Update on asthma management in primary care

Abstract: Asthma, a chronic inflammatory lung disease, is one of the most common and costly diseases in the United States, affecting people of all ages and all ethnic groups. While there is no cure for asthma, optimal disease control and quality of life are possible with proper management and treatment.

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Noninfectious diseases have surpassed infectious diseases as the dominant adversary in healthcare. Currently, asthma prevalence stands at historically high levels and puts a considerable burden on healthcare resources in the United States.[1] The CDC estimates that 25 million Americans are currently living with asthma.[2]

In 2007, the National Asthma Education and Prevention Program (NAEPP), coordinated by the National Heart, Lung, and Blood Institute of the National Institutes of Health, published the *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma*. These guidelines provide an evidence-based methodology for treating asthma with an emphasis on disease control. The goal of the guidelines is to prevent chronic and troublesome symptoms, require infrequent use of an inhaled, short-acting bronchodilator, maintain normal pulmonary function, maintain normal activity levels, and meet patients' and families' expectations for asthma care.

Nurse practitioners (NPs) have the opportunity to improve asthma outcomes and quality of life for patients. NPs are widely employed in primary care to manage asthma; research has demonstrated that NPs improve patient outcomes and provide equivalent care to that of physicians.[4] To best equip NPs for the role of asthma care provider, the NAEPP recommendations have been systematically reviewed using the common SOAP (subjective data, objective data, assessment, plan) format.[3] Using a SOAP format during the primary care visit is a simple, easy, and comprehensive technique to organize symptoms, observations, assessments, and treatment plans for patients with asthma.

Asthma: A single disease?

Asthma is a complex, chronic, inflammatory lung disease characterized by variable and recurring symptoms of airflow obstruction, bronchial hyperresponsiveness, and inflammation.[3] The interaction of these features determines the clinical manifestations and severity of the disease as well as the patient's response to treatment.[3] Underlying inflammation causes recurrent episodes of coughing, wheezing, shortness of breath, and chest tightness in susceptible patients. These episodes are generally associated with widespread but variable airflow obstruction, which is often reversible either spontaneously or with treatment.[3]

There has been a longstanding debate whether asthma is a single disease with a variable, clinical presentation or several diseases that present with variable airflow obstruction as a common feature.[5] In 2006, it was proposed that the different phenotypes expressed by patients with asthma are partially dependent on different disease processes in each person.[6] It is also suggested that asthma comprises distinct, heterogeneous, inflammatory disorders that are characterized by patients presenting with different phenotypes with distinct genetic components, environmental causes, and immunopathologic signatures.[7] Additional phenotypes will

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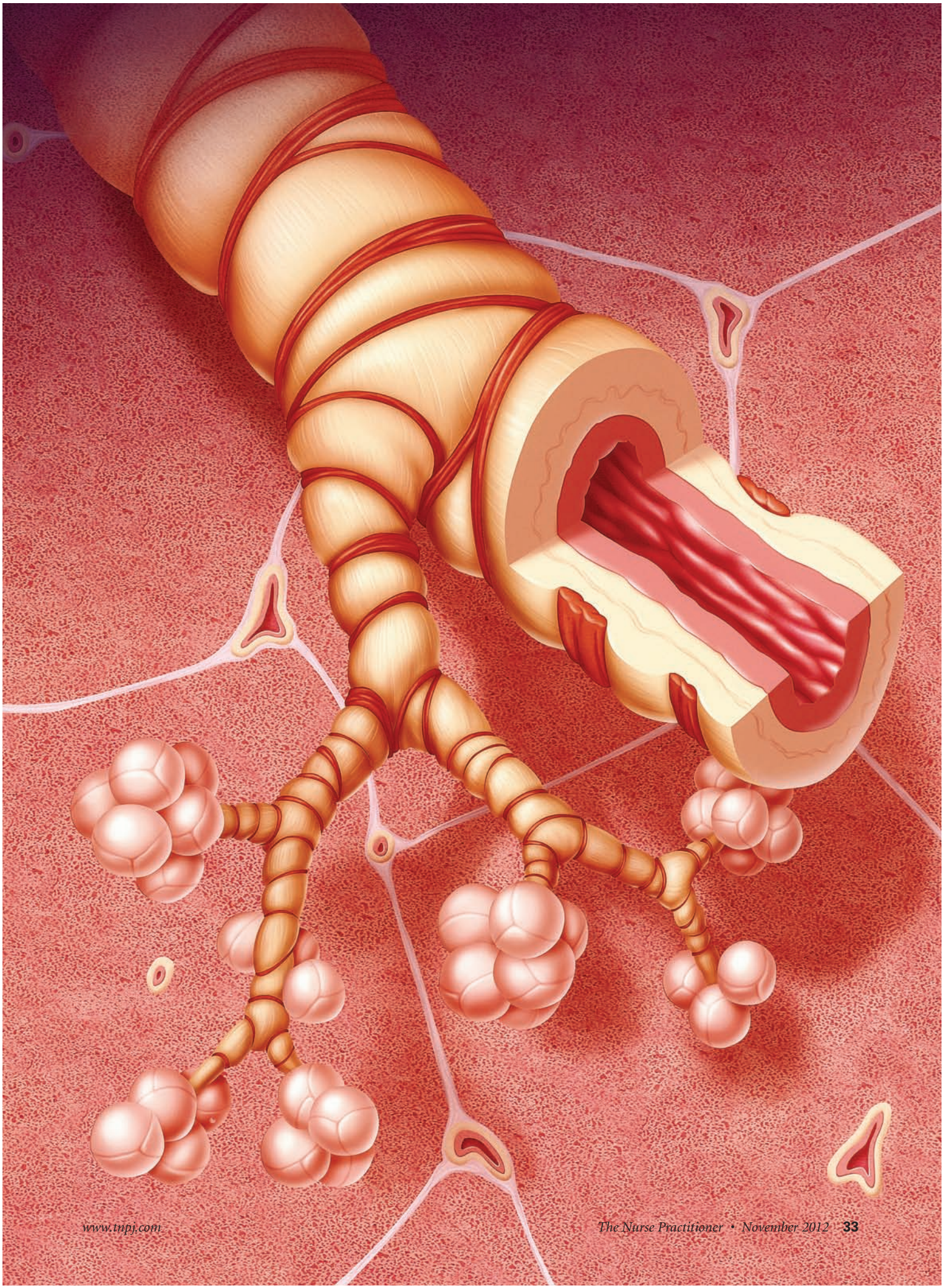
Key words: airway inflammation and hyperresponsiveness, asthma management, chronic inflammatory lung disease

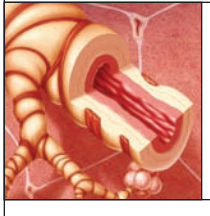


most likely be identified in the future as advances in genetics are reached, allowing the use of clear biomarkers.[7] Patient responses to asthma therapy varies considerably, most likely a result of the different sensitivities of the various asthma phenotypes.[7]

Lifespan considerations

Pediatrics. Asthma is the most common, chronic childhood disease, and its morbidity disproportionately affects children.[8,9] The majority of children who have one or two isolated wheezing episodes in childhood associated with a viral infection do not develop asthma; however, children who have multiple episodes of wheezing in infancy are more likely to develop asthma if they have other allergic disorders such as atopic dermatitis, food allergy, or allergic rhinitis.

Children younger than 2 years are the most difficult to diagnose and treat because the evidence base in this age group is limited.[10] Persistent asthma begins in the preschool years. Alterations in lung structure and function that develop during this time may determine asthma status/lung function throughout childhood and adolescence. The diagnosis of asthma depends on the risk factors of the child and a careful consideration of alternative diagnoses.[11]



Asthma is the most common, chronic childhood disease, and its morbidity disproportionately affects children.

Generally, older, high-risk children may be empirically treated. Intermediate- and low-risk children usually require further testing with spirometry if able, as do high-risk children who have a poor response to treatment.[12] A definitive diagnosis of asthma depends on the patient's history of reversible airway obstruction that responds to treatment with a bronchodilator and is confirmed with spirometry, or if there is symptom improvement with inhaled bronchodilators or corticosteroids.[12]

The NAEPP describes the use of the Asthma Predictive Index (API) in infants and children younger than 3 years (see *Asthma Predictive Index*). Using this index as a guide, healthcare providers and parents can watch closely for symptoms of asthma as a child grows, and if needed, intervene using the appropriate medications.[3]

Pregnancy. Asthma tends to follow a "rule of thirds" during pregnancy. This means that one-third of pregnant women with asthma improve, one-third get worse, and one-third remain the same as before pregnancy. Women tend to have a similar pattern as the first pregnancy with future pregnancies.

Pregnancy does not affect asthma management, and with a few exceptions, medications used to treat asthma during pregnancy are similar to the medications used to treat asthma patients who are not pregnant.[13] Inhaled corticosteroids are used to treat mild- to moderate-persistent asthma; a long-acting beta$_2$-agonist (LABA) or a leukotriene-receptor modifier may be added if needed.[14] Albuterol (Proventil), a pregnancy category C drug, is the preferred short-acting beta$_2$-agonist (SABA). An inhaled corticosteroid is the preferred long-term control medication. Budesonide (Pulmicort), a pregnancy category B drug, is the preferred inhaled corticosteroid because more data are available about this medication during pregnancy.[14]

Leukotriene-receptor antagonists, such as montelukast (Singulair; pregnancy category B) and zafirlukast (Accolate; pregnancy category B), are treatment options. Zileuton (Zyflo; pregnancy category C), a leukotriene inhibitor, should not be used during pregnancy.[13] If general anesthesia becomes necessary (for example, for emergency cesarean section), a general anesthetic that promotes airway dilation is recommended.[14]

Older adults. Asthma commonly presents in children but may present in middle-aged individuals. People older than 65 are the fastest-growing age group in the United States; one in five people with asthma are expected to be 65 or older by 2035.[15] Prevalence in this age group is 5% to 7%.[16] Due to disease comorbidities and delayed use of pulmonary function tests, asthma is underdiagnosed in the older adult, and asthma mortality of older adults is much higher than for younger patients.[16]

Subjective data

Chief Complaint. The history of present illness is generated by using the OLFQQAAT (**O**nset, **L**ocation, **F**requency, **Q**uality, **Q**uantity, **A**ggravating factors, **A**lleviating factors, **A**ssociated symptoms, **T**reatments tried), PQRST (**P**alliative factors, **Q**uality, **R**egion, **S**everity, **T**iming), or a similar system to get the symptom details in a methodical fashion. Patients usually request an evaluation because of symptoms related to the classic triad of asthma: cough, shortness of breath, and wheezing in response to identified asthma triggers such as change in temperature, air-borne irritants or allergens, a viral infection, exercise, hormonal changes, and/or emotions. The cough is characteristically dry, nonproductive, and will usually be worse at night. Some patients also describe the shortness of breath as tightness in the chest or a bandlike feeling. Typically, symptoms will

come and go over time, and it is important to ask how quickly the symptoms developed, and what relieved them. Although chronic cough can be a sign of many disorders it may be the only manifestation of asthma (especially in young children) and has been labeled cough variant asthma.[3] Cough-variant asthma is considered rare in adults, and its existence is currently under debate.[17] The NP should ask the patient or parent (if the patient is a child), how symptoms are affecting quality of life, or activities of daily living as this helps quantify the severity of the symptoms.

Review of systems. The review of systems (ROS) will help to identify pertinent health problems. For a chief complaint consistent with a diagnosis of asthma, a focused ROS may be limited to the head and neck, respiratory, and integumentary systems.[3] Specific questions may include the following:

- **Eyes:** Itchy, watery eyes, red eyes, or blurry vision
- **Ear/Nose/Throat:** Itching, ear popping, difficulty hearing, impairment of smell, post nasal drip, or sinus pain/ressure
- **Respiratory:** Shortness of breath with or without exercise, wheezing, chronic cough, chest tightness, or nighttime cough/shortness of breath
- **Gastrointestinal:** Heartburn, indigestion, or acid reflux
- **Integumentary:** Rashes, hives, or other skin manifestations related to allergy.

Past medical and family history. This should include general health, birth history and the date of the last menstrual period for female patients, childhood/adult illness, psychiatric illnesses, trauma or injuries, hospitalizations, surgeries, immunizations, and drug or environmental allergies. The patient should also be asked if he or she has ever been tested for allergies. Medical history should include the number of acute asthma exacerbations requiring ED visits, hospitalization, or admission to an ICU for treatment. Because asthma is more common in people with a family history of asthma or the diagnosis of atopic disease, a history of nasal sinus disorders such as allergic rhinitis and skin allergies in first-degree relatives should also be obtained.

Current medications. The NP should list any current medications that the patient is taking including over-the-counter drugs, and also herbal preparations and supplements. Some medications such as angiotensin-converting enzyme (ACE) inhibitors can cause a cough in up to 20% of patients.[18] Patients may confuse this drug-related cough with asthma. ACE inhibitors, especially in the case of an unstable airway, can trigger wheezing and bronchospasm.[19] Nonselective beta-blockers should be used with caution due to the potential risk of bronchospasm. Aspirin and nonsteroidal anti-inflammatory drugs may adversely affect asthma if the patient has a sensitivity to these drugs.[19,20]

Asthma Predictive Index

One major criteria	Or	Two minor criteria
Parental history of asthma		Evidence of food allergies/sensitization
Provider diagnosis of atopic dermatitis		≥4% peripheral blood eosinophilia
Evidence of sensitization to aeroallergens		Wheezing apart from colds

Source: National Heart, Lung, and Blood Institute, National Asthma Education and Prevention Program. Expert panel report 3: Guidelines for the Diagnosis and management of Asthma. 2007. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf.

Social history. The NP should ask patients about smoking history or prior exposure to tobacco smoke, wood-burning stoves, or fireplaces. Ask about recreational drug use because marijuana and crack cocaine, respectively, are the second- and third-most commonly smoked substances in the United States after tobacco, especially among teenagers and young adults;[21,22] both can affect the respiratory system negatively.[23,24] Any pets, dust mites, cockroaches, and mold should also be considered, as well as information about the age of the home, whether the home has carpeting, and if there is a basement.

Objective data

Vital signs. Temperature, pulse, respirations, blood pressure, and pulse oximetry should be obtained. Include height, weight, and calculate body mass index because there are studies that suggest a link between asthma and obesity.[25]

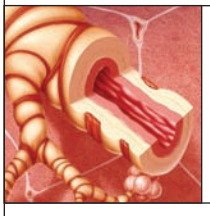
Physical exam. The upper respiratory tract, chest, and skin are the focus of the physical exam for patients with asthma.[3] Because asthma is an episodic disease, the clinical exam findings can be normal in patients with asthma. Exam of the nasal passages may reveal nasal polyposis or nasal congestion. Chest auscultation may reveal expiratory wheezes. Depending on the pattern of symptoms, exam findings may include a widespread wheeze audible on auscultation—or signs of respiratory distress such as tachypnea—and accessory muscle use. Features of atopic disease may be evident as well on exam.

Diagnostic tests. Spirometry is the key diagnostic test for patients with asthma, and accurate measurement of respiratory function is necessary to assess and manage asthma.[26] Spirometry determines variability of airflow obstruction due to asthma and measures the degree of airflow obstruction compared to predicted normal airflow and lung volumes. However, because asthma is an intermittent disease, a normal spirometry does not exclude diagnosis. Sig-

nificant reversibility as demonstrated by an increase in forced expiratory volume in 1 second (FEV_1) of more than 200 mL and 12% or greater from the baseline measure after inhalation of a short-acting bronchodilator (or 10% improvement of percent predicted FEV_1) is diagnostic of airway obstruction in adults.[27] This value has been found to be comparable in children.[28] The bronchodilator response should be considered even if spirometry is normal, for example, 80% or greater than predicted normal.

Spirometry parameters of greatest value when evaluating asthma are FEV_1, forced vital capacity (FVC), and FEV_1/FVC ratio. The FEV_1 is considered the gold standard in measuring airway obstruction because its measurement has been well established and is a predictor of future asthma exacerbations. A low FEV_1, relative to reference values, is directly associated with increased risk of asthma exacerbations.[3] The FEV_1/FVC ratio is used to identify a patient's lung pattern as either normal or abnormal, and if abnormal, can be further defined as an obstructive or restrictive defect:

- **Airflow obstruction** is characterized by a reduction in both FEV_1 and FEV_1/FVC relative to reference values.[3]
- **Airflow restriction** is characterized by a proportionately reduced FVC with a normal or increased FEV_1/FVC ratio, relative to reference values which can be present in obesity.[3]



Accurate measurement of respiratory function is necessary to assess and manage asthma.

Both FEV_1, in its ability to predict future risk for exacerbations, and FEV_1/FVC ratio, in its ability to identify abnormal lung patterns, have distinct but complementary values that aid in the diagnosis of asthma. Most adults and many children older than 5 years can perform spirometry, but many younger children should also be evaluated.[27] Because spirometry is based on maximal forced exhalation, the accuracy of its results is dependent on the patient's understanding, cooperation, and best efforts.

The peak flow rate (PFR) measurement can provide the patient and the clinician with objective data upon which to base treatment decisions; however, peak flow meters are not a substitute for spirometry.[29] Spirometry is calibrated for reliability, and although the test is effort-dependent, the visualization of the waveforms allows the clinician to disregard results that are inaccurate due to submaximal effort. PFR has a wide, normal range, and readings are also effort-dependent, so submaximal efforts (commonly seen in pediatric patients) invalidate the result.

Peak flow meters can be either electronic or mechanical. Unlike traditional mechanical meters, which only measure peak flow, electronic meters also measure FEV_1, and are considered to be a more reliable indicator of an impending acute exacerbation of asthma. Electronic peak flow meters are more expensive, and some insurance companies do not reimburse for them. Mechanical peak flow meters are more practical and less costly for asthma monitoring at home, especially with patients who have poor symptom perception.

Although PFR usually correlates well with FEV_1, this correlation decreases in patients with asthma as airflow diminishes.[29] Peak expiratory flow rate (PEFR) monitoring demonstrating diurnal variability (defined as highest daily PEFR—lowest daily PEFR/highest daily PEFR) and findings can suggest asthma. A diagnosis of asthma is considered if PEFR varies by at least 20% for 3 days per week over several weeks, or if PEFR increases by at least 20% in response to asthma treatment. It is also useful as an alternative to spirometry in an acute setting and can be readily performed as an outpatient or in the home to monitor disease progress. However, PEFR does not always reflect the level of airway obstruction as accurately as the FEV_1 and FEV_1/FVC ratio.

Bronchial challenge tests may be done to help confirm the diagnosis of asthma if spirometry does not show reversibility and variability or when a definitive diagnosis is needed. Bronchial challenge tests are performed in a pulmonary function lab and are divided as direct and indirect methods. These direct and indirect challenges reflect the baseline-fixed (airway remodeling) and episodic variable (inflammation) components of airway hyperresponsiveness, respectively:[30]

- **Direct:** using agents that directly constrict airway smooth muscle (methacholine)
- **Indirect:** using methods or agents that activate mast cells to release mediators, such as histamine and leukotrienes, to constrict airway smooth muscle.

Provocative methacholine challenge testing had been considered the most sensitive test to confirm a diagnosis of asthma when clinical diagnosis is unclear (a positive result is defined as a decrease in FEV_1 by more than 20% at 8 mg/mL), however, more recent findings suggest that both a direct test and an indirect test may be required in some patients to confirm or exclude a diagnosis of asthma.[31,32] Bronchial challenge tests that act indirectly are considered more specific than methacholine for identifying inflammation consistent with asthma.[32] A nonpharmacologic bronchial challenge (for example, the hypertonic saline challenge test)

may be more tolerable for children, and parents may find a test that does not involve drug administration more acceptable.[33]

Researchers continue to look for additional objective measurements in assessing and treating asthma. Exhaled nitric oxide levels can be used to monitor a patient over time and in combination with sputum eosinophilia, has a high sensitivity and specificity; however, neither is a standard test in the United States. The greater the level of an asthma patient's measured exhaled nitric oxide, the greater the airway inflammation. The NAEPP guidelines recommend adjusting the dose of inhaled corticosteroids on the basis of symptoms, SABA use, and spirometry results.[3] Exhaled nitric oxide measurements are a noninvasive marker that may serve as an alternative for adjusting inhaled corticosteroids therapy. There are new portable units available to measure the level of exhaled nitric oxide making its use more accessible to clinicians. Initial research has been promising on the benefit of exhaled nitric oxide measurements in asthma treatment; however, more research is needed to better understand how to practically use it in the clinical setting.

Symptom score measurements can facilitate the assessment of asthma control for children 5 years and older by using one of the validated tests including the Asthma Control Test (ACT), Asthma Control Questionnaire (ACQ), or the Asthma Therapy Assessment Questionnaire (ATAQ).[34] The validated questionnaires, ACT, ACQ, or ATAQ, are accurate tools for assessing patient-reported outcomes.

The ACT, a self-report, five-item questionnaire asks patients about symptoms in the previous month, yielding subjective data that can be incorporated into patient-centered treatment. Each answer on the ACT corresponds to a numeric score that is then totaled:

- A score of 20 or more indicates well-controlled asthma
- A score of 16 through 19 indicates not well-controlled asthma
- A score of 15 or lower indicates poorly controlled asthma.

Based on the numerical score, recommendations can be made to titrate pharmacologic therapy up or down. Additionally, the ACT has been shown to be valid and responsive to changes in asthma control over time.[35]

Allergy skin testing is the "gold standard" to determine allergen sensitivities in patients; however, in vitro tests are alternatives for those in primary care. Multiple methods have been used to measure serum allergens or immunoglobulin E results. These range from RAST, which was essentially a qualitative test, to the method of enzyme/substrate (ImmunoCap, Immulite).[36] With minor exceptions, RAST is now obsolete; however, the term "RAST" became a colloquialism for all varieties of these tests.[36] However, the use of RAST as a generic descriptor of these tests is not recommended.

The in vitro test most commonly used is the ImmunoCap, although the results are not as accurate as skin testing. A referral to an allergist is warranted if ImmunoCap test results are inconclusive or do not align with the patient's symptomology.[36] The test results can prompt a patient education discussion on allergen avoidance and environmental control in a patient-centered treatment approach. Patient education regarding environmental controls and allergen avoidance measures has been documented to increase asthma control.[3]

Assessment

Differential diagnoses. An important part of a patient's assessment is to consider and rule out differential diagnoses (see *Differential diagnoses*). When a patient presents with wheezing, coughing, shortness of breath, or chest tightness inconsistent with asthma diagnosis, further evaluation is warranted. There are important differential diagnoses to consider when evaluating the patient with suspected asthma, especially in the very young or when high doses of inhaled corticosteroids are required.

Severity is defined as the intrinsic intensity of the disease process and is measured most easily and directly in a patient not receiving long-term control therapy.[3] The four severity levels are intermittent, mild persistent, moderate persistent, and severe persistent. Three age groups have been established by the NAEPP for such classification: 0 through 4 years, 5 through 11 years, and 12 years and older.[3] The NAEPP has defined two categories when establishing the severity level of a patient: impairment and risk.[3] Impairment can be thought of as how the patient's asthma symptoms are presently perceived. Risk is an estimate of the likelihood that either an asthma exacerbations or loss of pulmonary function will progress over time. Both need to be considered and factored into the patient's treatment plan.

- To assess a patient's asthma severity, there are several impairment components used within all age groups:

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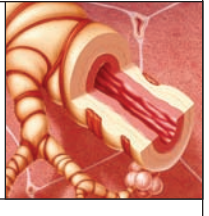

symptoms, nighttime awakenings, SABA use, and interference with normal activity. Additionally, the 5 through 11 years and 12 years and older categories include lung function.

- The only component evaluated within the severity risk domain is the number of exacerbations requiring an oral systemic corticosteroid. An exacerbation of asthma is defined as an episode of progressive worsening in symptoms and a reduction in lung function that interferes with the patient's ability to perform usual activities unless quick-relief therapy, such as an SABA and additional corticosteroid treatment, is used.[3]

A patient's level of disease severity is based on the most severe impairment or risk category identified during assessment. Together, impairment and risk, and their inherent components, are used to establish disease severity and determine which therapy to initiate. Assessment of impairment can be elicited from a careful medical history, questionnaires, and lung function measurement. Assessment of risk can be determined from a patient's medical history but is best-assessed using spirometry. The NAEPP recommends lung function measured by spirometry at least every 1 to 2 years, and more frequently for suboptimally controlled asthma.[3] Although spirometry was once reserved for the specialist's office, it is quickly becoming a necessary component of asthma care in the primary care setting.

Differential diagnoses

Infants and children	
Upper airway diseases	• Allergic rhinitis and sinusitis
Obstructions involving large airways	• Foreign body in trachea or bronchus • Vocal cord dysfunction • Vascular rings or laryngeal webs • Laryngotracheomalacia, tracheal stenosis, or bronchostenosis • Enlarged lymph nodes or tumor
Obstructions involving small airways	• Viral bronchiolitis or obliterative bronchiolitis • Cystic fibrosis • Bronchopulmonary dysplasia • Heart disease
Other causes	• Recurrent cough not due to asthma • Aspiration from swallowing mechanism dysfunction or gastroesophageal reflux

Adults

- Chronic obstructive pulmonary disease (chronic bronchitis or emphysema)
- Heart failure
- Pulmonary embolism
- Mechanical obstruction of the airways (benign and malignant tumors)
- Pulmonary infiltration with eosinophilia
- Cough secondary to drugs (for example ACE inhibitors)
- Vocal cord dysfunction

Source: National Heart, Lung, and Blood Institute, National Asthma Education and Prevention Program. Expert panel report 3: Guidelines for the Diagnosis and Management of Asthma. 2007. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf.

Plan

After determining disease severity, the NAEPP guidelines provide six clear steps for initiating therapy to assist—not replace—the clinical decision making required to meet individual patient needs. The stepwise approach includes three age categories: 0 through 4 years, 5 through 11 years, and 12 years and older (see *Stepwise treatment approach*).[3] All medication recommendations reflect the latest evidence on safety and efficacy.

The first step in assessing a patient's asthma is to classify the patient's asthma severity and initiate appropriate pharmacotherapy. Inhaled corticosteroids are considered the preferred long-term control therapy for all ages; the combination of LABA and inhaled corticosteroids is presented as an equally preferred option with increasing the dose of inhaled corticosteroids in patients 5 years or older. Omalizumab (Xolair) is considered in youth 12 years and older or adults who have allergies and require severe asthma care (referral to an allergist is warranted as this drug carries a risk of anaphylaxis).[3]

This stepwise treatment approach necessitates the reevaluation of treatment within 2 to 6 weeks of diagnosis with therapy adjustment as needed. The increasing use of SABA or use more than or equal to 2 days a week for symptom relief, not as prevention of exercise-induced bronchospasm, generally indicates inadequate control and the need to step up and intensify treatment.[3]

If a clear benefit in a patient's therapy is not observed within 4 to 6 weeks, the NAEPP recommends adjusting therapy or considering an alternative diagnosis. It is essential to verify correct device technique, confirm treatment adherence, optimize environmental control, and rule out comorbid conditions before assuming that the prescribed

therapy is ineffective. The NAEPP recommends stepping down therapy if the asthma is well controlled for at least 3 months.[3]

Long-term management. After establishing disease severity and initiating therapy, follow-up with the patient will focus on long-term disease management and achievement/maintenance of asthma control. The NAEPP uses the domains of impairment and risk to assess asthma control. The components of the impairment and risk control domains differ from those of the severity domains, and level of control is defined in one of three categories: well controlled, not well controlled, or very poorly controlled:

- The components of the control impairment domain in all age groups that define the patient's level of disease control are symptoms, nighttime awakenings, interference with normal activity, and SABA use for symptom control. Additionally, FEV_1 is included in the ages 5 through 11 and age 12 and older categories, and a validated questionnaire in the older than 12 years category.
- The components of the control risk domain in all age groups are exacerbations requiring oral systemic corticosteroids and treatment-related adverse effects.[3]

If the patient's asthma is well controlled, the NAEPP recommends maintenance of current therapy, to follow-up at 1 to 6 months to maintain such control, and to consider stepping down therapy (in stepwise approach) if the patient is well controlled for at least 3 months. If the patient's asthma is not well controlled, recommendations are to move up one step in all age groups (and maybe more in the older age groups), and reevaluate in 2 to 6 weeks. If the patient's asthma is very poorly controlled, the NAEPP recommends the consideration of short course of oral systemic corticosteroids, move up one to two steps, and reevaluate in 2 weeks.[3]

When to refer

According to the NAEPP, specific recommendations for referring a patient with asthma to see an allergist/asthma specialist for consultation or comanagement include the following:

- A single life-threatening asthma exacerbation.
- Treatment goals not being met after 3 to 6 months of treatment.
- Patient history of the following triggers: occupational, environmental inhalant, or an ingested substance.
- Atypical or complicated presentation of symptoms.
- Initial diagnosis of severe, persistent asthma.
- Need for additional diagnostic testing.
- Need for additional asthma self-management education.
- Treatment plans include continuous oral steroids.

Stepwise treatment approach

Children ages 0 through 4
Step 1: Preferred: SABA p.r.n.
Step 2: Preferred: Low-dose inhaled corticosteroid (ICS) Alternative: Cromolyn *or* montelukast
Step 3: Preferred: Medium-dose ICS
Step 4: Preferred: Medium-dose ICS + either LABA *or* montelukast
Step 5: Preferred: High-dose ICS + either LABA *or* montelukast
Step 6: Preferred: High-dose ICS + either LABA *or* montelukast Oral systemic corticosteroids
Ages 5 through 11
Step 1: Preferred: SABA p.r.n.
Step 2: Preferred: Low-dose ICS Alternative: cromolyn, leukotriene receptor antagonist (LTRA), nedocromil, *or* theophylline
Step 3: Preferred: Either low-dose ICS + either LABA, LTRA, or theophylline or medium-dose ICS
Step 4: Preferred: Medium-dose ICS + LABA Alternative: Medium-dose ICS + either LTRA *or* theophylline
Step 5: Preferred: High-dose ICS + LABA Alternative: High-dose inhaled corticosteroid + either LTRA *or* theophylline
Step 6: Preferred: High-dose ICS + LABA + oral systemic corticosteroid Alternative: High-dose ICS + either LTRA *or* theophylline + oral systemic corticosteroids
Age 12 and older
Step 1: Preferred: SABA p.r.n.
Step 2: Preferred: Low-dose ICS Alternative: Cromolyn, LTRA, nedocromil or theophylline
Step 3: Preferred: Low-dose ICS + LABA or medium-dose ICS Alternative: Low-dose ICS + either LTRA, theophylline, *or* zileuton
Step 4: Preferred: Medium-dose ICS + LABA Alternative: medium-dose ICS + either LTRA, theophylline, *or* zileuton
Step 5: Preferred: High-dose ICS + LABA *and* consider omalizumab for patients who have allergies
Step 6: Preferred: high-dose ICS + LABA + oral corticosteroid *and* consider omalizumab for patients who have allergies

Source: National Heart, Lung, and Blood Institute, National Asthma Education and Prevention Program. Expert panel report 3: Guidelines for the Diagnosis and Management of Asthma. 2007. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf.

- Patients with more than two courses of oral steroids in 12 months.[3]

Follow-up

The NAEPP recognizes that many patients with asthma do not perceive their asthma symptoms accurately, and recommends patient education to address this need.[3] Although it is not possible to cover every counseling topic in one visit given the time constraints placed on PCPs, a good resource to provide educational guidelines and the topic of coding for education in the primary setting has been provided by Cabana et al., 2005.[37]

Because asthma is highly variable over time, periodic monitoring in the clinic and daily monitoring at home, school, and work is essential. For patients to monitor their asthma successfully, they must first be taught self-monitoring technique and signs of worsening asthma. All patients should have written action plans that have been created in partnership with their NP. All forms of patient education must be tailored to the patient's literacy level and should occur at all points of care. NP

REFERENCES

1. American Lung Association. Trends in asthma morbidity and mortality. http://www.lungusa.org/finding-cures/our-research/trend-reports/asthma-trend-report.pdf.
2. Centers for Disease Control and Prevention. Asthma. http://www.cdc.gov/nchs/fastats/asthma.htm.
3. National Heart, Lung, and Blood Institute, National Asthma Education and Prevention Program. Expert panel report 3: Guidelines for the Diagnosis and Management of Asthma. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf
4. Borgmeyer A, Gyr PM, Jamerson PA, Henry LD. Evaluation of the role of pediatric nurse practitioner in an inpatient asthma program. *J Pediatr Health Care*. 2008;22(5):273-281.
5. Lötvall J, Akdis CA, Bacharier LB, et al. A new approach to classification of disease entities within the asthma syndrome. *J Allergy Clin Immunol*. 2011;127(2):355-360.
6. Wenzel SE. Asthma: defining of the persistent adult phenotypes. *Lancet*. 2006;368(9537):804-813.
7. Borish L, Culp JA. Asthma: a syndrome composed of heterogeneous diseases. *Ann Allergy Asthma Immunol*. 2008;101(1):1-8; quiz 8-11, 50.
8. World Health Organization. Asthma facts sheet. http://www.who.int/mediacentre/factsheets/fs307/en/index.html.
9. Akinbami L, Centers for Disease Control and Prevention National Center for Health Statistics. The state of childhood asthma, United States, 1980-2005. *Adv Data*. 2006;12(381):1-24.
10. Bacharier LB, Boner A, Carlsen KH, et al. Diagnosis and treatment of asthma in childhood: a PRACTALL consensus report. *Allergy*. 2008;63(1):5-34.
11. British Thoracic Society, Scottish Intercollegiate Guidelines Network. British guideline on the management of asthma. http://www.brit-thoracic.org.uk/Portals/0/Guidelines/AsthmaGuidelines/qrg101%202011.pdf.
12. BMJ Evidence Centre. Asthma in children. http://bestpractice.bmj.com/best-practice/monograph/782/diagnosis/step-by-step.html.
13. Rapp K, Rodgers L, Leon K, Roberts A. Optimizing patient care in asthma during pregnancy. *US Pharmacist*. 2011;36(7):30-34.
14. Weinberger SE, Schatz M. Physiology and the clinical course of asthma in pregnancy. http://www.uptodate.com/contents/physiology-and-clinical-course-of-asthma-in-pregnancy.
15. U.S. Census Bureau. Percent distribution of the projected population by selected age groups and sex for the United States: 2010 to 2050. 2008. http://www.census.gov/population/www/projections/summarytables.html.
16. American Allergy, Asthma and Immunology. Asthma in the elderly. 2009. http://education.aaaai.org/moodle/file.php/428/Asthma_Elderly_Part_I_-_Epidemiology_Pathophysiology_Natural_History_FINAL_.ppt20.
17. National Asthma Council Australia. Asthma management handbook. 2006. http://www.nationalasthma.org.au/uploads/handbook/370-amh2006_web_5.pdf.
18. Visser LE, Stricker BH, van der Velden J, Paes AH, Bakker A. Angiotensin converting enzyme inhibitor associated cough: a population-based case-control study. *J Clin Epidemiol*. 1995;48(6):851-857.
19. Bailey W. Trigger avoidance in asthma. 2011. http://www.uptodate.com/contents/trigger-avoidance-in-asthma-beyond-the-basics.
20. Salpeter SR, Ormiston TM, Salpeter EE. Cardioselective beta-blockers in patients with reactive airway disease: a meta-analysis. *Ann Intern Med*. 2002;137(9):715-725.
21. Tashkin DP. Airway effects of marijuana, cocaine, and other inhaled illicit agents. *Curr Opin Pulm Med*. 2001;7(2):43-61.
22. Han B, Gfroerer JC, Colliver JD. Associations between duration of illicit drug use and health conditions: results from the 2005-2007 national surveys on drug use and health. *Ann Epidemiol*. 2010;20(4):289-297.
23. Moore BA, Augustson EM, Moser RP, Budney AJ. Respiratory effects of marijuana and tobacco use in a U.S. sample. *J Gen Intern Med*. 2005;20(1):33-37.
24. Restrepo CS, Carrillo JA, Martinez S, Ojeda P, Rivera AL, Hatta A. Pulmonary complications from cocaine and cocaine-based substances: imaging manifestations. *Radiographics*. 2007;27(4):941-956.
25. Rance K, O'Laughlen M. Obesity and asthma: a dangerous link in children. *J Nurse Pract*. 2011;7(4):287-292.
26. National Asthma Council. Spirometry: the measurement and interpretation of ventilatory function in clinical practice. 2008. http://www.nationalasthma.org.au/uploads/content/211-spirometer_handbook_naca.pdf.
27. Miller MR, Hankinson J, Brusasco V, et al. Standardisation of spirometry. *Eur Respir J*. 2005;26(2):319-338.
28. Bussamra MH, Cukier A, Stelmach R, Rodrigues JC. Evaluation of the magnitude of the bronchodilator response in children and adolescents with asthma. *Chest*. 2005;127(2):530-535.
29. Neuspiel DR. Peak flow rate measurement. http://emedicine.medscape.com/article/1413347-overview#showall.
30. Cockcroft D, Davis B. Direct and indirect challenges in the clinical assessment of asthma. *Ann Allergy Asthma Immunol*. 2009;103(5):363-369.
31. Kraft W, DeSimone D. Asthma. 2011. https://www.essentialevidenceplus.com/content/eee/663?section=4.
32. Anderson SD, Brannan JD. Bronchial provocation testing: the future. *Curr Opin Allergy Clin Immunol*. 2011;11(1):46-52.
33. Law KW, Ng KK, Yuen KN, Ho CS. Asthma, bronchial hyper-responsiveness and non-pharmacological bronchial challenge tests in children. *Hong Kong Med. J*. 2000;6(1):99-104.
34. Fanta C, Carter E, Steib E, Haver K. *The Asthma Educator's Handbook*. New York: McGraw Hill Medical; 2007.
35. Nathan RA, Sorkness CA, Kosinski M, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol*. 2004;113(1):59-65.
36. Cox L, Williams B, Sicherer S, et al. Pearls and pitfalls of allergy diagnostic testing: report from the American College of Allergy, Asthma and Immunology/American Academy of Allergy, Asthma and Immunology Specific IgE Test Task Force. *Ann Allergy Asthma Immunol*. 2008;101(6):580-592.
37. Cabana MD, Bradley J, Meurer JR, Holle D, Santiago C, Clark NM. Coding for asthma patient education in the primary care setting. *J Med Pract Manage*. 2005;21(2):115-119.

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