcal vaccine has been dropped due to insufficient evidence of benefit (Indicator 9) (NAEPP, 1997).

Care of an Acute Asthma Exacerbation

Patients at high risk of death from exacerbations should be counseled to seek immediate medical care rather than initiate home therapy. Patients at high risk include those with a history of:

- past sudden severe exacerbation;
- prior intubation;
- two or more hospitalizations for asthma in past year;
- three or more emergency care visits for asthma in the past year;
- prior admission for asthma to an intensive care unit;
- hospitalization or emergency care visit within the past month;
- current use of systemic corticosteroids or recent withdrawal from systemic corticosteroids;
• comorbidity from cardiovascular or chronic obstructive pulmonary diseases;
• serious psychiatric or psychosocial problems (NAEPP, 1997).

The NAEPP recommends that all patients seen in the emergency department or other urgent care setting should be evaluated with a complete history in order to identify factors related to high risk of mortality. This history should include:

• time of onset and cause of current exacerbation;
• severity of symptoms;
• all current medications;
• prior hospitalizations and emergency department visits for asthma;
• prior episodes of respiratory insufficiency due to asthma (Indicator 10); and,
• other potentially complicating illnesses such as cardiac or pulmonary disease or diseases worsened by systemic corticosteroid therapy (NAEPP, 1997).

Further, the NAEPP recommends that all patients presenting to the emergency department with an asthma exacerbation should be evaluated with at least one measurement of airflow obstruction:

• peak expiratory flow rate measured with a peak flow meter; or
• one-second forced expired volume (FEV1) determined by spirometry (NAEPP, 1997) (Indicator 11).

These measures are important for determining appropriate treatment. NAEPP recommendations also state that all patients with an exacerbation should have an initial physical examination of the chest to assess airflow (NAEPP, 1997) (Indicator 13). At the time of the exacerbation, patients on theophylline should have serum theophylline level measured (Indicator 12). All patients should receive initial treatment with inhaled beta2-agonists (Indicator 14). Patients treated with beta2-agonists who have an FEV1 less than 70 percent of baseline should have an FEV1 or PEF repeated prior to discharge (NAEPP, 1997) (Indicator 15). Patients should be re-evaluated, including PEF or FEV1, after the initial dose of bronchodilator and after three doses of inhaled bronchodilator (60 to 90 minutes after initiating treatment). Patients
who have persistent symptoms, diffuse wheezes audible on chest auscultation, and a PEF or FEV$_1$ < 40 percent of predicted or baseline should be admitted to the hospital because of higher risks of complications and mortality (Indicator 17) (McFadden and Hejal, 1995). Patients with a good response to inhaled beta$_2$-agonist treatment should be observed for 30 to 60 minutes after the last treatment to ensure stability prior to discharge (NAEPP, 1997).

Listed below are the NAEPP follow-up care recommendations for a patient who has been stabilized after an acute exacerbation:

- Treatment should be given for at least three days (NAEPP, 1997).
- Treatment regimen should include systemic corticosteroids for all patients with an FEV$_1$ or PEF less than 70 percent of baseline (or predicted) at discharge, and for all patients at increased risk for potential life-threatening deterioration (Indicator 16).
- A follow-up medical appointment should occur within three to five days of discharge (NAEPP, 1997).

**Care of Patients Hospitalized for Asthma**

Patients whose airflow obstruction does not respond to intensive bronchodilator treatment require close attention in the hospital. They should be closely monitored and should have oxygen saturation measured (Indicator 18). Supplemental oxygen should be given to most patients to maintain the oxygen saturation greater than 90 percent. Hospitalized patients should be followed during the acute phase of the exacerbation with lung function measurement (PEF or FEV$_1$) before and after bronchodilator therapy. Thereafter, PEF or FEV$_1$ should be measured at least once a day until discharge (NAEPP, 1997).

All patients with asthma who are admitted to the hospital should receive systemic corticosteroids (preferably via intravenous route) (Indicator 19) and beta$_2$-agonists (Indicator 20). The administration of intravenous methylxanthines to hospitalized adults is controversial (Huang, 1993), and is not generally recommended by the NHLBI guidelines (NAEPP, 1997). Oxygen should be given to all patients with an oxygen
saturation less than 90 percent (Indicator 21); or with an FEV\textsubscript{1} or PEF less than 50 percent of predicted when arterial oxygen monitoring is not available. Patients with a pCO\textsubscript{2} greater than 40 should receive at least one additional blood gas measurement to evaluate response to treatment (Indicator 22). Chest physical therapy has not been found to be helpful for most patients, and is not recommended in the literature. Use of mucolytics (e.g., acetylcysteine, potassium iodide) should be avoided because they may worsen cough or airflow obstruction. Sedation (i.e., with anxiolytics and hypnotic drugs) should be avoided because of its respiratory depressant effect (Indicator 23). Since bacterial and mycoplasmal respiratory infections are thought to contribute only infrequently to severe exacerbations of asthma, use of antibiotics should be reserved for those patients with purulent sputum and/or fever (NAEPP, 1997).

**FOLLOW-UP**

Before discharge from the hospital, the patient’s medication should be adjusted to an oral and/or inhaled regimen. This should occur when the patient is minimally symptomatic and has little wheezing on chest exam. The NHLBI recommends close medical follow-up during the tapering period, but does not specify a follow-up interval. Since the taper of most patients will be finished within 14 days, a follow-up visit within that time seems reasonable (Indicator 24) but is not supported by any clinical trial evidence. Discharge medications should include a short-acting inhaled beta\textsubscript{2}-agonist and enough oral corticosteroid to complete a course of therapy or to continue until a follow-up visit. If inhaled corticosteroids are to be given, they should be started before the course of oral corticosteroids is completed (NAEPP, 1997).
REFERENCES


Executive Committee of the American Academy of Allergy and Immunology. 1993. Inhaled beta-2-adrenergic agonists in asthma. Journal of Allergy and Clinical Immunology 91: 1234-7.


RECOMMENDED QUALITY INDICATORS FOR ASTHMA

These indicators apply to men and women age 18 and older who have chronic asthma, and exclude patients with only exercise-induced bronchospasm. Only the indicators in bold type were rated by this panel; the remaining indicators were endorsed by a prior panel.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Quality of Evidence</th>
<th>Literature</th>
<th>Benefits</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Patients with the diagnosis of moderate-to-severe asthma should have had some historical evaluation of asthma precipitants within six months (before or after) of diagnosis.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease baseline shortness of breath. Improve exercise tolerance. Decrease steroid toxicity. Decrease number of exacerbations.</td>
<td>This may result in improved control of asthma and less need for medications such as steroids, which have undesirable toxicities.</td>
</tr>
<tr>
<td>2. Patients with the diagnosis of moderate-to-severe asthma should have baseline spirometry or peak flow performed within six months of diagnosis.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease baseline shortness of breath.</td>
<td>By documenting the diagnosis with spirometry, one can initiate the appropriate therapy, minimize inappropriate use of medications, and assess future worsening or improvement.</td>
</tr>
<tr>
<td>3. Spirometry should be measured in patients with chronic asthma at least every 2 years.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease shortness of breath. Improve exercise tolerance.</td>
<td>Sequential measurement spirometry is useful for therapeutic decisions. Knowing the person's baseline is useful for treatment of exacerbations.</td>
</tr>
<tr>
<td>Treatment (Therapy)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Patients with the diagnosis of moderate-to-severe asthma should have been prescribed a beta2-agonist inhaler for symptomatic relief of exacerbations to use as needed.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease shortness of breath. Prevent need for emergency room treatment.</td>
<td>Beta2-agonists are first-line therapy for asthma exacerbations. Asthmatics should have ready access to this therapy.</td>
</tr>
<tr>
<td>Indicator</td>
<td>Quality of Evidence</td>
<td>Literature</td>
<td>Benefits</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>5. Patients who report using a beta2-agonist inhaler more than 3 times per day on a daily basis (not only during an exacerbation) should be prescribed a longer acting bronchodilator (theophylline) and/or an anti-inflammatory agent (inhaled corticosteroids, cromolyn).</td>
<td>III</td>
<td>Executive Committee of the American Academy of Allergy and Immunology, 1993</td>
<td>Decrease baseline shortness of breath. Improve exercise tolerance.</td>
<td>This is somewhat controversial since some clinicians are still advocating chronic treatment with beta2-agonists. However, chronic treatment with beta2-agonists appears to increase bronchial reactivity and may contribute to asthma mortality.</td>
</tr>
<tr>
<td>6. Patients with moderate-to-severe asthma should not receive beta-blocker medications (e.g., atenolol, propranolol).</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Prevent worsening of shortness of breath.</td>
<td>Beta-blockade promotes airway reactivity.</td>
</tr>
<tr>
<td>7. Patients requiring chronic treatment with systemic corticosteroids during any 12 month period should have been prescribed inhaled corticosteroids during that same 12 month period.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease steroid toxicities.</td>
<td>There is a great deal of focus in the guidelines on the use of inhaled steroids and on reducing dependence on systemic corticosteroids.</td>
</tr>
<tr>
<td>8. Patients on chronic theophylline (dose &gt; 600 mg/day for at least 6 months) should have at least one serum theophylline level determination per year.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease shortness of breath. Improve exercise tolerance. Prevent theophylline toxicity.</td>
<td>Clearance of theophylline can vary even within the same individual. Patients may therefore become sub-therapeutic or toxic on doses that were previously therapeutic. Toxicities include tremulousness and agitation, nausea, vomiting, and cardiac arrhythmias.</td>
</tr>
<tr>
<td>9. Patients with the diagnosis of moderate-to-severe asthma should have a documented flu vaccination in the fall/winter of the previous year (September - January).</td>
<td>III</td>
<td>NAEPP, 1997; CDC, 1993</td>
<td>Prevent pneumonia secondary to influenza infection. Prevent asthma exacerbation.</td>
<td>Influenza can precipitate exacerbations and lead to secondary pneumonia in patients with asthma.</td>
</tr>
<tr>
<td>Indicator</td>
<td>Quality of Evidence</td>
<td>Literature</td>
<td>Benefits</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>----------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Diagnosis and Treatment of Exacerbations</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 10. All patients seen for an acute asthma exacerbation should be evaluated with a complete history including all of the following:  
  a. time of onset,  
  b. all current medications,  
  c. prior hospitalizations and emergency department visits for asthma,  
  d. prior episodes of respiratory insufficiency due to asthma. | III                 | NAEPP, 1997    | Prevent complications and medication toxicities. Reduce chance for future exacerbations. Prevent mortality. | Objective measurements are useful for treatment decisions. They help initiate appropriate level of therapeutic intervention and help direct treatment strategies. |
<p>| 11. Patients presenting to the physician’s office with an asthma exacerbation or historical worsening of asthma symptoms should be evaluated with PEF or forced expiratory volume at 1 second (FEV₁). | III                 | NAEPP, 1997    | Decrease shortness of breath.                                            | Objective measurements are useful for treatment decisions. They help initiate appropriate level of therapeutic intervention, whether that be with beta2-agonists, steroids, or hospitalization. |
| 12. At the time of an exacerbation, patients on theophylline should have theophylline level measured. | III                 | NAEPP, 1997    | Decrease shortness of breath.                                            | Theophylline clearance may vary to a great degree. Subtherapeutic levels in persons on chronic treatment may add to an exacerbation. |
| 13. A physical exam of the chest should be performed on patients presenting with an asthma exacerbation in the physician’s office or emergency room. | III                 | NAEPP, 1997; McFadden and Hejal, 1995 | Prevent mortality due to asthma.                                         | A silent chest may predict more severe asthma. A physical exam helps guide therapy by evaluating severity. |
| 14. Patients presenting to the physician’s office or ER with an FEV₁ or PEF &lt; 70% of baseline should be treated with beta2-agonists before discharge. | III                 | NAEPP, 1997    | Decrease shortness of breath.                                            | The percentage cut-off for this and the next three indicators are achieved through expert opinion; 70% is generally felt to be a cut-off for moderately severe exacerbations. It is generally agreed, however, that beta2-agonists are first-line drugs in an exacerbation. Lack of improvement indicates the need for additional therapy. If baseline is not available, predicted will be used. |</p>
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Quality of Evidence</th>
<th>Literature</th>
<th>Benefits</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Patients who receive treatment with beta2-agonists in the physician’s office or ER for FEV$_1$ &lt; 70% of baseline should have an FEV$_1$ or PEF repeated prior to discharge.</td>
<td>III</td>
<td>NAEP, 1997</td>
<td>Decrease shortness of breath.</td>
<td>Repeat measures assess response (or lack thereof) to therapy.</td>
</tr>
<tr>
<td>16. Patients with an FEV$_1$ or PEF &lt; 70% of baseline after treatment for asthma exacerbation in the physician’s office should be placed on an oral corticosteroid taper.</td>
<td>III</td>
<td>NAEP, 1997; McFadden and Hejal, 1995</td>
<td>Decrease shortness of breath.</td>
<td>Steroids have been shown to improve recovery, but little objective data exists to back up the appropriate cut-off. If patients do not improve significantly with beta2-agonists alone, then the severity of the exacerbation warrants steroid treatment.</td>
</tr>
<tr>
<td>17. Patients who have a PEF or FEV$_1$ &lt; 40% of baseline after treatment with beta2-agonists should not be discharged from the physician’s office.</td>
<td>III</td>
<td>NAEP, 1997; McFadden and Hejal, 1995</td>
<td>Prevent mortality from asthma.</td>
<td>The cut-off, though arbitrary, reflects severe asthma exacerbation. These patients require close supervision to prevent mortality.</td>
</tr>
<tr>
<td><strong>Inpatient Treatment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Patients admitted to the hospital for asthma exacerbation should have oxygen saturation measured.</td>
<td>III</td>
<td>NAEP, 1997</td>
<td>Prevent mortality. Prevent cardiac ischemia. Decrease shortness of breath.</td>
<td>Oxygen saturation identifies patients who are hypoxemic and for whom oxygen therapy should be initiated.</td>
</tr>
<tr>
<td>19. Hospitalized patients should receive systemic steroids (either PO or IV).</td>
<td>III</td>
<td>NAEP, 1997</td>
<td>Prevent mortality. Decrease shortness of breath.</td>
<td>Steroids improve recovery from severe asthma exacerbation. There is a debate regarding the preference of IV versus PO steroids.</td>
</tr>
<tr>
<td>20. Hospitalized patients should receive treatment with beta2-agonists.</td>
<td>III</td>
<td>NAEP, 1997</td>
<td>Prevent mortality. Decrease shortness of breath.</td>
<td>These are first-line agents for treatment of broncho-constriction</td>
</tr>
<tr>
<td>21. Hospitalized patients with oxygen saturation &lt; 90% should receive supplemental oxygen, unless pCO$_2$ &gt; 40 is previously documented.</td>
<td>III</td>
<td>NAEP, 1997</td>
<td>Prevent mortality. Prevent cardiac ischemia. Decrease shortness of breath.</td>
<td>90% is a conservative cut-off.</td>
</tr>
<tr>
<td>Indicator</td>
<td>Quality of Evidence</td>
<td>Literature</td>
<td>Benefits</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>22. Hospitalized patients with pCO₂ &gt; 40 should receive at least one additional blood gas measurement to evaluate response to treatment, unless pCO₂ &gt; 40 is previously documented.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Decrease shortness of breath. Prevent mortality.</td>
<td>CO₂ retention indicates poor gas exchange and fatigue, and these patients should be monitored closely for treatment response.</td>
</tr>
<tr>
<td>23. Hospitalized patients should not receive sedative drugs (e.g., anxiolytics), except if on a ventilator, physiologically dependent on sedatives, or in alcohol withdrawal.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Prevent worsening of shortness of breath.</td>
<td>Sedation may worsen exacerbation.</td>
</tr>
<tr>
<td>Follow Up</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Patients with a hospitalization for asthma exacerbation should receive outpatient follow-up contact within 14 days.</td>
<td>III</td>
<td>NAEPP, 1997</td>
<td>Prevent exacerbation recurrence.</td>
<td>NHLBI recommends follow-up but does not state a time interval. Two weeks seems reasonable since a taper off steroids is usually for approximately 2 weeks. Four weeks would be the outside range.</td>
</tr>
</tbody>
</table>

Definitions and Examples

1 Asthma precipitants include pollens, molds, viral infections, exercise, animals with fur, birds, and house-dust mites (mattresses, pillows, carpets, and upholstered furniture).

2 Toxicities of glucocorticoid therapy include fluid/electrolyte disturbances, peptic ulcer disease, ulcerative esophagitis, diabetes mellitus, glaucoma, psychosis, myopathy, osteoporosis, pancreatitis, impaired wound healing, adrenal atrophy, cataracts, and increased susceptibility to infections. (Barker et al., 1991).

3 An asthma exacerbation is characterized by acute obstruction to airflow. Exacerbations may be initiated through exposure to allergens and irritants, influenza, pneumonia, as well as other unidentified factors. Patients become acutely short of breath, tachycardic, and if severe, use accessory muscles of respiration. Exacerbation could lead to death if improperly treated. Treatment for an exacerbation should begin at home with beta₂-agonists. Physicians need to evaluate the severity of the exacerbation in order to initiate appropriate treatment.

4 Chronic treatment with systemic corticosteroids is defined as at least two prescriptions for systemic corticosteroids in a one year period or any continuous treatment with systemic corticosteroids for 30 days or more.
**Quality of Evidence Codes**

<table>
<thead>
<tr>
<th>I</th>
<th>RCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>II-1</td>
<td>Nonrandomized controlled trials</td>
</tr>
<tr>
<td>II-2</td>
<td>Cohort or case analysis</td>
</tr>
<tr>
<td>II-3</td>
<td>Multiple time series</td>
</tr>
<tr>
<td>III</td>
<td>Opinions or descriptive studies</td>
</tr>
</tbody>
</table>