

The National Asthma Education Prevention Program (NAEPP II) Guidelines for the Treatment of Asthma: Implications for the Pharmacist
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PLEASE NOTE: The content of the article was current at the time it was written. The exam for this article is not valid for CE credit after January 7, 2004.

Learning Objectives

After reading this article, the pharmacist should be able to:

1. List and define (as identified in the National Asthma Education Prevention Program [NAEPP II] Report):
 - a. The 4 components of effective asthma management
 - b. The 4 categories of severity of chronic asthma
 - c. The goals for treatment of persistent asthma

2. Discuss key points of the NAEPP II Report regarding:
 - a. The step-care approach to the treatment of persistent asthma
 - b. The mechanism and rationale for use of long-term controller medications (e.g., inhaled corticosteroids, theophylline, cromolyn, nedocromil, and salmeterol)
 - c. Monitoring and assessment of persistent asthma, including home peak flow monitoring, quality of life assessments, and asthma care plans
 - d. Management of asthma triggers

3. Identify and discuss ways that community or ambulatory pharmacists can implement the NAEPP II Guidelines in their practice.
 - a. Counsel patients about:
 - (1) Necessary health maintenance
 - (2) Home monitoring/asthma care plans
 - b. Assess and make recommendations to improve:
 - (1) Patient compliance
 - (2) Asthma control
 - (3) Use of prescription and over-the-counter medications

Abstract: The National Asthma Education and Prevention Program (NAEPP II) Expert Panel II Report updated its recommendations for the monitoring and treatment of asthma in February 1997. This article updates the pharmacy practitioner on significant changes from the first panel report published in September 1991. The Report identifies 4 components that are important for effective asthma management: 1) assessment and monitoring, 2) environmental control, 3) comprehensive pharmacologic therapy, and 4) patient education.

All patients should perform daily home peak flow monitoring with moderate-to-severe persistent asthma to detect the onset of acute asthma exacerbations. Peak flow monitoring may also be useful in other asthma patients to establish their personal best peak expiratory flow rate (PEFR), assess efficacy of changes in chronic medications, and identify asthma triggers. Patients with moderate to severe asthma or a history of severe asthma exacerbations should also have a written asthma care plan that specifies their chronic medications and recommendations for acute management of asthma exacerbations based on peak flow readings and asthma symptoms.

The patient in conjunction with health care professionals should identify goals for asthma therapy. Management of all patients with asthma should include environmental or trigger control and a short-acting beta agonist for acute asthma symptoms. Patients with mild, persistent asthma should also receive an anti-inflammatory agent to minimize the potential for the development of chronic lung impairment.

Patients with asthma require asthma education that is “integrated, systematic, and tailored to individual patient needs.” Content should include information regarding the disease, monitoring, and treatment of asthma and environmental control of asthma triggers. Pharmacists can be important providers of asthma education and can also verify a patient’s understanding and expand on information provided by other health care professionals. Ways pharmacists can implement the NAEPP II Guidelines into their practice are discussed.



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I. Introduction

The prevalence of asthma has increased over the last decade, and it affects 14 million people nationwide. The cost of asthma, which includes medical treatment, hospitalizations (approximately 500,000 per year), emergency room and office visits, and mortality have also increased.^{1,2} Other “costs” include the impact of asthma on the quality of life, such as restricted activity and decreased productivity from missed work or school. Factors cited as contributors to this problem include suboptimal therapy, patients’ lack of understanding of the disease state and

anti-asthma medications, and the lack of appropriate cooperative management and monitoring techniques.³

To improve the care of patients with asthma, the National Heart, Lung and Blood Institute's (NHLBI) National Asthma Education and Program (NAEP) Expert Panel was formed. It is a multidisciplinary panel of volunteers including physicians, scientists, pharmacists, and nurses who are experts in the treatment of asthma. The recommendations of the first NAEP expert panel were published in 1991.⁴ The National Asthma Education Prevention Program (NAEPP) panel was formed to revise and update the NAEP Report. The charges of the NAEPP were to: 1) review the asthma literature, 2) prepare practical recommendations for use by clinicians for the management and treatment of asthma, and 3) develop specific aids to assist in implementing the recommendations. Their initial report was published in July 1997.⁵ Currently, the NAEPP panel is working on another revision of these guidelines.^a

As the NAEPP II Guidelines summarize the current asthma literature and outline current standards of care for the treatment of asthma, it is an important document for all pharmacists who provide care to patients with asthma. The purposes of this article are to: 1) briefly summarize the contents of the NAEPP II Guidelines (especially the important changes from the first NAEP Report) and 2) discuss the application and integration of the guidelines related to persistent, adult asthma into the general practice of community or ambulatory care pharmacists. The NAEPP II Report also discusses the treatment of special patient populations (e.g., pediatric, elderly, and pregnant) and acute exacerbations of asthma. The interested reader is encouraged to refer to the complete NAEPP II Guidelines. These are available on the Internet at <http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm>.

II. NAEPP II Guidelines

Background

The NAEPP II Report uses the following “working definition” of asthma:

“Asthma is a chronic inflammatory^b disorder of the airways in which many cells and cellular elements lay 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 coughing, particularly at night or in the early morning. These episodes are usually associated with widespread but 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.”

Several key concepts are included in this definition. The first is that chronic inflammation of the airways plays an important role in causing symptoms of asthma and airway obstruction. Multiple inflammatory cell lines and associated mediators are thought to participate. Therefore, anti-

^a At the time this manuscript is being revised (December 2000) there is no anticipated publication date.

^b The emphasis placed on the underlined words is that of the author and not of the NAEPP II Guidelines.

inflammatory medications play a key role in controlling the cause of asthma. Most patients with moderate, persistent asthma will require a “quick relief” bronchodilator medication to control symptoms (i.e., beta agonist) and a “long-term-control” anti-inflammatory medication (e.g., inhaled corticosteroid). Perhaps more effective treatment of airway inflammation may improve the asthma outcomes discussed above. Also, better understanding of the pathogenesis of asthma has promoted research to find more effective pharmacologic therapy to selectively inhibit the desired cell lines and mediators with minimal, acceptable toxicity.

Asthma is also a reversible disease, meaning that patients may exhibit normal lung function and may be asymptomatic between exacerbations. This helps differentiate asthma from other obstructive lung diseases (e.g., emphysema or chronic bronchitis), but also means that with adequate treatment, patients with asthma can have normal lung function. However, there is some evidence that chronic inflammation from asthma can potentially result in chronic impairment of pulmonary function. Therefore, suppression of inflammation early in the disease may potentially prevent this change in lung function.

Asthma involves hypersensitivity (in addition to bronchoconstriction) of the airways. Hypersensitivity (or hyperresponsiveness) implies that the airways exhibit a variable response to triggers. The level of airway inflammation determines the degree of hypersensitivity and clinical severity of asthma. Therefore, during asthmatic exacerbations when there is increased inflammation of the airways, patients may have a greater reaction to their usual triggers or temporarily react to stimuli that are usually not bothersome. Hypersensitivity (and inflammation) of the airways may be evaluated by detecting large differences or variations (>20%) between the morning and evening peak expiratory flow rate (PEFR) readings⁶ (see **Table A**).

Overview of the NAEPP II Guidelines

The NAEPP II Guidelines are divided into 4 sections. Each section covers one of the 4 components that the NAEPP II stresses for effective asthma management:

1. Use of objective measures of lung function to assess the severity of asthma and to monitor the course of therapy
2. Environmental control of factors that precipitate asthma
3. Comprehensive pharmacologic therapy to prevent airway inflammation and treat asthma exacerbations
4. Education for a partnership in patient care

Component 1: Use of Objective Measures of Lung Function to Assess the Severity of Asthma and to Monitor the Course of Therapy

This section defines the levels of chronic disease severity (**Table B**^c), which are based on the frequency and severity of usual asthma symptoms and PEFR readings. However, all levels may potentially have severe, acute exacerbations. Also, the severity of an individual's asthma may vary over time (e.g., an individual's asthma may worsen as exposure to her asthma triggers increases). Importantly, the NAEPP II Goals of Asthma Therapy (**Table C**) include both medical goals and patient goals/expectations of therapy. Comprehensive monitoring plans should include ways to assess both sets of goals.

Peak Flow Monitoring

Home peak flow monitoring is recommended for patients with moderate-to-severe, persistent asthma and/or patients with a history of severe asthma exacerbations. Home peak flow monitoring can be used to assess the severity of an acute exacerbation. Patients should also have a written asthma action plan^d to assist them in assessing their symptoms, interpreting their PEFR readings, and recommending an appropriate course of action. Early therapy of acute exacerbations will likely quicken recovery, decrease the amount and duration of therapy necessary, and minimize hospitalizations and emergency room visits. Therefore, the purpose of checking the PEFR and using an action plan in this context is to guide the patient in detecting exacerbations early, assessing the severity of an exacerbation, adjusting/using relief medications, and seeking an appropriate level of medical care in a timely fashion.

Since it is important that even relatively young children (with asthma) understand how to use and interpret PEFR readings, the PEFR color zone system (**Table D**) was developed. This system uses the analogy of the colors of a traffic light to correspond to the PEFR color zones.

Daily morning (chronic) home peak flow monitoring is also recommended for patients with moderate to severe asthma^e as it can improve patient outcomes when used with an asthma care plan. More frequent (e.g., twice daily) monitoring may be used if the usual PEFR is <80% predicted or personal best. More frequent daily monitoring is used to assess the presence and degree of circadian variability in PEFR, which correspond to airway hyperresponsiveness and inflammation.^f

^c This replaces the categories of mild, moderate, and severe asthma as outlined in the first NAEP Expert Panel Report.

^d There are various samples of asthma action plans available. The NAEPP II Report includes some samples of commercially available forms. However, the Report does not recommend any particular form or format for action plans.

^e The recommended frequency is decreased from the 1991 NAEP Guidelines, which had recommended twice daily monitoring in most patients.

^f To identify circadian variability, the new recommendation is that the PEFR on awakening (prior to administering medications) is compared to one performed between noon and 2 p.m. (The prior recommendation was to check the readings at 7:00 a.m. and

Chronic daily PEFr monitoring is useful to do the following:

- Detect acute asthma exacerbations early so that patients seek prompt medical care
- Evaluate the effectiveness of changes in chronic drug therapy
- Provide an assessment of asthma severity to patients with a poor perception of symptom severity
- Quantify the degree of lung impairment

Patients may be asked to record or graph their daily PEFr readings in an asthma diary or PEFr logbook.^g Some diaries include room to record the degree of severity of their asthma symptoms and number of puffs of quick relief medication used each day. The asthma care practitioner then reviews their diary or logbook at each office visit.

Short-term, daily PEFr monitoring (e.g., checked twice daily for a few weeks) can also be beneficial in certain situations to:

- Evaluate the efficacy of changes in drug therapy (e.g., during step-up or step-down therapy to be discussed later)
- Identify an individual patient's triggers by detecting any changes in PEFr after exposure to a potential trigger
- Establish the patient's personal best PEFr to be used as a baseline or a goal for his/her chronic maintenance therapy

The personal best PEFr is not necessarily constant. It should be reevaluated periodically to document that asthma control is maintained and adjusted as needed as chronic control improves. For example, the personal best PEFr should be determined after changes in chronic drug therapy (since improvement in asthma control may result in an improvement of personal best PEFr) or every 6 months in young children to adjust for changes because of the child's growth.

The NAEPP II Guidelines also discuss the limitations of home peak flow monitoring. Patients require explicit instruction to effectively perform home peak flow monitoring, including PEFr technique, and how to record the values and interpretation of the readings. Problems can also occur with lack of compliance and device failure. Currently, there is not enough information to establish when a meter should be replaced (i.e., when does a meter wear out?). Inconsistent measurements can occur among different brands of peak flow meters. In addition, a standard population table of predicted PEFr values may not recognize ethnic variation in predicted values (e.g., Caucasian vs. African American vs. Asian vs. Hispanic vs. Native Americans).

7:00 p.m.) As noted in **Table B**, greater than a 20% difference in these two numbers is considered significant.

^g Samples of PEFr logs and diaries are included in the NAEPP II guidelines and other NAEPP II publications. The use of these for patients with asthma is analogous to daily home blood sugar monitoring in patients with diabetes.

Therefore, practitioners should recommend and use a device with brand-specific tables of predicted PEFRs. It is also recommended that each patient use the same brand of device over time and bring his/her own meter to check-ups. It is strongly recommended that a patient's personal best PEFr (versus predicted PEFr) be established and used whenever possible to account for individual or ethnic variation.^h Personal best PEFr should be reevaluated periodically (e.g., receiving a new meter) and the break points for the PEFr color zones (**Table D**) modified accordingly.

Quality of Life

The NAEPP II Guidelines recommend that the quality of life and functional status of patients with asthma be monitored routinely. The purpose is to evaluate the impact of asthma or asthma therapy from the patient's point of view. Quality of life can be assessed by asking the patient questions about how asthma affects his/her life (sample questions are included in the report) or by using one of several standardized quality of life questionnaires.ⁱ The goal is to minimize the negative impact of asthma on the patient's quality of life. This would include little or no missed school or work, good exercise tolerance or activity level, low frequency and severity of asthma exacerbations, and few/no nocturnal symptoms, hospital admissions, emergency room visits, or emergent physician visits. For children with asthma, one should also assess any negative impact of the child's asthma on the caregiver's activities or lifestyle. Quality of life should be periodically^j reassessed to verify that goals are met and maintained with changes in drug therapy.

Other Monitors

The report also recommends other monitors to assess the adequacy of therapy, which include the following: compliance with drug therapy and home peak flow monitoring, adequacy of Metered Dose Inhaler (MDI) technique, frequency of short-acting beta agonist use, frequency of oral pulse corticosteroid therapy, presence of adverse drug reactions, and adequacy of therapy in controlling symptoms. In addition, one should periodically verify that the patient has a current asthma action plan. This details chronic medications and actions that patients should take based on the severity of asthma signs, symptoms, and PEFr readings. Patient assessment of and satisfaction with their

^h The first expert panel report also recommended the use of the personal best PEFr. However, with the better appreciation of the limitations of standardized population tables of predicted PEFr values, the NEAPP II Report places greater emphasis on the use of the personal best PEFr.

ⁱ The NAEPP II Panel did not feel that there was enough information to recommend a specific quality of life survey (or even that a formal quality of life survey be used). However, the effect of asthma on the patient's activity should be assessed in some manner.

^j The NAEPP Report does not identify a specific time interval for quality of life assessments. The author interprets this to mean regular intervals on an ongoing basis (e.g., each follow-up visit that may be every 4 to 8 months depending on the stability of the patient's asthma).

asthma care should also be evaluated. In this regard, patients should know the goals and reasonable expectations associated with their therapy.

Component 2: Control of Factors Contributing to Asthma Severity

This section of the NAEPP II Guidelines discusses the identification and management of asthma triggers. Triggers are categorized as inhalant (e.g., outdoor and animal allergens, dust mites, cockroaches, fungi), occupational (e.g., chemicals or dusts), irritants (e.g., tobacco smoke and pollution), and other (e.g., gastroesophageal reflux disease, some medications, infections, rhinitis/sinusitis). It is important to identify a patient's triggers so that exposure can be avoided or minimized whenever possible. Should a patient be exposed to a known trigger, treatment with a short-acting beta agonist prior to, or soon after exposure, may help minimize symptoms.

Patients with asthma should not smoke (and exposure to second-hand smoke should be minimized), since tobacco smoke can decrease pulmonary function, increase the need for asthma medication, and increase the development of asthma in infancy. Patients should avoid exercising during periods of high-level air pollution (e.g., ozone warning or poor air quality days).

It is recommended that patients with persistent asthma undergo skin testing for perennial indoor allergens. The Report also provides recommendations for minimizing exposure to indoor allergens (e.g., reducing humidity levels; using air conditioners; methods to control dust mites; and minimizing exposure to pet allergens, cockroaches and fungi). Allergen immunotherapy may be considered in some patients whose symptoms are not controlled with environmental or pharmacologic management, and when there is a clear correlation between asthma symptoms and the allergen.

Beta blockers, including topical ophthalmic agents, may aggravate asthma. However, some patients with asthma may tolerate cardioselective beta blockers. Sulfites may be a trigger for some asthma patients. They are used as a preservative in foods and beverages (e.g., beer, wine, and dried fruit). Bronchoconstriction can be seen in response to aspirin. Those with this type of aspirin sensitivity should also avoid other nonsteroidal anti-inflammatory agents, as there is a cross-reaction with those agents. The prevalence of aspirin sensitivity increases with age and severity of asthma, and is often seen in patients who also have nasal polyps. Exposure to these agents may cause potentially life-threatening bronchoconstriction in sensitive patients. Cross-sensitivity is usually not seen with acetaminophen and non-acetylated salicylates (e.g., salsalate).

Treatment of other conditions, such as rhinitis or sinusitis, may improve asthma control. Treatment with intranasal corticosteroids is preferred to antihistamine-decongestant combinations or nasal cromolyn, since they reduce nasal inflammation, obstruction, and discharge and lower airway hyperresponsiveness and asthma symptoms. Patients with asthma who also complain of frequent heartburn and nocturnal asthma symptoms may show improvement with treatment of gastroesophageal reflux disease. Both the usual non-drug (e.g., elevation of the head of the bed, avoiding large meals close to bedtime, etc.) and pharmacologic therapies can be used (e.g., histamine₂ blockers and omeprazole). Patients with asthma should also receive an annual influenza vaccine to minimize the frequency or severity of viral upper respiratory infections, which can also serve as an asthma trigger.

Component 3: Comprehensive Pharmacologic Therapy to Prevent Airway Inflammation and Treat Asthma Exacerbations

The NAEPP II Guidelines classify medications as either long-term control (e.g., anti-inflammatory or long-acting bronchodilators) or quick-relief medications (e.g., short-acting bronchodilators).

Long-term Control Medications

In general, medications in this category should be taken on a daily basis to maintain optimal lung function.

Inhaled Corticosteroids

These agents inhibit inflammatory cell accumulation in the lung, inhibit inflammatory mediator production and edema, and increase the sensitivity of beta receptors. They reduce severity of symptoms and airway hyperresponsiveness, decrease the frequency of exacerbations, and prevent airway remodeling caused by chronic inflammation. Inhaled corticosteroids are very effective as single agents and are relatively nontoxic especially at low to moderate doses. For patient convenience, most can be given twice daily, and may even be effective as once daily regimens in some patients. Inhaled corticosteroids are recommended as first-line agents for the chronic prophylaxis of asthma.

Based on information available at that time, the 1991 NAEP Guidelines⁷ recommended dosing in numbers of puffs per day, regardless of the strength of the formulation or the potency of the corticosteroid. For example, the dosage recommended for patients with chronic, moderate asthma was 2 to 4 puffs twice a day and up to 2 to 6 puffs two to six times per day for chronic, severe asthma. The new guidelines attempt to estimate equipotent doses of these agents (**Table E**) by summarizing the data currently available.

To minimize the local corticosteroid side effects (i.e., oral candidiasis, dysphonia, and cough), it is recommended that patients use the lowest effective dosage with a spacer. Using a twice-daily (versus four times daily) regimen and “rinsing and spitting” after administration may also help. Inhaled corticosteroids have a dose-dependent effect on growth rate, which may cause a growth delay in children. Using moderate-high doses increases the potential of this effect. Hence, the lowest effective dose should be used and the child’s growth should be monitored. However, the potential for this is less than with systemic corticosteroids. In evaluating the overall effect of corticosteroid use on growth, it is important to note that poorly controlled asthma may also delay growth.

Although the actual risk of osteoporosis and bone fracture with chronic inhaled corticosteroids is not known, calcium (1000-1500 mg/day) and vitamin D (400 units/day) supplements should be considered for women (especially those on higher doses of inhaled corticosteroids with or without other risk factors of osteoporosis). Estrogen replacement may be appropriate for postmenopausal women receiving over 1000 mcg per day of inhaled corticosteroid.

Salmeterol

Salmeterol causes bronchodilation through stimulation of beta receptors, increases mucociliary clearance, and decreases the release of mediators from mast cells. Its mechanism and toxicities are similar to short-acting beta agonists. It is recommended for chronic prophylaxis only in combination with an inhaled corticosteroid. Because of its longer duration of action (12 hours), it is especially useful in providing long-acting, symptomatic control (e.g., for nocturnal symptoms and prior to prolonged exercise). However, it is not an acceptable substitute for a short-acting beta agonist for acute, symptomatic control, since it has a longer onset of action (15-30 minutes). Also, salmeterol should not be used in place of an anti-inflammatory agent, since it lacks defined anti-inflammatory effects. The daily dose should not exceed 4 puffs per day.

Leukotriene modifiers

Leukotrienes are released from inflammatory cells (mast cells, eosinophils, and basophils) and contribute to bronchoconstriction and airway edema, mucous production, and inflammatory cell chemotaxis. This new category of anti-asthma agents modifies the activity of leukotrienes by inhibiting 5-lipoxygenase to decrease leukotriene production (zileuton) or by decreasing leukotriene receptor activity (zafirlukast). Potential advantages of these agents include oral administration, a relatively low frequency and severity of side effects and a twice-daily dosing regimen (zafirlukast only). These are recommended as alternative agents for chronic prophylaxis of asthma in patients over 12 years old. Montelukast was released in the United States after the publication of the NAEPP II Report, so it is not specifically mentioned. It is dosed once daily, and can be used in children over 6 years old. Low-dose inhaled corticosteroid or cromolyn/nedocromil are the preferred agents in the NAEPP II Guidelines for initial therapy in most patients. This is because of the “modest” clinical effect of leukotriene modifiers in published studies and the lack of data documenting efficacy and toxicity in children and comparative efficacy to other agents.

Although these agents appear to be well tolerated, elevation of liver enzymes has been reported with zileuton. Therefore, routine monitoring of liver enzymes is recommended, which adds to the cost of its use. Zileuton inhibits CYP 3A4 hepatic enzymes, which metabolize warfarin and theophylline. Zafirlukast inhibits CYP 2C9 enzymes, which metabolize phenytoin and warfarin. The potential for clinically significant drug interactions with these agents is not well studied.

Cromolyn/nedocromil

The mechanism of these agents is to decrease the activation and release of inflammatory mediators by mast cells and to decrease the accumulation of eosinophils in lung tissue. The overall effect is to prevent (but not treat) the early and late asthmatic response. These agents are generally very well tolerated. Nedocromil may have some advantages over cromolyn, since it is more potent and may be effective in a twice-daily regimen. However, complaints of bad taste with nedocromil are fairly common. Both are recommended as first-line, chronic prophylactic agents for mild to moderate asthma and can be used for prophylaxis prior to exercise or other known triggers. Studies have not consistently shown a benefit of adding nedocromil to inhaled corticosteroid therapy. Therefore, the preferred regimen is to add salmeterol or theophylline when patients are not controlled with inhaled corticosteroids alone. However, adding nedocromil may be an acceptable alternative in some clinical situations.

Theophylline

Despite long-term clinical use and study, the precise mechanism and degree of anti-inflammatory activity of this agent remains unclear. Theophylline decreases eosinophil and T lymphocyte infiltration into the lungs, increases the strength of diaphragmatic contraction, and improves mucociliary clearance. However, it is used primarily for bronchodilation. Advantages of theophylline include oral administration (e.g., young children who may not be able to use MDIs) and a long duration of action. However, its potential for serious toxicities and drug interactions and the need for serum concentration monitoring limit its usefulness in chronic therapy. Theophylline is used primarily in combination with an inhaled corticosteroid for chronic prophylaxis. Because of the long duration of action, it may be especially useful for patients with nocturnal symptoms.

Relief Medications

Short-acting beta agonists are the drugs of choice for treatment of acute symptoms and prevention of exercise-induced bronchospasm. It is generally recommended that these agents be used as needed for the treatment of asthma symptoms. Therefore, the amount or frequency of short-acting beta agonist use may be a useful monitor of overall asthma control. However, it is recommended that no more than one canister be used per month. Because these agents do not decrease lung inflammation, daily or increasing use of a short-acting beta agonist may indicate the need to change the long-term control medications (e.g., increase the dose or add another long-term control medication).

Ipratropium has limited usefulness in the treatment of asthma. It is only recommended as an alternative agent in patients unable to tolerate a short-acting beta agonist or in combination with a short-acting beta agonist for very severe asthma exacerbations.

Short courses of systemic corticosteroids are recommended for moderate to severe acute exacerbations of asthma. They have been shown to prevent relapses, shorten recovery time, and decrease the progression of exacerbations.

Stepwise Approach to Chronic Asthma Therapy

The recommended stepwise approach for the treatment of chronic asthma is outlined in **Table F**. The recommendations stress the importance of long-term control with anti-inflammatory agents. However, short-acting beta agonists also play a very important role in the management of acute symptoms. Close monitoring is necessary to verify that asthma goals are achieved and maintained. Patients may be started on medications based on the severity of asthma at the time of diagnosis. Dosage increases or use of additional long-term control medications may be added if asthma goals are not achieved with initial therapy (i.e., step-up therapy). Alternatively, the NAEPP II Report also recommends step-down therapy. That is, to achieve asthma control more quickly, long-term control medications can be started at one level higher than indicated by the severity level of the asthma, or a short course of systemic corticosteroids may be given. The dosages of the long-term controller medications are decreased when the designated goals are reached. Regardless of which method is used initially, when asthma goals are achieved and maintained, the number and/or dosage of preventive medications may be decreased to the

minimum necessary to maintain asthma control. Trigger management and patient education are stressed in each step of therapy.

Considerations in Special Populations

Children

There is some evidence that early treatment of inflammation may decrease morbidity and the development of more serious asthma later. Consistent use of symptomatic treatment with short-acting beta agonists more than twice a week may indicate underlying inflammation and the need for long-term-control medications. Cromolyn or nedocromil have demonstrated benefit with limited toxicity, and are, therefore, recommended as first-line anti-inflammatory agents in this population. Children may be more sensitive to the toxicities of inhaled corticosteroids. Therefore, the “low,” “moderate,” and “high” doses are lower than in adults.^k Theophylline, because of its potential for toxicity and need for serum level monitoring, is only recommended as an alternative, chronic anti-inflammatory agent.

Inhaled drug delivery is more problematic in young children. Alternative delivery devices, such as extension devices with masks or nebulizers, or even use of oral medications (e.g., oral beta agonists or theophylline) may be necessary.

Older children should have a written asthma plan for the school. This includes reliable, prompt access to medications, how to assess and treat acute exacerbations, identification and avoidance of asthma triggers, and recommendations for the child’s self-administration of medications and management of exercise-induced bronchospasm. Older children and adolescents should be involved in the development of the asthma plan/goals and be taught self-management techniques.

Older adults

Older patients may have more difficulty administering inhaled medications correctly (e.g., poor inhaler technique owing to arthritis and poor hand-to-lung coordination). They may also have concurrent diseases that complicate asthma treatment. Patients with concurrent emphysema or chronic bronchitis may have a permanent, “non-reversible” impairment in lung function. Therefore, respiratory symptoms in these patients are generally less responsive to the usual asthma regimens. The elderly who have common diseases often use drugs that are relatively contraindicated in asthma (e.g., systemic or topical beta blockers). Because of concurrent disease states, older patients may be more sensitive to the adverse effects of asthma medications (e.g., fluid retention, confusion, agitation, glucose intolerance with acute systemic steroids, or tremor and arrhythmias with short-acting beta agonists). Older adults are more likely to develop aspirin sensitivity and/or be at risk for osteoporosis, as discussed previously.

Component 4: Education for a Partnership in Asthma Care

The NAEPP II Report describes this component as “the cornerstone of asthma management.” The recommended content for the education of patients with asthma is outlined in **Table G**. Patients need to be knowledgeable about all aspects of asthma management. This includes the

^k See the NAEPP II Report for the estimated clinical comparability of inhaled corticosteroids in children.

purpose, use, and administration of medications; the cause and monitoring of asthma; and the management of asthma triggers. Patients with a history of moderate-to-severe asthma exacerbations should also have a written, daily asthma care plan. In addition to outlining a patient's chronic, daily medications, asthma care plans should provide patient-specific recommendations for how and when to use relief medications, list the warning signs of severe exacerbations (**Table H**), and provide guidance when the patient should seek medical care.

The Report outlines 3 important characteristics for optimal asthma education programs. The program should begin at the time of diagnosis and be integrated into the patient's care. The primary asthma provider should introduce basic principles to the patient. However, other members of the health care team are important in clarifying and expanding the information provided to the patient. Patient education from alternate sources (e.g., other health care professionals including nurses, pharmacists, respiratory therapists, formal educational programs, pamphlets, and support groups) should not replace that provided by the primary asthma provider.

Secondly, asthma education should be systematic. This includes a comprehensive discussion of the important topics with continuous reinforcement and repetition of basic concepts. A hospitalization or emergency room visit for asthma should be viewed as a failure of the asthma care plan. An intensive review should be made of asthma goals, therapy, and care plan to identify and correct any deficiencies and to minimize future problems (e.g., Is there a need for long-term control medications? Is the patient noncompliant with prescribed therapy or have poor drug administration skills? Does the patient have a clear action plan?).¹

Lastly, asthma education should be tailored to individual patient needs. This includes recognizing and respecting cultural beliefs and presenting information at an appropriate educational level for the patient.

For an educational program to be successful, a partnership should be developed between the patient and the involved health care practitioners. The guidelines briefly discuss general strategies for developing such a partnership to increase patient compliance and participation in developing and implementing the asthma care plan (**Table I**). Open communication is essential. The patient and practitioners should discuss and jointly develop individualized treatment goals. For example, a patient's goals may include the ability to perform a desired level of activity, such as playing competitive sports or completing routine household chores without debilitating asthma symptoms. The asthma care plan should be individualized to meet these goals and include therapy and monitoring with which the patient is willing and able to comply.

The Role of the Pharmacist in Implementing the NAEP II Guidelines

Asthma therapy provides an excellent and unique opportunity for pharmacists to expand pharmaceutical care services, increase professional satisfaction, and improve patient outcomes. There is a great need for better patient education and improvement in patient outcomes for this

¹ The NAEP II Report provides a comprehensive checklist of educational topics to be discussed or reviewed with the patient on hospital discharge.

disease. Asthma management requires an in-depth knowledge of medications. However, it does not require extensive physical or laboratory assessment, which may not be practical or feasible in some pharmacy settings. Most of the important data necessary to monitor the efficacy of chronic asthma therapy can be acquired directly from the patient (e.g., frequency, pattern, and severity of symptoms and use of rescue medications). Therefore, pharmaceutical care for this disease could be implemented in most pharmacy practice settings (e.g., institutional, managed care, community, or clinic pharmacies) that have access to patients and that provide a suitable environment for patient education. Also, because of their availability in the community, pharmacists are potentially more accessible than other knowledgeable health care professionals (e.g., physicians or respiratory therapists). Pharmacists can, therefore, provide an important service in answering patient questions and conducting follow-up. Lastly, pharmacists have access to important patient information regarding the patient's actual usage of medications that may not be available to other practitioners.

Pharmacists can play an important role in implementing all 4 components of the NAEPP II Guidelines. However, in working with patients, the components of monitoring, optimizing drug therapy, and providing asthma education are often integrated. Working with asthma providers, pharmacists can serve as primary asthma educators. But, it is also important that pharmacists expand upon and verify the understanding of information provided by other health care professionals. It is important the pharmacists familiarize themselves with and use consistently the terminology used within the NAEPP II Guidelines (e.g., relief and controller medications, asthma care plan, personal best peak flow rate, etc.) Because patients may be receiving asthma education and reinforcement from different practitioners, it is important that all use the same terminology to avoid confusing the patient.

There are many sources of asthma education materials on a variety of topics available at little or no charge. Sources include the NAEPP, American Lung Association, Asthma and Allergy Foundation of America, Mothers of Asthmatics, local hospital asthma support groups, the Internet, and pharmaceutical manufacturers. Pharmacists should be comfortable demonstrating proper MDI and dry powdered inhaler (DPI) technique. Pamphlets, MDI and DPI placebos and videos are available to assist. Another useful source for information is the web site for the American Association of Asthma, Allergy and Immunology Initiative in Promoting Best Practices for Pediatric Asthma

<http://www.aaaai.org/professional/initiatives/pediatricasthmaguidelines/default.stm>. In selecting a variety of patient education materials for their practice, pharmacists should consider the age range, cultural diversity, and educational level of their patients.

The American Pharmaceutical Association, colleges of pharmacy, and pharmaceutical companies offer programs certificate programs on asthma management. Interested and experienced pharmacists may want to obtain certification as an asthma educator. The National Certified Asthma Educator Board was established in September 2000 to develop a multidisciplinary, national certification exam for asthma. One potential advantage to those having such certification would be reimbursement for providing asthma education to patients (similar to Certified Diabetes Educators). It is anticipated that the exam will be available in late 2002.

Detecting Undiagnosed or Undertreated Asthma

Pharmacists can often identify patients with asthma who may be undiagnosed or undertreated. Screening for use of over-the-counter asthma medications may identify such patients. Some of these patients may not have reported the use of these medications or their symptoms to their primary physician. As a result, they are not diagnosed with asthma, and the lack of comprehensive medical care may have serious consequences.^m Others may fail to see their physician regularly and, thus, not have an active prescription for a short-acting beta agonist. Still others (because of continued symptoms) may be using over-the-counter medications in combination with their prescription medications. There may be reasonable (usually short-term) indications for the use of over-the-counter asthma medications. For example, the patient from out of town may be purchasing an over-the-counter inhaler because he left his prescription beta agonist inhaler at home. However, a pharmacist should inquire closely whenever the use of over-the-counter medications is detected to rule out undiagnosed or undertreated asthma. Patients who use over-the-counter medications regularly should be strongly encouraged to discuss this use with their primary care or asthma care provider to rule out undiagnosed or undertreated asthma. Various vitamins and herbal remedies including vitamins C and E, fish oils, ma huang, ginseng, and echinacea have been promoted for asthma. Patients using these agents should be strongly encouraged to discuss their use with their primary asthma practitioner. It is very unlikely that these would replace long-term control medications. In addition, some of these (e.g., ma huang and ginseng) have the potential to cause adverse effects and drug interactions.

Routine review of a prescription profile may also reveal potential undertreatment of asthma. Generally, patients receiving salmeterol should also be using both a short-acting beta agonist and an anti-inflammatory medication. Also, patients regularly refilling a short-acting beta agonist (one canister per month) may need a “step-up” in their chronic therapy. (e.g., either an additional long-term control agent or an increase in the dose).

Pharmacists may also assess the adequacy of asthma therapy by reviewing a patient’s goals for therapy and quality of life. The Asthma Quality of Life Questionnaire, Living with Asthma Questionnaire, and St. George’s Respiratory Questionnaire are examples of disease-specific, self-administered questionnaires that have been used to assess the impact of asthma on an individual’s quality of life.⁸ Each contains 30 to 70 questions to measure the impact of asthma on various domains or aspects of the patient’s life (e.g., activity limitation, emotional impact, and symptom severity). These surveys are helpful in quantifying the impact of asthma and/or documenting improvement in quality of life with therapy. However, such questionnaires may not be practical to routinely perform and evaluate in many pharmacy settings.

Alternatively, pharmacists could use one or more quality-of-life questions suggested in the NAEPP II Guidelines. Patients returning for refills could be briefly questioned regarding recent

^m The well-publicized death of a 16-year-old, nationally known model was reported to be due to undiagnosed asthma (based on autopsy results). The teenager had never reported respiratory symptoms to her physician, but had been treating herself with an over-the-counter beta agonist medication. (*Wall Street Journal* July 1996).

asthma exacerbations, symptom frequency, or any limitations in desired activities resulting from asthma. Presence of any of these may be indicative of undertreated asthma. In any situation where the pharmacist suspects undiagnosed or undertreated asthma, the patient should be referred for medical evaluation.

Optimizing Drug Delivery

Pharmacists may also optimize therapy by maximizing drug delivery. This includes an appropriate choice of drug-delivery device and correct technique. Poor MDI technique is a common problem. Several studies have shown that fewer than 50% of patients demonstrate correct technique.⁹ Lack of adequate instruction often contributes to this problem. Fewer than 50% of patients will use correct MDI technique after receiving only written instructions.¹⁰ Demonstrating MDI technique to the patient has been shown to improve the effectiveness of instruction.¹¹ Some patients may require several attempts to achieve adequate technique. In addition, a significant proportion of patients may require repeated review and instruction in order to maintain correct technique.¹²

Some patient populations may need more instruction or assistance with MDI technique. For example, older patients with cognitive deficits or poor hand strength may need additional instruction to use MDI effectively.¹³ Some may require either spacing devices or an alternative route of drug administration. Young children may also need a spacer (with or without face masks) or nebulizers. Different sizes of face masks and spacers are available. All patients receiving inhaled corticosteroids should use a spacing device (if the MDI prescribed does not have one built-in. [e.g., Azmacort™]) Patients should also be counseled to rinse their mouth and spit after use of inhaled corticosteroids to avoid local side effects.

Pharmacists should double-check that patients receiving new prescriptions for MDIs and DPIs have been adequately instructed on the correct technique. Patients should be able to demonstrate correct MDI technique with a placebo inhaler. If not, the pharmacist will need to demonstrate correct technique with a placebo MDI, allow the patient additional attempts to practice, and recommend a spacer, as appropriate. Periodic cleaning of MDIs and spacers should also be reviewed. Recommendations for cleaning vary by device. Similarly, when patients receive refills, their technique should be periodically reassessed and corrected if necessary. MDIs and/or spacers should also be examined for dust, lint, and drug accumulation. The problem of poor drug delivery may also be compounded by the development of new delivery devices. The phasing out of chlorofluorocarbon (CFC)-containing MDIs requires the development of new devices or delivery systems (e.g., non-CFC-containing MDIs, dry powdered or breath-activated inhalers). The correct technique for dry powdered and breath-activated inhalers differs from that of standard MDIs. Patients may be concurrently using more than one type of device. In dispensing these devices, the pharmacist should double-check that patients have been appropriately instructed and are aware of any differences in technique.

Another issue is determining when a MDI should be replaced. MDIs are licensed to deliver a specified amount of medication per puff for a certain number of doses, but contain an overfill of medication and propellant. Patients who use their MDIs until they are totally empty may not be receiving the appropriate dose of medication after using the labeled number of puffs. In addition,

patients may not pay attention to the amount of medication remaining and, thus, not replace their MDIs in a timely fashion. There are not extensive data in the literature addressing this issue. However, one study¹⁴ reported 94% of patients used their MDIs until they were completely empty. Of these, 69% reported an increase in symptoms as a result of running out of medication. Until this is better studied, MDIs of regularly scheduled medications should probably be replaced after the labeled number of doses (e.g., if the canister contains 120 doses and the patient is receiving 8 doses per day, it should be replaced every 15 days). Azmacort™ now includes a check-off label in the patient package insert, which helps to track the number of doses used. Patients may check the contents of any as-needed MDIs using the “canister flotation test”¹⁰ to avoid running out of medication. Because of changes in MDI technology, this practice should be discouraged. Alternatively, patients may track the number of doses used using an over-the-counter electronic device such as the Doser. However, this device adds extra expense and must be replaced with each inhaler.

Compliance

Optimizing therapy does not end with the selection of a drug and regimen. Poor compliance with medications has been identified as a significant cause for emergency room visits in children with asthma.¹⁵ Causes of noncompliance may be multifactorial. The methods to improve patient compliance discussed in the NAEPP Guidelines are useful for working with patients with asthma (**Table I**).

Patients need to know and understand the differences between long-term control medications (to be taken daily) and relief medications (to be taken only as needed). Unless the airways are very inflamed, a patient will notice an immediate response after taking a short-acting beta agonist, an effect not evident immediately after using an inhaled corticosteroid. It can be very difficult for patients to understand that using the short-acting beta agonist merely treats the symptoms (i.e., bronchoconstriction) but not the cause of their asthma (i.e., inflammation). Therefore, the rationale for use of these medications should be clearly explained and the importance of daily administration of their anti-inflammatory medication should be emphasized. Patients should not discontinue or alter the dosage of these medications without consulting their asthma care provider.

Medication regimens may be inconvenient. Inhaled corticosteroid regimens requiring doses three to four times per day may hinder compliance. Regimens using the same number of puffs per day in a twice-daily regimen may improve compliance and overall efficacy. At this time, not enough is known about the equivalent doses to recommend automatic therapeutic interchange of inhaled corticosteroids. However, it might be reasonable under some circumstances to recommend a change in the agent used. For example, a change to a higher potency corticosteroid might be recommended if the number of puffs per day of a low potency corticosteroid significantly impairs

ⁿ The canister flotation test is performed by removing the MDI canister from the mouthpiece and depositing it into a container of water. Full canisters will sink to the bottom of the container. As the canister empties it will progressively rise in the water. Totally empty canisters will float on top of the water. Most MDI patient package inserts contain a diagram for performing and interpreting this test.

patient compliance. In addition to potency, products differ greatly on the number of puffs per canister. Both will influence the overall cost and, perhaps, compliance with therapy.

Education and convenient regimens may not be enough to ensure compliance. Patients may have many concerns or questions regarding medications. For example, patients may have experienced adverse drug reactions, heard about the dangers of “steroid” use by athletes or chronic prednisone use, or have concerns regarding “dependency or addiction” to chronic asthma medications. Cultural or family attitudes toward illness and medications may also make patients reluctant to comply with chronic therapy. Many patients may not feel that daily medications are necessary. In one survey, almost 50% of patients expressed a reluctance to use inhalers in public.¹⁶

In another study, one third of patients did not keep their inhalers accessible.¹⁷ A short-acting beta agonist should be available at all times for the treatment of acute symptoms. Also, administration prior to a known trigger or immediately following an unexpected trigger may minimize symptoms. While it is important for all patients with asthma to have access to their inhalers, it can be a particular problem for children with asthma to access their medications during school hours because the school nurse often keeps them. However, some states (e.g., Missouri) have passed laws that permit students to carry and administer their asthma inhalers during school hours with permission of their parents and physician. Pharmacists and other health care professionals need to remind parents that part of “back-to-school” planning includes preparing and informing teachers, coaches, and school nurses of the student’s asthma care plan and assuring the child that s/he will have access to needed asthma medications in a timely fashion.

Using refill information, pharmacists can identify patients who are noncompliant with their chronic medications or overusing acute medications. Pharmacists should attempt to identify the reason for the noncompliance and address any medication-related concerns the patient may have (e.g., addiction potential and use of inhalers in public, etc.). Often, pharmacists are the only health care professionals who have access to this information and can make an objective assessment of actual patient compliance.

Home Peak Flow Monitoring

Pharmacists could expand their role in home peak flow monitoring by stocking peak flow meters (just as many of them stock home glucose monitors). Many of these devices are considered prescription devices. Patients need instruction in correct technique, the recording and interpretation (individual color zones) of the readings, and determination of personal best PEF. Periodic patient follow up is needed to assess peak flow technique and to evaluate the home peak flow monitoring log. The PEF readings should be compared to predicted or personal best PEF. Patients not achieving PEF goals may need adjustment of their long-term control medications.

Asthma Care Plans

Pharmacists can also play a role in developing, clarifying, and reinforcing asthma care plans, some of which are very detailed and patient specific. Pharmacists can ask if patients have an asthma care plan and review it with the patient to verify/reinforce his understanding. For

example, patients with moderate to severe exacerbations may be able to minimize the severity of exacerbations by starting oral corticosteroids promptly and, therefore, may be given prescriptions to start them “as needed.” When dispensing such prescriptions, pharmacists should verify that the patient has been given specific instructions and clearly understands the indications for starting these medications. For example, if the patient’s personal best PEFR is 400, s/he might be instructed to start prednisone 10 mg daily, if PEFR is less than 50% of his personal best PEFR (or <200). It is also important that the patient promptly reports the need for oral corticosteroids to his/her asthma care provider in order to receive further instructions and follow-up. If the patient seems unsure of the instructions, these should be clarified with the prescriber and confirmed with the patient.

However, asthma care plans can also be relatively general. For example, instructions on prescriptions for a short-acting beta agonist are often written to be taken every 4-6 hours “as needed.” Depending on the patient, “as needed” may be interpreted to mean anything from “anytime I wheeze” to “only when I am very short of breath.” This can result in overuse or underuse of these agents. Patients should be questioned regarding their understanding of the guidelines for using a short-acting beta agonist. In the context of a general care plan for home peak flow monitoring, “as needed” can be better described as use prior to exposure to one’s triggers (e.g., exercise) and/or every 4 to 6 hours while one’s PEFR remains in the yellow zone. This gives the patient a more objective and consistent way to determine the need for relief medication. General care plans also stress the importance of taking long-term control medications daily, even when the patient feels fine and PEFR readings are in the green zone.

All patients with asthma (especially those with a history of moderate to severe exacerbations) should be questioned whether they have established a well-understood asthma care plan. Children should have a care plan to manage exacerbations that may occur at school or during extracurricular activities. Those patients who are unsure, lack understanding, or appear to be overusing or underusing their short-acting beta agonist should be encouraged to develop an asthma care plan in conjunction with their primary asthma care provider. The pharmacist may provide some general guidelines; however, more detailed and specific plans should be developed in consultation with the patient’s asthma care provider. Depending on their practice, pharmacists may be able to play a very active and important role in coordinating the development of patient-specific asthma care plans.

Pharmacists can also encourage patients to see their asthma care provider if they do not appear to meet the goals of asthma therapy and/or do not see their practitioner regularly. Patients with moderate to severe asthma who do not perform home peak flow monitoring and/or have an action care plan should also be referred to their asthma practitioner.

Pharmacists can also play a role in the monitoring of asthma by assessing a patient’s understanding of the goals of asthma therapy and their satisfaction with care. For example, a patient may feel dissatisfied with chronic medication that is perceived to be ineffective. Questioning the patient may reveal intermittent use and an expectation of immediate action (similar to the Primatene[®] Mist commercials on television.) Better understanding of the drug’s purpose and mechanism may encourage the patient to take the medication correctly and improve

actual (and perceived) efficacy. Conversely, a patient may accept suboptimal control or frequent symptoms because “I have asthma and just have to live with it.” Pharmacists can explain to the patient that while asthma cannot be cured, it can be controlled. They can encourage patients to discuss symptoms and therapeutic options more fully with their asthma care provider so that better control is achieved.

Trigger Management

Patients with asthma may know some of their triggers, but sometimes need help identifying others. Once identified, patients should be reminded to pretreat with a short-acting beta agonist prior to exposure to a known trigger (e.g., exercise or dogs). Concurrent drugs that may worsen asthma should be identified and discontinued if possible. Patients, especially as they grow older, should be questioned periodically regarding the development of aspirin sensitivity. Patients with asthma should avoid beta receptor blocking agents including ophthalmic agents. The practitioners who were unfamiliar with the patient’s asthma history may have prescribed these medications. If necessary, cardioselective beta blockers may be tried with careful monitoring for increasing asthma symptoms and decreasing PEFrs.

Pharmacists can also assist patients with asthma (or their parents and close family members) in smoking cessation, by providing patient educational materials regarding the health hazards of smoking and second-hand smoke and appropriate smoking cessation techniques. Patients can be referred to smoking cessation support groups at local hospitals, the American Lung Association, or other groups. With the availability of nicotine replacement products over the counter, pharmacists can evaluate the smoker’s potential for nicotine withdrawal symptoms (e.g., use of the Fagerstrom questionnaire^{18 19}) and recommend nicotine replacement products and regimens, as appropriate.

Frequent use of some over-the-counter agents (e.g., sinus/cough and cold products, antacids, or histamine₂ receptor blocking agents) or complaints of nasal congestion, heartburn, or regurgitation in patients with asthma may signal the presence of chronic rhinitis or gastroesophageal reflux disease. Patients may be unaware that optimal treatment of these conditions may improve their asthma control. They may need to be referred to their primary or asthma care practitioner for further treatment. Pharmacists should also remind patients of non-drug measures (e.g., avoiding acidic foods, decreasing caffeine intake, and avoiding eating at bedtime) that may improve gastroesophageal reflux symptoms in some patients.

Pharmacists can also participate in seasonal programs to encourage/remind patients with asthma and others at risk to receive annual influenza vaccinations. Regional programming on air quality (e.g., American Lung Association) may also be available. Patients with asthma should be informed regarding availability of such daily air quality information and know to limit outdoor exposure and avoid outdoor exercise during high ozone periods.

Conclusions

The NAEPP II Guidelines emphasize 4 components for care of patients with asthma, including assessment and monitoring, comprehensive pharmacologic management, environmental control, and patient education. Patients with moderate to severe persistent asthma or a history of severe

exacerbations from asthma should perform daily home peak flow monitoring and have an asthma care plan. Environmental control and trigger management should be part of the care of all patients with asthma. Patients should be involved with defining the goals of their asthma therapy. Asthma education should be integrated, systematic, and tailored to patient needs. Anti-inflammatory medications are the foundation of all long-term-control asthma regimens, since control of chronic inflammation may prevent long-term lung impairment. Short-acting beta agonists are first-line agents for management of acute asthma symptoms.

Pharmacists can serve as a primary source of all aspects of asthma education including the disease, medications, and monitoring. They can also explain, clarify, and reinforce information provided by other health care providers. Routine screening of pharmacy profiles and brief questioning of a patient with asthma can reveal patient misconceptions regarding therapy, educational needs, suboptimal asthma control, and noncompliance with therapy. Also, pharmacists can play an important role in verifying patient understanding of both the disease and therapy, improving compliance, and maximizing drug delivery. Patients who are suspected of having undiagnosed or undertreated asthma should be referred to their physician. Many of these interventions are relatively short and can be incorporated by pharmacists into their everyday dealings with patients. By providing these professional services, pharmacists have an opportunity to enter into a “partnership” with patients and other health care professionals in the treatment of asthma.

Table A. Performing and Recording the Peak Expiratory Flow Rate

A peak expiratory flow rate (PEFR) is a spirometric pulmonary function test that assesses the acute status and/or chronic control of asthma. It assesses large airway function by measuring the maximum rate of air expelled in the first 10 msec of a breath. Various models of peak flow meters are available. The PEFR is more commonly used than other spirometric tests (i.e., FEV₁) because a peak flow meter is relatively small and inexpensive.

In order to perform the test, the patient takes a deep breath and blows hard and fast into the peak flow meter. It is considered “effort dependent” in that the cooperation or effort of the patient can greatly influence the results. The degree of effort (e.g., good, adequate, poor) should be assessed subjectively by observing the patient’s technique. This is recorded along with the highest value from 3 patient attempts.

This patient’s PEFR is then compared with a table of predicted volumes based on the patient’s height, age, and sex, and may be reported as the absolute value and/or either 1) the percent of the predicted value or 2) the percent of the patient’s “personal best” value. (The personal best value is the best or highest value recorded for that patient over a 2- to 3-week period when the asthma is well controlled.) The second option may be more valuable when the patient’s personal best is significantly different from the predicted value.

Example: A 40-year-old female who is 5 feet, 6 inches tall performs a peak flow 3 times (360, 390, 350). The highest of these 3 values (390) is compared with the predicted value (436) from a table of population averages. Her results are then reported as a PEFR of 390 (which is the best of 3, with good effort) and 89% predicted ($390/436 \times 100$).

Table B. Classification of Asthma Severity

Category	Symptoms	Exacerbations	Physical Activity	PEFR
Severe persistent	Continuous	Frequent	Limited	$\leq 60\%$ predicted or Variability $> 30\%$
Moderate persistent	Daily symptoms or Use of short-acting beta agonist Nocturnal symptoms > 1 time per week	May last days or ≥ 2 times per week	Affected during exacerbations	Between 60% to 80% predicted or Variability $> 30\%$
Mild persistent	Symptoms > 2 times per week, but < 1 time per day Nocturnal symptoms > 2 times per month		May be affected during exacerbations	$\geq 80\%$ predicted or Variability 20% to 30%
Mild intermittent	Asymptomatic between exacerbations Symptoms ≤ 2 times per week Nocturnal symptoms ≤ 2 times per month	Brief	Not limited	Normal between exacerbations $\geq 80\%$ predicted Variability $< 20\%$

Table C. NAEPP II Goals and Monitoring of Asthma Therapy

Goals	Examples of Monitoring Parameters
1. Minimize and prevent chronic asthma symptoms	Frequency and severity of signs and symptoms, presence and frequency of nocturnal symptoms
2. Achieve normal pulmonary function	Chronically achieve predicted or personal best PEFR
3. Maintain normal exercise/activity level	QOL questionnaires, functional status, exercise tolerance/distance, number of days of missed work or school
4. Prevent acute exacerbations and the need for emergent hospitalizations or treatment	Number and severity of acute exacerbations, number and length of hospitalizations, number of emergency room or emergent physician visits for asthma
5. Minimize adverse drug reactions from asthma medications	Monitor and question patient regarding adverse reactions
6. Meet patient's expectations of asthma care	Monitor patient satisfaction with care (e.g., surveys), achieve patient goals for therapy.

Table D. Interpretation of PEFR Color Zones

Color	Percent Predicted/Personal Best*	Interpretation
Green	80% - 100%**	Good control (continue chronic medications)
Yellow	50% - 80%***	Caution (asthma control may be changing or worsening)
Red	<50%	Medical alert (stop, seek medical advice/care)

Example: If a patient's "personal best" PEFR is 500, her PEFR values of over 400, 250-400, and less than 200 would correspond to her "green," "yellow," and "red" zones, respectively.

* Use of personal best (if known) is recommended as more patient specific

** Some recommend >90% for "tighter" control

*** Some recommend breaking the yellow zone into "low" and "high" yellow zones, since this range is very broad and may include wide range of symptom control

Table E. Estimated Clinical Comparability of Adult Doses^a for Inhaled Corticosteroids

Drug (Brand names) (puffs/canister)	Dosage (puffs/day)		
	Low	Medium	High
beclomethasone (<i>Beclovent</i> [®] , <i>Vanceril</i> [®])(200)			
42 mcg/puff	4-12	12-20	>20
84 mcg/puff	2-6	6-10	>10
budesonide turbohaler (<i>Pulmicort</i> [®])			
200 mcg/puff	1-2	2-3	>3
flunisolide (<i>AeroBid</i> [®]) (100)			
250 mcg/puff	2-4	4-8	>8
fluticasone(<i>Flovent</i> [®]) (120)			
44 mcg/puff	2-6	---	---
110 mcg/puff	2	2-6	>6
220 mcg/puff	---	---	>3
triamcinolone (<i>Azmacort</i> [™]) (240)			
100 mcg/puff	4-10	10-20	>20

^a This comparison is based on the limited data from the in vitro and clinical trials currently available. It is also based on several assumptions:

1. The topical vasoconstriction activity is comparable to the topical anti-inflammatory activity in the lung.
2. The topical vasoconstriction activity is relative to the binding affinity and half-life of an individual agent in the lung.
3. The different delivery systems (dry powdered inhaler, metered dose inhaler, etc.) may deliver different amounts of drug to the lung.
4. Different agents may have different systemic absorption from the lungs and oral bioavailability.

Table G. Important Educational Content for Patients with Asthma

Asthma

- Basic mechanisms of inflammation and bronchoconstriction
- Common symptoms
- Goals of therapy

Monitoring and Medications

- Roles for each medication (e.g., quick relief [symptomatic] treatment vs. long-term controller [prevention] medications)
- Administration techniques for any drug devices (e.g., metered dose or dry powdered inhaler, nebulizers, spacers)
- Replacement and cleaning of inhalers and spacers
- Self-management plan for chronic therapy (i.e., use of asthma care plans)
- Signs of worsening asthma
- Warning signs to seek medical assistance
- Home peak flow monitoring (for those with moderate-to-severe persistent asthma or history of severe exacerbations)
 - Technique
 - Recording
 - Use of asthma diaries

Environmental Control

- Identification, avoidance, and elimination of triggers
- Pretreatment prior to trigger exposure

Table H. Signs and Symptoms of Severe Exacerbations from Asthma^a

- Breathlessness at rest
- Unable to speak in complete sentences (i.e. speaks in phrases or words)
- Agitated, drowsy, or confused
- Respiratory rate > 30 breaths per minute (adults)
- Uses accessory respiratory muscles to breathe
- Pulse >120 (adults) or bradycardia
- Peak flow rate < 50% predicted or personal best
- Peak flow response to beta agonist lasts < 2 hours

^a Other signs or symptoms may be seen on physical exam or with laboratory (e.g., presence of pulsus paradoxus of >25 mm Hg (adults), PaO₂ <60 mm Hg, and/or PaCO₂ >42 mm Hg, or SaO₂ < 91%).

Table I. Methods to Increase Patient Compliance

- Use effective patient-practitioner communication techniques
 - *Encourage open, two-way communication
 - *Be friendly, attentive, reassuring, and encouraging
 - *Use open-ended questions

- Address patient concerns
 - *Assess patient perceptions of disease severity and medications
 - *Discuss concerns and questions about asthma and medications

- Increase social support systems
 - *Assess social support (family, friends, etc.)
 - *Encourage patient to involve important family members or friends
 - *Refer to support groups, psychologists, social workers, or therapists, as appropriate

- Develop care plans that consider patient factors
 - *Identify any barriers to compliance (cost, patient concerns, lifestyle, ethnic, or cultural beliefs, etc.)
 - *Adapt initial care plans to remove or minimize barriers
 - *Simplify care plan as much as possible
 - *Use language (written and verbal) that is understandable to the patient (educational level, age, culture, and native language)
 - *Adjust care plans over time to increase convenience and efficacy or address problems or concerns

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