Asthma: Calming the Airways

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Contact hours: 4.5

Course price: $39

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Course Summary

Clinical characteristics of asthma and related airway inflammation, plus the host and environmental factors that contribute to asthma, as well as medication management and the client education essential to optimal results.

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Criteria for Successful Completions

80% or higher on the post test, a completed evaluation form, and payment where required. No partial credit will be awarded.

Course Objectives

When you finish this course you will be able to:

1. Discuss the incidence and prevalence of asthma in the United State.
2. Explain the classifying and assessing of asthma.
3. Defend the importance of rigorous client education about asthma.
4. Summarize the differential diagnosis and comorbidities of asthma.
5. List the environmental factors that contribute to asthma.
6. Explain medication management of asthma.
7. Describe the way in which partnering with clients leads to optimal results.

Overview of Asthma

Advances in science have led to an increased understanding of asthma and have improved approaches to treatments that can achieve good control over symptoms. Yet, in spite of these advances, the rate of asthma is up to 15% of the population in westernized countries and even higher in less-developed countries, making this disease a worldwide concern.

In the face of these difficulties, the challenge is to help all asthma sufferers, particularly those at high risk, to receive quality asthma care. This goal can best be met through identification of new asthma incidents using the most current knowledge, along with correct assessment of triggers and severity of symptoms, which is essential to improving outcomes for clients as well as decreasing morbidity and mortality.

Incidence and Prevalence

Both the incidence and prevalence of asthma have grown considerably over the past two decades, increasing the cost of care in offices and emergency departments as well as increasing rates of inpatient hospitalizations. In 2009 asthma prevalence was 8.2% of the U.S. population (24.6 million people). It was higher within certain population subgroups including females, children, African Americans, those of Puerto Rican decent, persons with family income below the poverty level, and those residing in the Northeast and Midwest regions of the United States (Akinbami, 2011).

In 2007 there were 1.75 million asthma-related emergency department visits and nearly half a million asthma hospitalizations. Asthma emergency visit and hospitalization rates were higher among females than males, among children than adults, and among black than white people. Despite the high burden from adverse impacts, use of some asthma management strategies based on clinical guidelines for the treatment of asthma remained below the targets set by the Healthy People 2010 initiative (Akinbami, 2011).

Aside from quality-of-life issues experienced by all asthma sufferers, the prevalence of the disease and the number of individuals requiring intensive care is creating a burden on the healthcare system, which is left with the task of planning care that addresses correct use of medication while factoring in home, school, and workplace triggers over which there is little control.

Genetics

It is well recognized that asthma has an inheritable component despite that fact that the genetics involved in the development of asthma are only partly known (Holgate, 2004; Ober & Thompson, 2005). To date, many genes have been found that either are involved in, or linked to, the presence of asthma. The role of genetics in immunoglobulin E (IgE) production, airway hyper-responsiveness, and dysfunctional regulation of inflammatory mediators (eg, cytokines, chemokines, growth factors) has appropriately captured attention. In addition, studies are investigating genetic variations that may determine a person’s response to therapy.

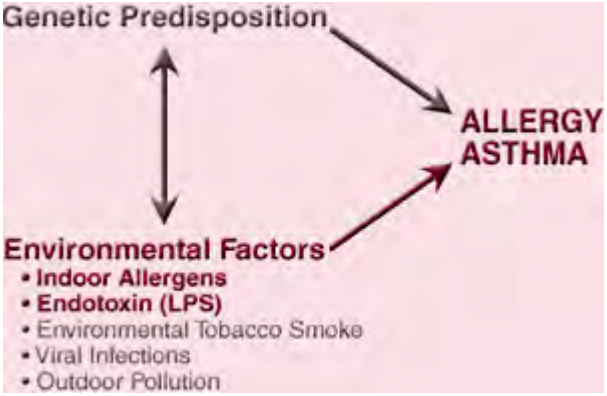
How sex hormones or related hormone production are linked to asthma has not been established but hormones may contribute to the onset and persistence of the disease. In early life the prevalence of asthma is higher in boys. At puberty, however, the sex ratio shifts, and asthma appears predominantly in women (Horwood et al., 1985).

Atopy, the genetic predisposition for the development of an IgE-mediated response to common airborne allergens, is the strongest identifiable factor for developing asthma. A history of atopy is often found in clients and their families and is commonly manifested by conditions such as:

- Allergen exposure–induced wheeze
- Allergic rhinitis, conjunctivitis
- Cutaneous manifestations including eczema or dermatographism (a form of chronic urticaria)

Individuals with these findings plus chronic cough should be considered potential candidates for asthma when accompanied by characteristic respiratory symptoms. As seen in the illustration below, a genetic predisposition when combined with environmental factors can precipitate asthma in certain individuals.

Relationship Between Genetics, Environmental Factors, and Asthma



Source: NIH, n.d.

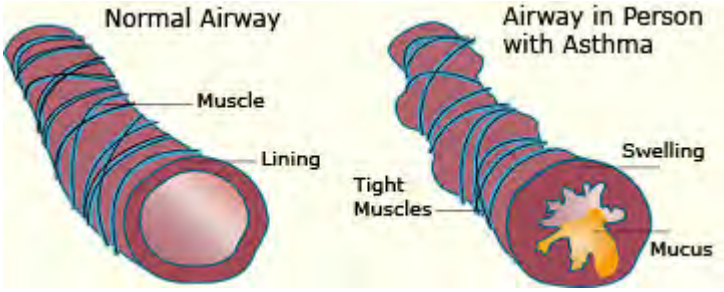
Definition of Asthma

Asthma is a chronic respiratory disease characterized by inflammation and narrowing of small airways. As a guide to describing asthma and identifying treatment directions, the working definition of asthma and the guidelines put forth in the 1997 Expert Panel Report 2 (EPR 2) remain valid:

> **Asthma** is a chronic inflammatory disorder of the airways in which many cells and cellular elements play a role: in particular, mast cells, eosinophils, T lymphocytes, macrophages, neutrophils, and epithelial cells. In susceptible individuals, this inflammation causes recurrent episodes of wheezing, breathlessness, chest tightness, and 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 hyper-responsiveness to a variety of stimuli. Reversibility of airflow limitation may be incomplete in some clients with asthma. (NIH, NHLBI, 1997)

Asthma severity can range from mild with occasional symptoms to severe with persistent symptoms that impact quality of life. However, even people with mild disease can suffer severe attacks. Common attack triggers include airway irritants, allergens, respiratory infections, stress, and exercise. Morbidity, direct healthcare costs, indirect costs such as lost productivity, and mortality due to asthma continue to pose a high burden in the United States (Akinbami, 2011).

Comparison of Normal and Asthmatic Airways



Source: NIH, n.d.

Classifying and Assessing Asthma

The 2007 Expert Panel Report 3 (EPR 3), published by the National Heart, Lung, and Blood Institute, updated the 1997 guidelines to help practitioners in diagnosing and managing asthma. The working definition of asthma, identified in 1997 and quoted above, remains unchanged, with its emphasis on classifying asthma in terms of the severity of symptoms and control measures. In EPR 3, control and severity are now broken out into two different sections that address:

- Degree of impairment as well as risk
- Impairment reflecting the actual symptoms experienced, including nighttime cough
- Change in activities of daily living (ADLs)
- Use of short-acting inhaled bronchodilators
- Spirometry for children over the age of five with risk assumed by the need for oral corticosteroids such as prednisone to manage exacerbation of symptoms. (NIH, NHLBI, 2007)

Whether a healthcare practitioner is assessing a client presenting in the early or initial stages of asthma, during a routine followup to evaluate status, or during an exacerbation of symptoms, the diagnostic strategies and management of asthma are organized around four governing principles:

- **Objective tests**: Tests such as pulmonary function and spirometry along with the physical examination, client history, and client report of symptoms allow a practitioner to diagnose and assess the characteristics and severity of asthma and to monitor whether asthma control is achieved and maintained.
- **Education**: One of the most critical components of assessment and management of asthma. It creates an effective partnership and promotes self-identification and reporting of symptoms.

- **Control**: The means for controlling and preventing asthma symptoms are well established. Control of asthma symptoms includes the identification and management of environmental factors and co-morbid conditions that affect asthma.
- **Pharmacologic therapy**: Based on symptoms, which may be stepped up or down according to changes in the status of the disease (NIH, NHLBI, 2007). Treatment includes use of medication for short-term relief, daily medication to avert attacks, monitoring of early symptoms, and avoiding factors that trigger attacks (Akinbami, 2011).

Classification Guidelines

The 2007 EPR 3 guidelines established definitions to assist in determining the classification of asthma during the initial assessment and as part of ongoing treatment:

- **Severity**: the intrinsic intensity of symptoms. This is best established if the client is not already receiving long-term control therapy such as inhaled corticosteroids.
- **Control**: the degree to which symptoms, functional impairment, and risks are minimized and the goals of therapy are met.
- **Responsiveness**: the ease with which recommended therapy controls symptoms.
- **Impairment**: any functional limitations the client is experiencing or has recently experienced that reflect frequency and intensity of symptoms.
- **Risk**: the likelihood of asthma exacerbations, progressive decline in lung function (or, for children, reduced lung growth), or adverse effects from medication. (NIH, NHLBI, 2007)

Classification Tables

To further aid in the classification of asthma, the National Asthma Education and Prevention Program (NAEPP) established classification tables—organized by age groups—as part of their guidelines for treatment. Symptoms can be categorized during initial evaluation using these tables. Note that the components of severity and impairment are identified and further classified as intermittent, mild persistent, moderate persistent, and severe persistent according to frequency.

Classifying Asthma Severity for Children 0 to 4 Years of Age				
	Intermittent	Mild, persistent	Moderate, persistent	Severe, persistent
Symptom onset	≤2 days per week	>2 days per week but not daily	Daily	Throughout the day
Nighttime awakening	0	1–2x per mo	3–4x per mo	>1x per wk
Short-acting beta2-agonist use for symptom control (not prevention of EIB)	≤2 days per week	>2 days per wk but not daily	Daily	Several times per day
Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited

Source: NHLBI, NIH, 2011. Modified from EPR 3: Classifying Asthma Severity and Initiating Treatment in Children 0–4 Years of Age.

In children ages 0 to 4 years, persistent asthma symptoms include such findings as cough, wheeze, chest tightness, shortness of breath that occurs more than 2 days a week, nighttime cough ≥1–2 times per month, use of bronchodilator more than 2 days per week but not daily, and interference with activity—which in this age group may include feeding along with routine movement. These factors comprise the impairment criteria new to the EPR 3 (NIH, NHLBI, 2007).

Classifying Asthma Severity for Children 5 to 11 Years Old				
	Intermittent	Mild, persistent	Moderate, persistent	Severe, persistent
Symptom onset	≤2 days per wk	>2 days per wk but not daily	Daily	Throughout the day
Nighttime awakening	≤2x per mo	3–4x per mo	>1x/wk but not nightly	Often 7x per wk
Short-acting beta2-agonist use for symptom control (not prevention of EIB)	≤2x days per wk	>2 days per wk but not daily	Daily	Several times per day
Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
Lung function	Normal FEV1 between exacerbations FEV1 >80% predicted FEV1/FVC >85%	FEV1 = >80% predicted FEV1/FVC >80%	FEV1 = 60–80% predicted FEV1/FVC = 75–80%	FEV1 <60% predicted FEV1/FVC <75%

Source: NHLBI, NIH, 2007. Modified from EPR 3: Classifying Asthma Severity and Initiating Treatment in Children 5–11 Years of Age.

Note: In this age group, pulmonary function test factors are included (FEV1, FEV/FVC ratio). This meets the objective testing criteria and will be discussed more fully following the tables.

Classifying Asthma Severity in Youths ≥12 Years of Age and Adults				
	Intermittent	Mild, persistent	Moderate, persistent	Severe, persistent
Symptom onset	≤2 days per wk	>2 days per wk but not daily	Daily	Throughout the day
Nighttime awakening	≤2x per mo	3–4x per mo	>1x/wk but not nightly	Often 7x per wk
Short-acting beta2-agonist use for symptom control (not prevention of EIB)	≤2 days per wk	>2 days per wk but not daily and not more than 1x on any day	Daily	Several times per day
Interference with normal activity	None	Minor limitation	Some limitation	Extremely limited
Lung function	Normal FEV1 between exacerbations FEV1 >80% predicted FEV1/FVC normal	FEV1 = >80% predicted FEV1/FVC normal	FEV1 >60% but <80% predicted FEV1/FVC reduced 5%	FEV1 <60% predicted FEV1/FVC reduced >5%
Normal FEV1/FVC: 8−19 yr = 85% 20−39 yr = 80% 40−59 yr = 75% 60−80 yr = 70%				

Note: Under impairment criteria, normal FEV1/FVC percentages change. These changes allow for normal physiologic processes associated with aging.
Source: NHLBI, NIH, 2011. Modified from EPR 3: Classifying Asthma Severity and Initiating Treatment in Youths ≥12 Years of Age and Adults.

Using the preceding three tables to classify severity, pulmonary function (FEV1, FEV1/FVC) measures range from none in the 0 to 4 age group to specific percentages for ages 5 and up. Children under the age of 5 are presumed unable to comply with instructions sufficiently to achieve reliable results. Because this data is critical to establishing classification, it is useful to review definitions and the process for calculating percentages.

Assessment

The initial assessment of asthma severity is made immediately after diagnosis or when the client is first encountered, ideally before the client requires some form of long-term control medication. Assessment is made on the basis of current spirometry, history, and the client's recall of symptoms over the previous 2 to 4 weeks (detailed recall of symptoms decreases over time). If the assessment is made during a visit in which the client is treated for an acute exacerbation, then asking the client to recall symptoms in the period before the onset of the current episode helps to determine the appropriate interval for followup visits.

Spirometry (Pulmonary Function Testing)

Pulmonary function testing (PFT) uses spirometry to measure flow/volume loops to assess response to **short-acting beta agonists (SABA)** such as albuterol. Measures are made before and after use of the SABA and compared against predicted normal values for age, height, and gender. The three primary measures that pertain to asthma are:

1. FEV1 (amount that can be forcefully exhaled in 1 second)
2. FVC (total amount of air exhaled starting from a full inhalation to the end of a full, forced exhalation)
3. FEV1/FVC (ratio of the two values expressed as a %)

The following frequencies for spirometry testing are recommended by EPR 3 (NIH, NHLBI, 2007) during initial and ongoing management of asthma:

- At the time of initial assessment (children 5 and above)
- After treatment was initiated and symptoms stabilized
- During periods of progressive or prolonged loss of asthma control
- At least every 1 to 2 years if symptoms are stable

In a symptomatic person, the FEV1 and FVC are measured and compared to the reference values. Values above 80% of reference are generally considered normal but this varies somewhat depending on age.

In a typical asthma case, initial evaluation shows a decrease in FEV—often below the 80% reference range—and reduced FEV1/FVC indicating airflow obstruction. A pre-and-post bronchodilator test should be performed using a SABA to see whether airflow obstruction is reversible. Reversibility is determined when there is at least a 12% change and ≥200mL increase in capacity.

This testing is simple to perform and is often done during an outpatient office visit—assuming the equipment is present and staff are appropriately trained. Reference ranges are readily available through the Centers for Disease Control (CDC) website. Worksheets to calculate values can be viewed there. To illustrate how simple this is to calculate, look at the upcoming theoretical case.

Physical Examination

The upper respiratory tract, chest, and skin are the focus of the physical examination for asthma. Physical findings that increase the probability of asthma include:

- Hyperexpansion of the thorax—especially in children, use of accessory muscles, appearance of hunched shoulders, chest deformity.
- Sounds of wheezing during normal breathing, or a prolonged phase of forced exhalation. Wheezing may only be heard during forced exhalation but it is not a reliable indicator of airflow limitation.
- Increased nasal secretion, mucosal swelling, and/or nasal polyps.
- Atopic dermatitis/eczema or any other manifestation of an allergic skin condition.

The absence of these findings does not rule out asthma, because the disease is by definition variable, and signs of airflow obstruction are often absent between attacks.

If cough is the primary symptom being addressed and the client or caretaker is unable to supply an adequate history, a useful strategy is to evaluate **above** (cough related to rhinitis or other allergic symptoms of the upper airway) and **below** (cough coming from GERD, or reflux). These two conditions should always be considered when evaluating a persistent cough because they are common and can exacerbate or mimic many of the respiratory symptoms associated with asthma.

Patients with **atopy**—the genetic tendency to develop allergic responses—are currently thought to be disposed to overproduce immunoglobulin E (IgE) and often have an asthma variant that is severe and persistent. The common triad of symptoms in clients presenting with atopy are:

- Asthma
- Perennial allergies and hay fever
- Skin rash or eczema

The last two conditions can cause varying degrees of itching at the affected sites. These clients require comprehensive history and assessment because their symptoms are often difficult to control and they require multi-system management to achieve good control of their asthma.

Flares in one arm of the triad may precede asthma or predict that asthma symptoms—potentially life-threatening—are worsening. Although asthma is typically associated with an obstructive impairment that is reversible, neither this finding nor any other single test or measure is adequate for diagnosis.

Other diseases are also associated with this pattern of abnormality. This is why it is vital to include a thorough history for both the client and immediate family members, and to assess for the presence of environmental triggers when considering which type of therapy is needed.

Tom, a 20-year-old Caucasian college student, was diagnosed with asthma as a child but has had no episodes of wheezing or coughing in more than 8 years. He is 71 inches tall. He does not smoke, is on no medication, and started experiencing symptoms after moving in with a roommate who has a cat. Because his history is positive for asthma—his symptoms are present during the day (causing him to miss classes), and he has been awakened by cough an average of 3 nights a week—a decision is made to go ahead with the pulmonary function test to see whether he meets the criteria for asthma.

Here are the results of his pre-bronchodilator test, which compares the measured and reference ranges and expresses the findings as a % of reference. Recall that 80% of reference is generally considered normal in this age group.

- *FEV1 (measured): 3.61 (reference = 4.81, % reference = 75%)*
- *FVC (measured): 5.21 (reference = 5.77, % reference = 90%)*
- *FEV, % (measured): 69*

These numbers are obtained by dividing the part (measured) by the whole (reference) in the case of FEV1 and FVC; the FEV% is calculated by dividing the measured FEV1 by the FVC.

Tom is given a nebulizer treatment with a SABA (albuterol), and then allowed to wait 15 to 20 minutes for the medication to become effective. Here are the results of the post-bronchodilator spirometry:

- *FEV1 (measured): 4.35 (% reference = 90, % change = 20)*
- *FVC (measured): 5.39 (% reference = 93, % change = 3)*

- *FEV, % (measured): 81*

Tom meets the criteria for significant change because he shows improvement in his FEV1 (at least 12%) and his symptoms are reversible after treatment with a SABA. In fact, his change of 20% shows robust response to treatment.

We can now assess Tom's status by comparing his level of symptoms against criteria on the age-appropriate asthma severity chart and begin to plan for his treatment needs. To do this we refer to the four components of care outlined earlier: (1) objective testing, (2) education, (3) control of environmental factors, and (4) pharmacologic therapy.

Client Education About Asthma

The client must be thoroughly educated regarding the variability of the disease and changes necessary to achieve the best control possible. Asthma control requires some significant life changes that may or may not be acceptable—or even possible—for a given client. This is illustrated in the case of Tom, who is probably experiencing a reactivation of his disease from exposure to cat dander, which is a common trigger.

Effective management includes a partnership approach between the client and the healthcare team, with emphasis on the need for adequate control of symptoms using appropriate medications and elimination, or at least mitigation, of environmental factors known to cause exacerbations.

Client education at this time must also reinforce the concept that the potential exists at any level of severity—including intermittent—for a severe exacerbation that can result in serious illness, hospitalization, or even death.

The Rules of Two (below) is a simple and useful tool to support the client in increasing awareness of symptoms. If any of the criteria are met, the client can schedule an office visit to review factors that may be exacerbating the asthma and have adjustments made to the medication routine if needed.

Test Your Knowledge

The Rules of Two is:

A. A simple and useful tool to support the client in increasing awareness of symptoms.

B. Genetically, if one person in the family has asthma, another is likely to have it too.

C. Clients who have asthma should see their physician at least twice a year.

D. Those who have asthma should see their physician at least twice a month..

Answer: A

Rules of Two

- Need for SABA (rescue inhaler) such as albuterol more than 2 times a week (exclude use for intermittent asthma when used as premedication for exercise)
- Awaken at night with asthma symptoms more than 2 times a month (This includes cough, wheeze, chest tightness, or shortness of breath.)
- Refill your SABA (rescue inhaler) more than 2 times a year (Consider that children may need multiple inhalers for school or daycare, in the case of parents living apart, and so on.)

Source: Baylor Health Care System, 2001.

When any of these conditions are met, clients are assumed to have decreasing levels of control and they require evaluation, which can help determine if they are using their medications correctly, if their medications need to be changed, or if there are triggering events that can be modified, avoided, or eliminated. Members of the healthcare team can also use these questions during scheduled followup visits to determine the need for focused teaching or a change in treatment.

Clients exhibiting severe symptoms must be treated immediately to prevent respiratory arrest. Signs and symptoms are grouped according to their severity criteria, ranging from mild to imminent arrest. Some objective measures that are seen in adults are shown on the following table. Symptoms differ for children according to their age.

Some Objective Measures Seen in Adults with Asthma				
	Mild	Moderate	Severe	Arrest imminent
Symptoms				
Air hunger	While walking; can recline	At rest; prefers sitting	At rest; sits upright	Extreme
Talks in…	Sentences	Phrases	Words	May exhibit gasping
Alertness	May be agitated	Usually agitated	Usually agitated	Drowsy, confused
Signs				
Respiratory rate	Increased	Increased	Often >30/min	Erratic
Wheeze	Moderate; end expiratory	Loud; throughout exhalation	Loud; inspiratory and expiratory	Absent; silent lung; no air movement
Pulse	<100	100–120	>120	Bradycardia
Functionalcriteria				
PEF	≥70%	40%–69%	≤40%	<40% or unable to obtain PEF
O2 saturation on room air	>95%	90%–95%	<90%	ABG needed for accurate assessment

Source: NIH, NHLBI, 2011. Adapted from EPR 3.

In summary, clinical assessment and measures to correctly identify, classify, and treat asthma are available to guide the healthcare team and the client in improving overall outcomes and minimizing risk. A partnership approach reinforces a client's ability to be an active participant in care. Correctly implemented these measures promotes the goal of therapy, which is to achieve symptom control by reducing impairment and managing risks.

Differential Diagnosis and Comorbidities

Healthcare professionals working in the emergency department, on medical and surgical floors of the hospital, in clinics and private offices, and other locations where clients are seen, are aware of the axiom "All that wheezes is not asthma." When wheezing and other symptoms commonly associated with asthma do not respond to traditional therapies, the reason may be that the client has another disease that mimics asthma, or a comorbidity that is complicating it.

Differential Diagnosis

Differential diagnosis is the use of a systematic process of elimination, comparing and contrasting clinical findings to determine the cause of an illness. Use of a well-defined, systematic approach in assessing for asthma increases the likelihood that the disease will be correctly identified and classified according to established criteria.

The history and examination must be sufficiently comprehensive to include an investigation of potential comorbidities and precipitating factors, which can exert a strong influence on the course of the disease or cloud the diagnosis. When the diagnosis of asthma is not clear —as may be the case in intermittent disease (especially between exacerbations)—diseases with symptoms that mimic asthma must be considered and properly managed to improve overall quality of life.

Infants and Children

In children under age 5, the assurance with which one can determine the diagnosis of asthma is complicated by the fact that these young clients are typically not able to comply with the instructions necessary to perform spirometry. Coughing and wheezing can occur for a variety of reasons; however, recurrent episodes of cough and wheezing is most often due to asthma in both children and adults.

Under-diagnosis of asthma in children occurs frequently—particularly if the child is seen by a variety of providers in numerous sites—and the child may receive a diagnosis of bronchitis, bronchiolitis, or possibly pneumonia, even though the signs and symptoms are compatible with a diagnosis of asthma. However, when a child does not respond to treatment, and there is a reasonable certainty that treatments are being administered correctly, other causes of airway disease should be considered. A partial list is as follows.

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 (GERD)

Adults

Adults also sometimes have conditions that can be confused with asthma, and these should be evaluated using appropriate diagnostic testing to rule them in or out. A partial list of common conditions in adults includes:

- COPD (chronic bronchitis or emphysema)
- Congestive heart failure
- Pulmonary embolism
- Mechanical obstruction of the airways (benign and malignant tumors)
- Pulmonary infiltration with eosinophilia
- Cough secondary to drugs (eg, ACE inhibitors)
- Vocal cord dysfunction
- Gastroesophageal reflux disease (GERD)
- Allergic rhinitis, sinusitis

Comorbidities

Several comorbid chronic conditions have been demonstrated to impede asthma management. If these conditions are identified and treated properly, asthma control usually improves. Some of the more common comorbid conditions include gastroesophageal reflux disease (GERD), obesity, obstructive sleep apnea, rhinitis/sinusitis, and underlying mental health problems including stress and depression. Clients with severe forms of mental illness may experience complications due to an inability to follow instructions for medication use.

When considering comorbidities, they often act as a complicating factor, and exacerbate the underlying asthma symptoms until they are identified and managed. In this case, the overall picture of asthma may improve significantly. Any time clients display symptoms that suggest asthma, but their symptoms are not responding to treatment, they should be evaluated for other conditions known to affect breathing.

To clarify the role that a differential diagnosis or comorbidity may be playing relative to respiratory symptoms and asthma, the clinician must first assess whether the recommended treatment for asthma is being taken as ordered. The following questions may be helpful in determining whether asthma is being refractory to treatment of whether an alternate/additional diagnosis needs to be explored:

- Can you tell me which medications you use and when you use them?
- Who told you that you had asthma?
- Can you show or describe your technique for using medication?
- How many places do you go to receive healthcare? (Clients who receive advice from multiple locations or providers may become confused about which medication regimen to follow.)
- Do you use more than one pharmacy for your medications? (Verify dates of initial fill and refills.)

Adequate treatment of the comorbid condition may lead to an improvement in asthma symptoms, with corresponding improvement in the severity classification and medication routine. Asthma therapy may be stepped down if symptoms remain stable for several months.

If respiratory symptoms are successfully treated and if other symptoms abate, the client may not have asthma at all and the differential diagnosis should be reviewed.

Let’s return to our theoretical client, Tom, to see how this might work.

Based on Tom’s symptoms—nighttime waking 3 times a week, an FEV1 of 75% (5% below reference), daily asthma symptoms, and missed classes—his severity was classified as “moderate persistent.”

Tom was given a short course of oral prednisone, started on a moderate-strength inhaled corticosteroid (ICS), instructed to use inhaled albuterol (SABA) 2 puffs twice daily, advised on abatement strategies for cat dander exposure, and told to return in 4 weeks or as needed if his symptoms got worse.

After 2 weeks he called the office to report that he was continuing to have nighttime coughing that had increased to every night, and he was using up to 8 puffs of his albuterol every day to try to control his symptoms. He had complied with all abatement measures recommended to minimize exposure to animal dander. He was instructed to come to the office immediately for further evaluation.

During questioning about additional changes since moving from the dorm to an apartment, Tom reports that there have been notable changes to his diet. He is eating more fast foods, eating later at night, and snacking as he studies. He is drinking 1 to 2 beers at night while socializing with his roommate. He frequently awakens in the morning with poor appetite and doesn’t eat until lunchtime. He drinks several cups of very strong coffee during the day, and also drinks caffeinated sodas. He is experiencing some esophageal reflux.

Based on his symptoms, Tom is provided with instructions on diet and lifestyle measures designed to reduce symptoms of GERD and begins empiric treatment with a proton pump inhibitor (PPI) at night. He is instructed to continue with the recommended medications for his asthma and return to the office in 7 to 10 days—sooner if the symptoms continue to worsen.

When Tom returns for his scheduled visit he reports that he is following recommendations for GERD, has not needed his PPI for the last 2 nights, and only requires his albuterol once a day, usually shortly after returning to his apartment in the evening.

Tom’s case illustrates the importance of obtaining a full history when initiating therapy. When the client appears refractory to reasonable control measures, the clinician must proceed to questions and testing that focus on conditions suggested by the client’s history and physical examination. GERD, in particular, is well known to exacerbate asthma because the backflow of stomach acid into the esophagus causes additional irritation to the airways and lungs.

Obesity can also be associated with GERD and obstructive sleep apnea, which are known to complicate asthma. Rhinitis, or postnasal drip, may indicate that the client has an underlying sinus infection requiring treatment. A productive cough with mucopurulent sputum should not be treated as asthma even though it has lasted more than the 7 to 10 days typical for a viral infection.

Regardless of what additional conditions may be contributing to the client's symptoms, if the diagnosis of asthma has been made using the classical characteristics of the disease—symptoms, airway obstruction, inflammation, and hyper-responsiveness—it is of vital importance to determine if the client is using his medications properly before subjecting him to the time and expense of pursuing other diagnoses.

We will return to Tom later to see what additional measures may assist him in gaining control over his symptoms. Although Tom is a young college student in his first independent living situation, he is an ideal subject for study because he is unusually cooperative and amenable to education.

Environmental Factors in Asthma

Environmental triggers, irritants, allergens, occupational exposures, and other causal factors must be considered in clients with asthma symptoms.

Triggers, Irritants, and Allergens

Successful long-term control of asthma requires identifying environmental triggers, allergens, and irritants that increase symptoms or precipitate exacerbations. Because these factors are at least potentially modifiable, it is important to either remove or minimize them to reduce overall risk.

Education and abatement are essential prerequisites for convincing clients about the need for specific allergen avoidance. It is only possible to convince clients to undertake the abatement measures when they know what their triggers are.

Determination of sensitivity to a specific allergen is usually not possible through the client's medical history alone, but requires testing. Current recommendations for avoidance measures are allergen-specific and clients should be tested for sensitivity only to allergens they may be exposed to. Skin or in vitro tests educate clients about the role of allergens in their disease and are reliable in determining the presence of specific allergens. These tests, however, do not determine whether the specific immunoglobulin is responsible for the client's symptoms.

Inhaled Allergens

The most important allergens for children and adults appear to be those that are inhaled. Exposure to inhaled allergens increases airway inflammation and symptoms. Substantially reducing such exposure may significantly reduce inflammation, symptoms, and need for medication. Demonstrating a patient's relevant sensitivity to inhalant allergens will enable the clinician to recommend specific environmental controls to reduce exposures. It will also help the patient understand the pathogenesis of asthma and the value of allergen avoidance (NIH, NHLBI, 2007).

Dust Mites

House dust mites are universal in areas of high humidity (most areas of the United States) but are usually not present at high altitudes or in arid areas unless moisture is added to the indoor air via swamp coolers and other moisture sources. Mites depend on atmospheric moisture and human dander for survival. High levels of mites can be found in dust from mattresses, pillows, carpets, upholstered furniture, bed covers, clothes, and soft toys. The client's bed is the most important source of dust mites to control. Washing bedding is advised, preferably in hot water, but cold water, detergent, and bleach can also be effective.

Chemical agents are available for killing mites and denaturing the antigen; however, the effects are not dramatic and do not appear to be sustained for long periods. Use of these agents in homes of persons who have asthma and are sensitive to house dust mites should not be recommended routinely. Vacuuming removes mite allergen from carpets, but is inefficient at removing live mites. Eliminating conditions in which mites flourish such as areas with abundant densely layered fabric or carpeting and substituting them for surfaces that are easily cleaned is effective, but may not be practical or possible.

Pet Dander

Warm-blooded animals—including pets and rodents—produce dander, urine, feces, and saliva that can cause allergic reactions. Successful controlled trials of high animal dander concentrations and abatement have been reported for schools and homes in which no animal is present (Dilley & Phipatanakul, 2017) but where significant dander counts have been recorded.

High-efficiency particulate air (HEPA) cleaners reduce airborne particles in homes with dogs, but this does not hold true for cat dander, which has greater allergenic properties and is far more sensitizing. Preventing pets from having access to the bedroom—and possibly the living room—may reduce the total allergen load inhaled although by itself this measure may not be enough. Weekly washing of the pet will remove dander and dried saliva that will otherwise accumulate in the house; however, the role of washing in allergen avoidance is not established once an individual has been sensitized (Dilley & Phipatanakul, 2017).

Cockroaches

Cockroach sensitivity is common among clients who have asthma, and those who live in inner cities suffer disproportionately. In a study of asthma in an inner-city area, asthma severity increased with increasing levels of cockroach antigen in the bedrooms of children who were sensitized.

Avoidance of conditions in which cockroaches are known to flourish is effective in reducing populations, but this can be difficult in poorly maintained and densely crowded living quarters in urban settings. Clients and caretakers should not leave food or garbage exposed. Poison baits, boric acid, and traps are preferred to other chemical agents such as sprays or fumigant bombs, because the latter can be irritating when inhaled by persons who have asthma. If volatile chemical agents are used, or a building is commercially fumigated, the home should be well ventilated after the chemicals have been dispersed, and the person who has asthma should not return to the home until the odor has dissipated. Care should be taken that young children do not have access to cockroach baits and poisons (Dilley & Phipatanakul, 2017).

Indoor Fungi (Molds)

Indoor fungi are particularly prominent in humid environments and homes that have problems with dampness. Children who live in homes with moisture problems have increased respiratory symptoms (NIH, NHLBI, 2007), but the relative contribution of fungi, house dust mites, or irritants is variable, making it difficult to guarantee improvement using a "one size fits all" approach. Because an association between indoor fungi and respiratory and allergic disease is suggested by some studies (NIH, NHLBI, 2007), measures to control dampness or fungal growth in the home seems logical and may be beneficial.

Outdoor Allergens

The strongest associations between mold-spore exposure and asthma have been with outdoor fungi, such as *Alternaria*, which is ubiquitous in the environment and is a natural part of fungal flora almost everywhere. *Alternaria* spores are airborne and found in the soil and water, as well as indoors and on objects. *Alternaria* species are capable of growing both indoors and out, on buccal mucosa, on eyelids, and within respiratory tracts. When inhaled they can produce toxic compounds that readily cause opportunistic infections in immunocompromised people such as AIDS clients. Inhalant allergen exposure to seasonal outdoor fungal spores has been implicated in fatal exacerbations of asthma.

Sensitization to outdoor pollens carries less risk for asthma, although exposure to grass and ragweed pollen has been associated with seasonal asthma exacerbation. Clients can reduce exposure during peak pollen season by staying indoors with windows closed in an air-conditioned environment, particularly during the midday and afternoon when pollen and some spore counts are highest. Conducting outdoor activities shortly after sunrise or in the evening hours will result in less exposure to pollen. These actions may not be realistic for some clients, especially children.

Food Allergens

Food allergens are not a common precipitant of asthma symptoms. Foods are an important cause of anaphylaxis in adults and children, but significant lower respiratory tract symptoms are uncommon even with positive double-blind food challenges (NIH, NHLBI, 2007). However, asthma is a risk factor for fatal anaphylactic reactions to food or immunotherapy.

Irritants

In addition to questioning clients about exposure to common inhalants whose presence can be confirmed through allergen testing, the clinician must also consider the role of irritants such as tobacco smoke, air pollution, and indoor chemical pollution on the course of the disease.

Environmental Tobacco Smoke

Exposure to environmental tobacco smoke (ETS) is common in the United States. Environmental tobacco smoke is associated with increased respiratory symptoms, decreased lung function, and greater use of health services among those who have asthma in all age groups, although negative effects may vary by age (NIH, NHLBI, 2007). Exposure to maternal smoking has been shown to be a risk factor for the development of asthma in infancy and childhood. Effects of ETS on a child's asthma are known to be more severe when the mother smokes than when others in the household smoke. Heavy smokers may be less aware than light smokers of the effects of ETS exposure on children (NIH, NHLBI, 2007).

The primary modes of exposure to ETS for adults who have asthma may be when they are at work or traveling. This becomes problematic because people are less likely to ask for personal consideration when they are in a group or an unfamiliar setting. If the smoker happens to be the asthma clients' superior, the request is even more unlikely, leaving the asthma client with few alternatives besides increasing the use of SABA.

Environmental tobacco smoke exposure operates as a cofactor in wheezing and predisposes the client to other insults such as infections. Smoking outdoors to avoid exposing others may not adequately reduce exposure for children. Encourage parents of children who have asthma not to smoke. Be prepared to refer them to resources to help them stop smoking.

Be sensitive to the difficulty most people experience in attempting to rid themselves of this habit; many who are not currently experiencing any negative effects from smoking cite such factors as better weight control and decreased anxiety as reasons they continue to smoke, making it difficult to convince them of the benefits. As a routine part of asthma care, clients should be counseled concerning the negative effects of smoking and ETS and supported in their efforts to become tobacco free.

Increased Pollution Levels

Increased pollution levels—especially particulate matter ≤10 micrometers, which includes nitric oxide (NO_2), ozone, and sulfur dioxide (SO_2) among others—have been reported to precipitate symptoms of asthma, increase SABA use, and increase ED visits and hospitalizations for asthma. Exposure to pollutants may increase airway inflammation, predicting increased need for short-term relief medications. When practical, asthma clients should avoid outdoor exertion as well as exercise when air pollution levels are high; they need to follow medical recommendations for followup care if an exacerbation occurs when weather or pollution are likely contributors.

Indoor Pollution

Indoor pollution in the form of formaldehyde and volatile organic compounds (VOCs)—which can arise from sources such as new linoleum flooring, synthetic carpeting, particleboard, wall coverings, furniture, and recent painting—have been implicated as potential risk factors for the onset of asthma and wheezing. Clinicians should advise clients to be aware of the potential irritating effects of newly installed furnishings and finishes.

Paints and finishes, furnishings and floor covering advertised as VOC free are now readily available, but are significantly more expensive than standard products, making them inaccessible to middle- or low-income earners. For comparison, a one-gallon can of standard indoor wall paint averages about $12 less per gallon than VOC-free paint. Floor coverings and furnishings have an even greater differential; thus, "green" products are being marketed to those with higher levels of income. Clients should be advised that, where strong sensitivities exist, money spent on avoidance of VOCs is best spent in the bedroom, where the asthma client spends the most concentrated period of time.

Unvented gas stoves and appliances cause increased indoor levels of NO_2. Use of gas stoves for cooking has been associated with increased respiratory symptoms, including wheezing in school children and increased prevalence of bronchial hyper-responsiveness in atopic adults. However, data from the National Health and Nutrition Examination Survey III (NHANES III) did not suggest any impact of gas-stove use on pulmonary function or respiratory symptoms in other adults who have asthma. This can probably be explained by the larger surface area of adult lungs compared to pediatric lungs.

Infants at high risk for asthma who were exposed to higher levels of NO_2—but levels currently not considered harmful—had increased days of wheezing and shortness of breath (NIH, NHLBI, 2007). When un-flued gas heaters in schools were replaced, NO_2 levels decreased by two-thirds, accompanied by significant reduction in both daytime and nighttime asthma symptoms (NIH, NHLBI, 2007). This has important implications when evaluating children who are spending most of their day in a new school or daycare setting who experience an otherwise unexplained increase in symptoms.

Exposure to gas heaters and appliances in infancy has been found to be a risk for wheezing, asthma, and bronchial hyper-responsiveness in school-aged children. They also promote conditions favorable to house dust mites, making the effects additive. Fumes from wood-burning appliances or fireplaces can exacerbate symptoms in persons who have asthma. Adults and children who depend on fires for their main heat source may have symptoms that are difficult to control, particularly if they live in a house that is relatively airtight, which prevents turnover of inside air. Sprays and strong odors, particularly perfumes, which have become ubiquitous in typical household and laundry cleaning products, can also irritate the lungs and precipitate asthma symptoms.

Occupational Exposures

Early recognition and control of exposures are particularly important in occupationally induced asthma. The longer an exposure occurs the less likely the worker is to be able to isolate and avoid an offending agent, and the more sensitized they are to the offending agent. Occupational asthma is suggested by a correlation between asthma symptoms and work, as well as with improvement when away from work for several days.

In particular, isocyanates are a volatile family of chemical agents used widely in the manufacture of common household items including foams, clothing with spandex fibers, shoes, carpet padding, insulation, mattresses, automobiles, car seats, and other products too numerous to name. In 1974 the Occupational Safety and Health Association (OSHA) began publishing safety standards for industrial workers—including those working in shipyards, construction, the auto industry and others—advising of risks from isocyanates with symptoms ranging from rashes to respiratory symptoms. Since then, more data has accumulated on these chemicals because their use continues to proliferate and they appear in more everyday products.

More information on this category of chemicals can be gained by going to the OSHA website and looking up *isocyanates*. General Industry Standards are recommended in publication number 29CFR1910, which summarizes workplace safety standards, including those involving management of highly hazardous chemicals.

The list of potential sources of exposure permeates our society, with the greatest burden being borne by those workers who are employed in manufacture and especially those in closed environments with poor ventilation. In addition to being able to provoke and exacerbate asthmatic symptoms, isocyanates are listed as potential human carcinogens. Twenty-five states, plus Puerto Rico and the Virgin Islands, have OSHA-approved state plans and have adopted their own standards and enforcement policies in an attempt to minimize exposure. However, of the twenty-five, the plans for Connecticut, Illinois, New Jersey, New York, and the Virgin Islands cover public-sector employment only.

Occupational exposure should be considered when the following are present.

Potential for workplace-related symptoms

- Recognized sensitizers (eg, isocyanates, plant or animal products)
- Irritants or physical stimuli (eg, cold/heat, dust, humidity)
- Coworkers who have similar symptoms

Patterns of symptoms (in relation to work exposures)

- Improvement occurs during vacations or days off (may take a week or more).

- Symptoms may be immediate (<1 hour), delayed (most commonly, 2–8 hours after exposure), or nocturnal.
- Initial symptoms may occur after high-level exposure (eg, a spill).

Many clients may fail to associate their symptoms with work, because symptoms often begin several hours after exposure. Recently, common jobs—such as domestic cleaner, laboratory technician, and house painter—have been associated with increased rates of asthma (NIH, NHLBI, 2007). Serial peak flow records at work and away from work can confirm the association between work and asthma. Workplace exposure to sensitizing chemicals, allergens, or dusts can induce asthma that persists after the exposures are terminated. This effect should be distinguished from allergen- or irritant-induced aggravation of pre-existing asthma.

Client confidentiality issues are particularly important in work-related asthma. Even general inquiries about the potential adverse health effects of work exposures may result in reprisals against the client. Clients who have asthma need to be informed of this possibility and be full partners in the decision to approach management regarding control of workplace exposures. If possible, they should be referred to specialists in workplace exposure to help protect them from reprisals or dismissal. In the current work climate, it is vital that asthmatic clients be fully informed of the potential for employer retaliation because job loss may trigger loss of health insurance.

If clients elect to pursue workplace exposure, their concerns are more likely to be taken seriously if they can provide objective findings that show symptoms being provoked consistently by conditions present in the workplace. Clients being evaluated for possible work-related exposure should be taught to do serial documentation for 2 to 3 weeks, including up to 2 weeks of work followed by 1 week away from work, and to:

- Record when symptoms and exposures occur
- Record when a SABA is used
- Measure and record peak flow (or FEV1) every 2 hours while awake

Early recognition and control of factors such as inhalant allergens, irritants, and workplace exposure is critical in the overall management of asthma. The goal of medication management should always be directed at measures that minimize the complexity and intensity of medications, using the lowest doses necessary to maintain control of symptoms.

Managing risk factors is essential to stabilizing the disease and calls for a comprehensive history to discover any existing factors that make asthma more difficult to control and manage. Upon diagnosis, ask questions of the client (or caretaker) that reveal patterns of exposure in order to associate possible triggers with active symptoms. To start, determine the frequency and extent of the client’s exposure to allergens and irritants. Be sure to consider the possibility that exposures are taking place away from the client’s home.

Sample Questions for Identifying Factors That Can Exacerbate Asthma

Inhalant allergens

- Does the client have symptoms year round? (if yes, proceed with focused questions)
- Does the client have pets? Are they kept indoors?
- What types of pets?
- Is there dampness or moisture in any room of the house?
- Is there mold visible in any room in the house?
- Has the client seen cockroaches or rodents in the house?
- Are symptoms worse when carpets and upholstered surfaces are being vacuumed?
- Is there a swamp cooler in the house?
- Do the client's symptoms worsen at certain times of the year? (if yes, determine when)
  - Early spring (trees)
  - Late spring (grasses)
  - Late summer and autumn (weeds)
  - Summer and autumn (*Alternaria*, Cladosporium, mites)
  - Cold months in temperate climate (animal dander)

Tobacco smoke

- Does the client smoke?
- Is the client exposed to secondhand smoke in the home, in a car, or at work, daycare, or school?

Indoor/outdoor pollutants and irritants

- Is there a wood-burning stove or fireplace used in the home? Main source of heat?
- Are there other unvented stoves or heaters in the home?
- Is the client exposed to strong odors or fumes from scented products, cleaning agents, or sprays?
- Have there been recent renovations or painting in the home?

Workplace exposures

- Does the client cough or wheeze during the week but not on weekends or when away from work?

- Do the client's eyes or nasal passages become irritated soon after arrival at work?
- Are there co-workers with similar symptoms?
- What agents are known to be used in the workplace?

These questions are provided as examples and have not been assessed for validity and reliability. Source: Adapted from NIH, NHLBI, 2007.

With this additional information in mind, let's revisit our student Tom, who improved when he implemented measures to control his reflux. Another month has elapsed since he was seen and he has returned to the office for his routine scheduled appointment. He has been on his inhaled corticosteroid for 6 weeks total and has taken no further oral prednisone. He does, however, find that on most days he needs to use his SABA in the evening after he has been home for several hours, and occasionally again in the morning. Tom is requesting a refill on his albuterol (SABA), which he has had for only 6 weeks.

Tom keeps his door closed during the day so the cat doesn't sleep on his bed. When home, he leaves his door open so he can carry on conversations with his roommate. Tom's room in the apartment is in the back and is actually a converted porch containing numerous houseplants, which are a hobby for Tom. Tom doesn't smoke but his roommate does; however, Tom says the roommate only smokes outside. Tom's bed is an aging foam futon placed on the floor, which he thinks is synthetic carpet over concrete. When asked about the possibility of cockroaches or rodents Tom is sheepish, shrugging his shoulders: "You know what it's like when it's just a couple of guys." He is certain there are no mice or other rodents: "The cat takes care of that."

This level of exposure to allergens and irritants is not unusual. Without obtaining this additional input, his clinician might simply keep increasing Tom's medications when he needs education about the effect these exposures are having on his asthma. He has used an entire canister of albuterol in 6 weeks. Each canister typically has 200 actuations, or 100 doses if a dose is 2 puffs. The Rule of Two recommends two canisters a year as a standard to measure control. It is probable that Tom is using the SABA more frequently than he realizes, since he was not advised to keep a symptom diary and has no written Asthma Action Plan to help monitor his symptoms. Unless a comprehensive survey is included as part of his plan of care, it is likely that he will quickly move to a more complicated medication regimen with more potent drugs. (This may be necessary in any event, depending on his willingness and ability to make changes.)

At this point, it is critical to develop a cooperative healthcare partnership that has a strong component of education and emphasizes self-care principles, while negotiating agreements about the goals of treatment, specific medications, and the actions Tom will take to reach the agreed-upon goals.

Tom has persistent asthma. Although his initial response to medication appeared good, continued exposure to allergens and irritants is complicating management. He is at risk for further exacerbation and seems destined to have further deterioration if steps are not taken to improve control. He is open to allergy testing, agreeing that he has significant exposures. He is amenable to this approach because he likes the idea of being able to "see" the results.

Other Causal Factors

Other factors can cause asthma exacerbations in some individuals. These include the use of aspirin, NSAIDS, beta blockers, and sulfite-containing foods.

Aspirin and NSAIDS

Some client's asthma symptoms are precipitated when they take aspirin or other nonsteroidal anti-inflammatory medications (NSAIDs). Clients who have sensitivity to aspirin often have cross sensitivity to NSAIDs, and vice versa. Up to 21% of adults and 5% of children may have this response and, when they do, the potential exists for a severe or fatal exacerbation.

Alternatives to aspirin that usually do not cause acute bronchoconstriction in aspirin-sensitive clients include acetaminophen or the cox-2 inhibitor celecoxib (Celebrex). However, care should be taken when making these recommendations because neither of these alternatives is risk-free. New guidelines for acetaminophen have emerged because the risk for liver failure is much greater than previously suspected. Moreover, even the generic form of celecoxib is relatively expensive and may not be covered by an insurance plan.

The prevalence of aspirin sensitivity increases with age and severity of disease, and aspirin may appear in products not specifically aimed at treating pain and fever. In cases where a co-morbid condition necessitates use of aspirin, desensitization treatment followed by daily aspirin therapy may be undertaken with the supervision of a specialist qualified to treat the condition and manage reactions that can include anaphylaxis.

Beta Blockers

Beta Blockers are in a class of drugs often used to treat hypertension and other cardiac conditions. They are also used occasionally for the off-label management of mood disorders, migraine syndrome, and other chronic conditions that do not respond to conventional therapies. As a group, beta blockers are further classified as either **cardiac-selective** or **noncardiac-selective**. Some asthma clients who have milder forms of the disease may be able to tolerate some of the cardiac-selective forms. This therapy should only be undertaken as a last resort, and careful supervision must continue for the duration of therapy. Some ophthalmologic drops containing beta blockers are used to treat glaucoma; these should be avoided in asthma clients sensitive to beta blockers.

Sulfites

In clients with severe persistent asthma, sulfite-containing foods have caused severe asthma exacerbations. Sulfites can be found in processed and preserved foods such as potato products, shrimp, dried fruits, beer and wine, among others. Clients should be educated to read labels for sulfite and avoid those products.

Though food allergies are known to have serious and potentially fatal outcomes in a sensitized individual, there is no immunotherapy that has been successful in treating these potential triggers. Education to identify and avoid these agents is the only treatment known to prevent a potential IgE-mediated response to food allergy. Clients are still encouraged to eat a varied and well-balanced diet containing fruit, vegetables, and whole grains, while excluding foods that increase symptom severity.

Now that the roles of triggers and abatement measures are more fully understood, let us go back to the case of Tom, who has returned to his primary care provider’s office after seeing an allergist, who confirmed that Tom has severe sensitivity to cat dander and moderate sensitivity to mold and house dust mites. He does not appear to be sensitive to cockroach droppings. With this information we can make recommendations to Tom that will help him gain control of his asthma.

Test Your Knowledge

1. Recommendations that Tom be tested for specific allergens are based on:
   A. Client report of symptoms.
   B. A history positive for triggers.
   C. Client-requested testing.
   D. A history positive for exposure to allergens and symptoms.

2. Tom asks you which of his triggers can be confirmed through testing. You reply:
   A. Irritants such as smoke and inhalants, including dander, mites, and mold.
   B. All inhalants, including isocyanates.
   C. Inhalants such as dander, mites, and mold.
   D. Inhalants such as dander, mites, and mold and irritants such as sulfite.

3. When counseling Tom regarding his allergen exposure, you inform him:
   A. He must immediately move to housing with no cats or his condition will deteriorate.
   B. If removing the cat is objectionable, he must take steps to minimize cat dander exposure including keeping the cat out of his room, keeping his door closed, and keeping the cat off upholstered surfaces in the house.
   C. If removing the cat is objectionable, a HEPA filter placed in Tom's room will remove dander from the immediate environment, which should help manage exposure.
   D. No measures are necessary because there is no positive correlation at this time between allergen exposure and symptom exacerbation.

4. Tom is agreeable to making changes to reduce his exposure to cat dander and asks if there are more things he can change that might be helpful. You advise him that the next priority area would be:
   A. Ensuring that all food is contained and garbage placed in sealed containers.
   B. Removing the carpet in his bedroom because it is placed over concrete.
   C. Washing his bedding regularly to eliminate mites.
   D. Encasing his mattress and pillow in allergen covers and washing his bedding weekly in hot water over 130°F.

5. Tom is considering immunotherapy to help manage his response to cat dander and wants to know your thoughts, so you:
    A. Recommend immunotherapy highly because it will cure his cat allergy forever.
    B. Discourage immunotherapy because the serum available against cat dander is not very effective.
    C. Discourage immunotherapy knowing that his continued exposure to cat dander will make the therapy ineffective.
    D. Recommend immunotherapy with the provision that he commit to a course of treatment that will take 3 to 5 years to complete before response can be completely determined.

Answers: 1-D, 2-C, 3-B, 4-D, 5-D

Immunotherapy

Immunotherapy is usually reserved for patients whose symptoms occur all year or during a major portion of the year and in whom controlling symptoms with pharmacologic management is difficult because the medication is ineffective, multiple medications are required, or the patient is not accepting the use of medication.

Controlled studies of immunotherapy, usually conducted with single allergens, have demonstrated reduction in asthma symptoms caused by exposure to grass, cat, house dust mites, ragweed, *Cladosporium*, and *Alternaria*. A meta-analysis of seventy-five randomized, placebo-controlled studies has confirmed the effectiveness of immunotherapy in asthma, with a significant reduction in asthma symptoms and medication and with improvement in bronchial hyperreactivity (NIH, NHLBI, 2007). This meta-analysis included 36 trials for allergy to house dust mites, 20 for pollen allergy, and 10 for animal dander.

In the United States, standardized extracts are available for house dust mites, grasses, short ragweed, and cat, and there are non-standardized extracts of other pollens and for dog that appear to have similar potency. Available extracts for cockroach and mold, on the other hand, vary widely as to allergen content and allergenic potency, and their effectiveness in specific immunotherapy has not been demonstrated (NIH, NHLBI, 2007).

Few studies have been reported on multiple allergen mixes that are commonly used in clinical practice. One, which included high doses of all allergens to which the children were sensitive, demonstrated reduction in asthma symptoms compared to lower doses of the same allergens or placebo. Another study, in which the children were given optimal medical therapy and in which the only perennial allergen administered was house dust mite, demonstrated no improvement in asthma symptoms between active and placebo therapy (NIH, NHLBI, 2007).

The course of allergen immunotherapy is typically of 3 to 5 years' duration. Severe and sometimes fatal reactions to immunotherapy, especially severe bronchoconstriction, are more frequent among patients who have asthma, particularly those who have poorly controlled asthma, compared with those who have allergic rhinitis. If use of allergen immunotherapy is elected, it should be administered only in a physician's office, where facilities and trained personnel are available to treat any life-threatening reaction that can, but rarely does, occur. For this reason, enthusiasm for the use of immunotherapy in asthma differs considerably among experts (NIH, NHLBI, 2007).

Medication Management of Asthma

Pharmacologic therapy can prevent and control asthma symptoms, improve quality of life, reduce frequency and severity of symptoms, and reverse airflow obstruction. It is essential that medications be chosen based upon the specific criteria revealed when classifying the client's asthma. The long-term management of asthma needs to change in response to the severity of symptoms, so a stepwise approach to medication management is important (see "Applying the Stepwise Approach," below).

Using the stepwise approach, the client is evaluated based on observation of symptom severity, as well as pulmonary function testing (PFT). Medication is stepped up or down to deliver the lowest dose of medication that maintains good symptom control. Before looking at the steps, we will review the basic groups of medications available to treat asthma.

Asthma medications fall into two general classes: (1) **controllers**, long-term control medications taken daily to achieve and maintain control of persistent asthma, and (2) **rescue**, quick-relief medications taken to address acute airflow obstruction and bronchoconstriction. Clients who have persistent asthma need prescriptions for both. Clients with intermittent symptoms, such as exercise- or cold-induced asthma, typically need only a rescue inhaler that is used 15 to 30 minutes before exposure.

Controller (Long-Term) Medications

Corticosteroids

Corticosteroids are the most potent and effective anti-inflammatory medications currently available. They block late-phase reaction to allergens, reduce airway hyper-responsiveness, and inhibit inflammatory-cell migration and activation. Corticosteroids are available in inhaled forms (inhaled corticosteroids, or ICS) and in oral or injectable forms. Inhaled corticosteroids are commonly used in the long-term control of asthma.

Short courses of **oral systemic corticosteroids** are often used to gain prompt control of symptoms when initiating long-term therapy; long-term oral systemic corticosteroid is used for severe persistent asthma. **Intravenous steroids** may be used in an inpatient setting to manage an acute exacerbation. When administered for quick relief, these last two routes are not considered controllers, but are classed as rescue strategies.

Numerous preparations exist either as metered dose inhalers (MDI) or dry powder inhalers (DPI) with varying strengths. Dosages are ranked as low, medium, or high by multiplying the strength of the dose in the specific MDI times the number of puffs taken per day (which might range from a low of 1 to a high of 8). Limiting the number of puffs needed by changing to a higher dose is a desirable strategy to simplify therapy.

Samples of inhaled corticosteroids and the number of puffs needed to receive appropriate therapy in children over 12 and adults are presented in the following table.

Number of Inhaled Corticosteroid (ICS) Puffs Needed for Children >12 and Adults			
Drug	Low daily dose	Medium daily dose	High daily dose
Beclomethasone HFA 40 or 80 mcg/puff	80–240 mcg	240–480 mcg	>480 mcg
Budesonide DPI 90, 180, 200 mcg/inhalation	180–600 mcg	600–1200 mcg	>1200 mcg
Flunisolide HFA 80 mcg/puff	320 mcg	320–640 mcg	>640 mcg
Fluticasone HFA/MDI: 44, 110, 220 mcg/puff	88–264 mcg	264–440 mcg	>440 mcg
DPI: 50, 100, 250 mcg/puff	110–300 mcg	300–500 mcg	>500 mcg
Mometasone DPI 200 mcg/inhalation	200 mcg	400 mcg	>400 mcg
Triamcinolone acetonide 75 mcg/puff	300–750 mcg	750–1500 mcg	>1500 mcg

Dosing for children varies considerably, with levels generally being lower at the upper end of the low category and titrated downward from there. The doses are given as guidelines only, and individuals with case-specific requirements need to seek expert opinion from a trusted source.

What can be said about dosing for children is that, in spite of known risks, ICS is the preferred choice for long-term control for children of all ages. The adverse effect on growth in height for children on low-to-medium ICS is a reduction of ≤1 cm in the first year of therapy. These children should have their growth monitored.

For children requiring high-dose ICS for more than 1 year, especially if occasional courses of systemic corticosteroids are used, there may be increased risk of growth defects, reduced bone density, and cataract formation. Children should always be monitored for these known adverse effects. In children of ages 1 to 4, Budesonide suspension—typically given with a face mask and nebulizer—is the only FDA-approved ICS therapy. Fluticasone DPI is approved for children aged 4 and up.

Cromolyn Sodium and Nedocromil

Cromolyn sodium and nedocromil stabilize mast cells and interfere with chloride channel function. They are used as alternative—but not preferred—medication for the treatment of mild-to-persistent asthma. They may be used as preventive treatment before exercise or unavoidable exposure to known allergens. The main protection conferred in children by this class of medications is as adjunct therapy to reduce exacerbations leading to hospitalization.

Immunomodulators

Omalizumab (Xolair, an anti-IgE) is an injectable monoclonal antibody that prevents binding of IgE to the high-affinity receptors on basophils and mast cells. Omalizumab is used as adjunctive therapy for clients ≥12 years of age who have allergies and severe persistent asthma. Clinicians who administer omalizumab should be prepared and equipped to identify and treat anaphylaxis. This medication is reserved for clients whose asthma is not controlled using alternative therapies appropriate to their level of severity, in whom treatment fails to control symptoms adequately. The dose is given every 2 to 4 weeks and is calibrated to the client body weight and IgE activity before starting therapy.

Leukotriene Modifiers

Two leukotriene modifiers (LRTA) are available—montelukast (for clients >1 year of age) and zafirlukast (for clients ≥7 years of age). The 5-lipoxygenase pathway inhibitor zileuton is available for clients ≥12 years of age. As a group these medications are either adjunct or alternative treatments for mild persistent asthma. Zileuton has the added disadvantage of being hepatotoxic and requires liver function monitoring.

Long-Acting Beta Agonists (LABAs)

The principal action seen in LABAs is relaxation of smooth muscles in the upper airways through stimulation of beta2 receptors. Salmeterol and formoterol are bronchodilators that have a duration of at least 12 hours after a single dose; however, with chronic regular administration this effect is reduced to less than 5 hours.

Black box warnings have been added to all preparations containing LABA due to an increased number of deaths and severe exacerbations seen in clients using it. These results were seen largely in clients using LABA inappropriately, either in treating acute symptoms or as monotherapy.

The EPR 3 (2007) recommendations acknowledge that LABA is effective for the majority of clients whose asthma is not well-controlled with ICS alone; therefore, when weighing the risks and benefits of LABA the following points should be considered:

- LABAs are not to be used as monotherapy for long-term control of asthma.
- LABAs are used in combination with ICS for long-term control and prevention of symptoms in moderate or severe persistent asthma (step 3 care or higher in children ≥5 years of age and adults)
- Of the adjunctive therapies available, LABA is the preferred therapy to combine with ICS in youths ≥12 years of age and adults.
- Daily doses of LABA should not exceed 100 mcg of salmeterol or 24 mcg of formoterol.

Additional concerns exist with regard to the use of LABA's in children. For clients ≥5 years of age who have moderate-to-persistent asthma or asthma inadequately controlled on low-dose ICS, the option to increase the ICS dose should be given equal weight to the option of adding LABA. For clients ≥5 years of age who have severe persistent asthma or asthma inadequately controlled on step 3 care, the combination of LABA and ICS is the preferred therapy.

Combination Products

Combination products include:

- Fluticasone/salmeterol (Advair)
- Budesonide/formoterol (Symbicort)
- Mometasone/formoterol (Dulera)

These products combine fixed doses of ICS and LABA and are available in varying strengths and preparations, but they should not be used unless symptoms are severe.

Methylxanthine

Sustained-release theophylline is a mild to moderate bronchodilator used as an alternative, but not preferred, adjunctive therapy with ICS. Theophylline may also have mild anti-inflammatory properties. Monitoring of serum theophylline concentrations is essential.

Rescue (Quick Relief) Medications

Anticholinergics

Inhaled anticholinergic medications inhibit muscarinic receptors, thereby reducing vagal response of the airway. Ipratropium bromide (Atrovent MDI) provides additive benefit to SABA in moderate to severe asthma exacerbations and may be used as an alternative bronchodilator to clients unable to tolerate SABA. Tiotropium (Spiriva) MDI provides a longer duration of action. Ipratropium and albuterol are available as a combined MDI under the trade name of Combivent.

Short-Acting Beta Agonists (SABA)

Albuterol, levalbuterol, pirbuterol are all bronchodilators that relax smooth muscle and are used for relief of acute symptoms.

Systemic Corticosteroids

Oral or IV formulations are used for moderate and severe exacerbations or as adjunct therapy to SABA to speed recovery and prevent exacerbations.

The Stepwise Approach for Managing Asthma Medications

The stepwise approach to therapy, in which the dose and number of medications and frequency of administration are increased as necessary and decreased when possible, is used to achieve and maintain optimal control. Because asthma is a chronic inflammatory disorder of the airways with recurrent exacerbations, therapy for persistent asthma must emphasize efforts to suppress inflammation over the long term and to prevent exacerbations. Recommendations in the stepwise approach to therapy are based on the Expert Panel’s review (EPR 3) of the literature and cumulative experience.

Based on the table below, it is possible to apply the step approach to choosing an appropriate medication based on the severity of initial symptoms. As has been noted, the amount of ICS is increased at each step, with the addition of LABA or a combined ICS/LABA product such as Advair being added at Steps 3 or 4.

Step Therapy Recommendations for Children 0 to 4 years of age		
Step 1	SABA prn	Albuterol
Step 2	Low-dose ICS	Budesonide respules 0.25–0.5 mg/day OR fluticasone 44 mcg, 2 puffs with spacer/mask BID
Step 3	Medium-dose ICS	Budesonide respules 0.5 mg BID or 1 mg daily OR fluticasone 110 mcg, 1 puff with spacer/mask BID
Step 4	Medium-dose ICS + LABA or montelukast	ICS (see Step 3) plus montelukast 4 mg daily OR Advair HFA 45/21 mcg, 2 puffs with spacer/mask BID
Step 5	High-dose ICS + LABA or montelukast	Montelukast 4 mg + fluticasone 220 mcg BID OR montelukast 4 mg + budesonide 1 mg BID OR Advair HFA 115/21 mcg, 2 puffs with spacer/mask BID
Step 6	High-dose ICS + oral steroids + LABA or montelukast	Prednisolone + Step 5 therapy

Step Therapy Recommendations for Children 5 to 11 years of age		
Step 1	SABA prn	Albuterol
Step 2	Low-dose ICS	Fluticasone HFA 44 mcg, 1–2 puffs with spacer BID Fluticasone 50 mcg Diskus, 1–2 puffs BID Mometasone DPI 100 mcg once daily Budesonide DPI 90–180 mcg BID Beclomethasone HFA 40 or 80 mcg, 1 puff BID
Step 3	Medium-dose ICS OR low-dose ICS + LABA or montelukast	Fluticasone HFA 110 mcg, 1 puff with spacer BID Mometasone DPI 200 mcg daily Budesonide DPI 180 mcg, 2 puffs BID Beclomethasone 80 mcg, 2 puffs BID ALTERNATIVE: Advair 45/21 mcg, 2 puffs with spacer BID OR Low-dose ICS (Step 2) + montelukast 5 mg OR Symbicort 80/4.5 mcg, 2 puffs with spacer BID
Step 4	Medium-dose ICS + LABA (ICS + montelukast is non-preferred alternative)	Advair 45/21 mcg, 2 puffs with spacer BID OR Advair Diskus 100/50 mcg or 250/50 mcg, 1 puff BID OR Symbicort 160/4.5 mcg, 2 puffs with spacer BID NOT PREFERRED: Medium-dose ICS (Step 3) + montelukast 5 mg
Step 5	High-dose ICS + LABA (montelukast is non-preferred alternative)	Advair 115/21 mcg, 2 puffs with spacer BID OR Advair 250/50 mcg, 1 puff BID NOT PREFERRED: montelukast 5 mg + Fluticasone 220 mcg, 1 puff with spacer BID OR Montelukast 5 mg + mometasone 200 mcg, 1 puff BID

Step Therapy Recommendations for Children 5 to 11 years of age		
Step 6	High-dose ICS + oral steroids + LABA (montelukast is non-preferred alternative)	Prednisolone + Step 5 therapy

Step Therapy Recommendations for Children ≥ 12 years of age		
Step 1	SABA prn	Albuterol
Step 2	Low-dose ICS	Fluticasone HFA 110 mcg, 1 puff BID Fluticasone 50 mcg Diskus, 1–2 puffs BID Mometasone DPI 200 mcg once daily Budesonide DPI 90–180 mcg 1 puff BID Beclomethasone HFA 80 mcg 1 puff BID; 40 mcg, 1–3 puffs BID Ciclesonide 80 mcg, 1 puff BID Triamcinolone 75 mcg, 2–5 puffs BID Flunisolide HFA 80 mcg, 2 puffs BID
Step 3	Low-dose ICS + LABA OR medium-dose ICS	Advair 45/21 mcg, 2 puffs BID OR Advair Diskus 100/50 mcg, 1 puff BID OR Symbicort 80 mcg 2 puffs BID
	Low-dose ICS + montelukast (non-preferred alternative)	Medium-dose ICS: fluticasone HFA 220 mcg, 1 puff BID mometasone DPI 200 mcg, 2 puffs daily or 1 puff BID budesonide DPI 180 mcg, 2 puffs BID beclomethasone HFA 80 mcg, 2–3 puffs BID ciclesonide 160 mcg, 1 puff BID triamcinolone 75 mcg, 6–10 puffs BID flunisolide HFA 80 mcg, 3–4 puffs BID NOT PREFERRED: Low-dose ICS (Step 2) + montelukast
Step 4	Medium-dose ICS + LABA (ICS + montelukast is non-preferred alternative)	Advair 115/21 mcg, 2 puffs BID OR Advair Diskus 250/50 mcg, 1 puff BID OR Symbicort 160/4.5 mcg, 2 puffs BID NOT PREFERRED: Medium-dose ICS (Step 3) + montelukast

Step Therapy Recommendations for Children ≥ 12 years of age		
Step 5	High-dose ICS + LABA AND consider omalizumab for those with allergies	Advair 115/21 mcg or 230/21 mcg, 2 puffs BID OR Advair 250/50 mcg, 1 puff BID OR Advair 500/50 mcg, 1 puff BID
Step 6	High-dose ICS + oral steroids + LABA AND consider omalizumab for those with allergies	Prednisolone + Step 5 therapy

If needed, oral steroids are given at Step 6 for severe asthma or if an exacerbation meets severity criteria at any step. Exacerbations requiring use of systemic steroids must be considered when assessing overall risk. Albuterol is used for intermittent symptoms but any time the Rules of Two apply—SABA >2x/week; night wakening with symptoms >2x/month; refill of rescue >2x/year)—clients need evaluation for step and triggers because they do not have good control.

If symptoms are well-controlled, the current step is maintained and regular follow-up occurs at 1- to 6-month intervals depending on symptom severity. If control is good for at least 6 months, a step down in therapy may be considered. Before stepping up therapy, inquire about adherence to current medications, demonstrate correct inhaler (or alternate device) technique, discuss adherence to environmental controls, and review co-morbidities. Alternate treatments such as montelukast or nedocromil are considered when side effects to preferred treatments exist.

The steps of care for managing asthma assist the healthcare team to determine whether the therapy being used matches severity of symptoms. Deciding which step of care is appropriate for a client depends on whether long-term control therapy is being initiated for the first time or whether therapy is being adjusted. Care is stepped up to regain control, and it is stepped down for clients who have maintained control for a sufficient length of time to determine the minimal amount of medication required to maintain control or reduce the risk of side effects.

The classification of asthma severity tables discussed earlier, which consider the severity of both impairment and risk domains, provide a guide for initiating therapy for clients who are not currently taking long-term control medications. Once therapy is selected, or if the client is already taking long-term control medication, the client's response to therapy will guide decisions about adjusting therapy based on the level of control achieved in both the impairment and risk domains.

We can now combine our knowledge of severity classification, co-morbidities, environmental allergens and triggers, along with pharmacotherapy recommendations using the Stepwise approach to further assess Tom in view of our improved understanding and determine whether he could benefit from adjustment to his routine.

Recall that Tom's asthma was initially classified as moderate-persistent. He received a short burst of systemic prednisone, an intermediate dose of ICS, and a SABA to use for acute symptom relief. Let us assume that the Tom's ICS need is met using Fluticasone 220 mcg/puff and that he takes 440 mcg/day or 1 puff BID. At 6 weeks he had already used one whole canister of his SABA (albuterol), which led to further assessment of environmental triggers. Removal of the cat to reduce dander exposure was judged as not possible. Tom elected to proceed with immunotherapy for the cat dander but it will take several years before his treatment is completed.

Test Your Knowledge

1. Tom's need for re-assessment of medication regimen at this time is based primarily on:
   A. His use of Fluticasone does not meet the standard for medium-dose ICS.
   B. His ongoing poor control automatically dictate a step up in therapy.
   C. He has just started immunotherapy and requires a step down in therapy.
   D. His overuse of SABA is a significant concern regardless of other factors.
2. Tom is currently receiving ICS therapy at:
   A. Step 2.
   B. Step 3.
   C. Step 4.
   D. Step 5.
3. In considering alternatives to Tom's current therapy, an acceptable alternative would be:
   A. Low-dose ICS + LABA.
   B. Low-dose ICS + montelukast.
   C. Medium-dose ICS + LABA.
   D. Medium-dose ICS + montelukast.
4. Prior to considering a step up in therapy it would be necessary to ascertain:
   A. Exposure to inhalants, irritants and foods.
   B. Compliance with immunotherapy routine.
   C. Adherence to medication, MDI technique, and environmental controls.
   D. Compliance with lifestyle recommendations and medication to manage GERD.

Answers: 1-D, 2-B, 3-C, 4-C

Partnering with Clients for Optimal Results

Client Education

Asthma self-management education provides clients with the skills necessary to control asthma and improve outcomes; it should be integrated into all aspects of asthma care and it requires repetition and reinforcement. To be effective, asthma education should:

- Begin at the time of diagnosis and continue through followup care.
- Involve all members of the healthcare team.
- Introduce, assess, and reinforce key concepts for control at every visit.

Negotiate agreements about the goals of treatment, specific medications, and the actions clients will take to reach the agreed-upon goals to control asthma.

A team approach to care is a useful technique for delivering health education. Recent studies have focused on the use of specially trained nurse educators to provide asthma education. Three randomized controlled trials (RCT) and three observational studies used advanced practice nurses trained in asthma care to deliver self-management education to adults in outpatient settings.

In one RCT, a hospital-based nurse specialist delivered self-management education during three sessions (Levy et al., 2000). Compared to clients receiving usual care, the educated clients significantly increased use of ICS for control, decreased need for SABA for rescue, achieved higher mean and less variable PEF, and had significantly lower symptom scores, doctor visits, and urgent care visits for asthma after 6 months. The reduction in asthma morbidity in this study may have been related to the strong emphasis, during the educational sessions, placed on improving asthma self-management skills during exacerbations.

In another RCT, self-management education with peak flow monitoring and a written asthma action plan—individualized to the client's severity—was delivered in one session that was then reinforced in two subsequent visits (Janson et al., 2003). Compared to the control condition (monitoring only), self-management education significantly improved adherence to ICS medications, quality of life, and perceived control of asthma.

In an attempt to reduce high hospitalization rates and healthcare utilization, yet another RCT (Urek et al., 2005) examined the effectiveness of three educational interventions in adults: asthma school, an educational booklet, and individual verbal instruction. Asthma school, which included three 4-hour sessions of group education, produced the most significant improvement in quality of life, while individual verbal instruction produced the best overall response in terms of both asthma control and quality of life.

Hopman and colleagues (2004) used nurse specialists to educate children and adults who had asthma through a standardized 2-hour asthma education program given across seven clinical centers in a large, multi-site observational study. The program resulted in significant improvements (decreases) in hospital utilization and missed activity days over 6 months. Two other observational studies of adults who had asthma, in which clients were taught and cared for by specially trained asthma nurses (Lindberg et al., 2002), showed significantly reduced symptoms and days of activity limitation as well as significantly decreased markers of airway inflammation (Janson et al., 2001).

Respiratory therapists also provide asthma education in hospital, emergency department, and clinic settings, and may direct clinical pathways and algorithms in hospital settings. An observational trial of 60 pediatric clients who attended a special clinic focusing on inhaler technique demonstrated that MDI technique improved significantly after MDI demonstration, teaching, and reinforcement (Minai et al., 2004). Respiratory therapists also participate actively in clinical protocols or pathways that are implemented in acute care settings for management of acute exacerbations in hospitalized clients.

Pharmacists also have a role in client education and are in a unique position to advise both clients and clinicians when medication use is exceeding standard recommendations. They may also reinforce the need for a client to have a "clinical home" with a single provider or primary clinician directing care, even though this may involve use of specialists, for severe cases, and other members of the healthcare team to deliver specific components of care.

The primary goal in asthma care is to manage symptoms using the minimal amount of medication necessary to achieve good symptom control while avoiding adverse effects. In order to achieve this goal both the clinician and client must be in agreement regarding the client's asthma control. Clients often do not understand or have sufficient awareness of their symptoms until they have experienced significant deterioration in their symptoms to the point that they require either emergency department care or hospitalization. Aside from the risks inherent in a severe exacerbation of asthma symptoms, the client is also potentially exposed to invasion by more serious pathogens when receiving hospital-based care.

Once the diagnosis of asthma has been confirmed, early education includes teaching regarding:

- Basic facts about asthma
- What defines well-controlled asthma and the client's current level of control
- Roles of medications
- Skills (eg, inhaler technique, use of a valved holding chamber [VHC] or spacer)

- Self-monitoring
- When and how to handle signs and symptoms of worsening asthma
- When and where to seek care
- Environmental exposure control measures

Ongoing discussion about client perception of symptom control reinforces the need for clients to become the experts for their particular disease status. This allows the healthcare team to uncover discrepancies between objective measures of the client's status and clients' self-report of symptoms. Clients and their families should always be given support and positive reinforcement for changes they make in any of the variables that affect the course of the disease, even if these measures only party address desirable changes. With open communication established, the likelihood increases that the client will be a reliable and accurate reporter of all aspects that influence home management.

A further consideration in creating effective partnerships for care is inclusion of the client, parent, or caretaker in decision-making about asthma and asthma treatment, and identifying preferences and barriers to effective treatment. If clinicians and clients have different treatment goals, the partnership aspect of care is unlikely to succeed, with a decrease in satisfaction or an increase in frustration experienced by both parties, to the benefit of neither.

Choosing a treatment regimen that improves outcomes and addresses preferences that are important to the client and caregiver encourages adherence to the plan of care. However, education that provides information only—without skills training—improves knowledge but does not reduce hospitalizations, ED visits, unscheduled doctor's visits, or lost work days. Nor does it improve lung function and medication use, which should be the focus of care. Therefore, a written asthma treatment plan is the best method for ensuring that both the client and clinician are clearly in agreement about treatment goals and the means to achieve them.

Reviewing the success of the treatment plan with the client or caregiver at each visit and making adjustments as needed allows clients to experience increased confidence in their ability to participate in management of their disease. Self-monitoring may be about recognizing symptom severity or it may be based on peak flow readings as part of a written asthma treatment plan.

Several standardized forms are available with a simple, yet comprehensive, set of instructions that enable the client to make decisions based on daily self-monitoring and provide criteria for recognizing and handling worsening asthma, including need for assistance. Written asthma action plans are particularly recommended for clients who have moderate or severe persistent asthma, a history of severe exacerbations, or poorly controlled asthma.

When self-management is the chosen method for maintaining asthma control, peak-flow-based is equivalent to symptom-based self-management, so long as there is a written plan with instructions on how to recognize and handle worsening asthma that includes self-adjustment of medications and followup guidelines.

Peak Flow Meters

A **peak flow meter** is a device that measures how well air moves out of lungs. During an asthma episode the airways of the lungs slowly begin to narrow. The peak flow meter may signal narrowing in the airways hours and sometimes even days before the client experiences any worsening of symptoms.

Peak flow meters are most helpful for clients who have to take medications every day. Clients are taught to use their peak flow meters to:

- Learn what makes their asthma worse (eg, triggers, environmental factors)
- Determine if their treatment plan is working well
- Decide when to add or stop medicine
- Decide when to seek emergency care

Two Peak Flow Meters

Source: Wikipedia Commons.

A "personal best" reading is needed to establish baseline. This differs from client to client depending on severity of the disease. During the two-week window when personal best is being calculated, the client checks by taking the following steps:

1. Move the indicator (red arrow) to the bottom of the numbered scale.
2. Stand up.
3. Take a deep breath, filling the lungs completely.
4. Place the mouthpiece in your mouth and close your lips around it. Do not block the hole with your tongue.
5. Blow out as hard and fast as you can in a single blow.

Repeat steps 1 thru 5 for a total of three times and record the best of the three. Readings should be taken 2 to 3 times a day for two weeks with at least one rising and one afternoon reading. If a dose of SABA is taken, a measurement should be made 15 minutes later. Once a personal best is obtained, the client is instructed to add medications as indicated on the written plan.

Various standardized forms are available as templates for the asthma action plan. Some are free and can be reproduced free of charge. One example of such a form is available through the NIH at https://www.nhlbi.nih.gov/files/docs/public/lung/asthma_actplan.pdf.

The client is given medication instructions based on whether their readings place them in the "green" zone (80% of personal best) with additional instructions if the readings fall into the "yellow" (50%–79%) or "red" (below 50%) zones. The form may have additional instructions regarding trigger avoidance as well as emergency help instructions.

Correctly used, information and management based on a peak flow meter can be effective in helping the client to identify early declines in pulmonary functioning—but it is not necessarily superior to symptom based self-monitoring strategies, especially if the client is not compliant due to the time necessary to implement peak flow.

Symptom Based Self-Assessment

An additional method of self-management depends on the client's ability to ascertain changes in respiratory status. This is typically done using some sort of validated questionnaire that quantifies symptoms experienced both initially and at follow-up visits.

Initial assessment includes questions designed to elicit the following history:

- In the past four weeks, how much work, school, ADLs missed due to symptoms?
- In the past four weeks, how many nights awakened due to cough, symptoms?
- Do you believe your asthma is well controlled?
- What was the highest number of puffs on your SABA per day in the past four weeks?

A number is assigned and the client is then given a written asthma action plan based on symptoms. Examples of validated instruments that can be used for symptom-based management include:

- Asthma Control Questionnaire (Juniper et al., 1999)
- Asthma Therapy Assessment Questionnaire (Vollmer et al., 1999)
- Asthma Control Test (Nathan et al., 2004)
- Asthma Control score (Boulet et al., 2002)

These can also be viewed by going to the NIH website referenced above.

Additional Considerations to Reinforce Partnership

As already noted, whether peak flow monitoring or the symptom based self-assessment is used to quantify symptoms, a written asthma plan must be provided with specific instructions regarding medication changes, trigger avoidance, and emergency measures.

To educate effectively, the healthcare team must be aware that assumptions regarding the client's literacy status can lead to misunderstandings that do little to promote good symptom control. **Literacy** can refer both spoken and written instructions. Providers should use simple and direct language to elicit information from clients at each visit, avoiding words understood only by the medical professional.

In general, written instructions can be assumed to be understandable if they are written at a fifth-grade level, but this varies depending on cultural and developmental factors; however, even if the literacy level appears to be lower than fifth grade, the client can still be educated. Using pictures and demonstration with return demonstration can also be highly effective. Group teaching sessions may be appropriate for some individuals and have an added benefit of providing peer support.

Regardless of which methodology is used, the partnership will be more effective and mutually satisfying if the clinician remembers to start each visit by asking the client or caretaker what specific concerns and/or goals they would like addressed. In the course of the visit further emphasis is given to asthma control, overall treatment goals, medications being used, and quality of life.

The partnership aspect of care, which is client-focused and addresses client responsibility as an active team member, is also reinforced by asking such questions as:

- What worries you most about your asthma?
- What do you want to do that you can't now because of symptoms?
- What improvement do you expect from medications?

Use of questions that focus specifically on client concerns is effective in emphasizing the need for clients to have continual awareness of the ways their life is being affected by asthma and thus to increase their willingness to adhere to the comprehensive plan of care.

Evidence is now abundant that asthma self-management education is effective in improving outcomes of chronic asthma. Specific training in self-management skills is necessary to produce behavior that modifies the outcomes of chronic illnesses such as asthma. Expert care, with regular review by health professionals, is necessary but not sufficient to improve outcomes. Clients must actively participate in their own care, which means consciously using strategies and taking actions to minimize exposure to factors that make asthma harder to control and adjusting treatments to improve disease control.

The ultimate goal of both expert care and client self-management is to reduce the impact of asthma on related morbidity, functional ability, and quality of life. The benefits of educating people who have asthma in the self-management skills of self-assessment, use of medications, and actions to prevent or control exacerbations, include reduction in urgent care visits and hospitalizations, reduction of asthma-related healthcare costs, and improvement in health status.

When our client Tom was seen for an unscheduled followup visit close to the time of his initial diagnosis, he was overusing his SABA to control symptoms related to environmental exposures. After becoming more knowledgeable about medications and the Step approach to managing medications, you determined that elimination of all triggers was not practical. You spoke to the primary care clinician about alternative approaches to treatment for Tom's symptoms, which have been classified as moderate-persistent. With Tom's participation and agreement, his medication was changed to a combined product containing ICS and LABA in the form of fluticasone/salmeterol.

Knowing that it would be a while before he could expect any degree of remission of cat dander allergy from the immunotherapy, Tom agreed to be extremely observant of measures to control his exposure to this particular allergen. Tom's roommate has agreed to restrict the cat's access only to areas not used communally. You have scheduled Tom to come to the office to focus on educational aspects of care to promote his ongoing ability to self-manage his symptoms. Being a student, he is eager to participate, especially as he wants to make sure he can continue to enjoy his school and social life. Therefore you plan on tailoring your educational interventions to include the following concepts in care.

Test Your Knowledge

1. When asthma has been diagnosed, education focuses on the following:
   A. The client's primary responsibility for ensuring a positive outcome.
   B. The client's becoming comfortable with handing over control to professionals.
   C. Basic facts about asthma, definition of control, role of medication, and self-monitoring.
   D. Differential diagnosis, need to manage co-morbidity, client's use of the step approach to manage their own medications.

2. The best approach to ensure client adherence to treatment recommendations for asthma emphasizes the:
   A. Need for members of the healthcare team to take a primary role in monitoring client use of medications.
   B. Use of a partnership approach with an emphasis on support and effective communication to reinforce the client's role as a team member.
   C. Need for the primary clinician to assign clear boundaries about the kinds of education delivered wherever the client might be seen.
   D. Need to turn most decision making regarding treatment over to the client.

3. Of the strategies available to promote client awareness of their symptoms, which of the following statements is true?
   A. The peak flow method is preferred because it is easy to use and provides objective data.
   B. A validated symptom-based self-management strategy is best because it makes clients responsible for managing their symptoms.
   C. Neither peak flow monitoring nor symptom-based self-management are effective because most clients don't understand them.
   D. Either peak flow or symptom-based self-management can be used, but they must be accompanied by a written asthma plan.

4. A written asthma action plan is a necessary adjunct to client education because it:
   A. Prevents the client from over-utilizing office staff time asking questions.
   B. Clarifies measures to be taken at each level of severity, including the need for additional or emergency assessment.

C. Lets the client know how poor their symptom control is.

D. Reinforces that clients are capable of managing their symptoms with little help.

Answers: 1-C, 2-B, 3-D, 4-D

Tom elects to use a combination of a peak flow meter and his written asthma plan. He appreciates the acknowledgement needs will result in the best degree of symptom management. He reports that improved management of exposure to triggers, especially cat dander, along with the change in his medication, and in lifestyle to control his GERD, has resulted in his needing his SABA only once in the last month.

Tom understands that he must have symptom control at the same level for at least three months before a step down in his medication will be considered. He is able to demonstrate appropriate use of his MDI and verbalizes good understanding of changes to his therapy, including the possible need for additional intervention, outlined on his asthma action plan, should his symptoms become less stable. In summary, he has been an ideal client, the likes of which may never be seen again!

Implications for Practice

Effective care of asthma requires comprehensive assessment, appropriate diagnosis using current criteria, development and implementation of a written plan of care, and evaluation of the client's response to treatment.

As asthma increases in prevalence—and there are multiple factors including genetics, environmental triggers, and allergens that contribute to symptom severity—clinicians must maintain a high level of awareness in order to detect asthma and initiate treatment early to preserve client's overall quality of life while preventing morbidity and mortality.

Knowing that asthma is an episodic disease, and that physical symptoms may vary dramatically with time, all members of the client's healthcare team must remain alert to the possibility that mild but chronic symptoms that are being treated as viral, bacterial, or another type of illness may be masking what is, in fact, asthma.

In considering the diagnosis of asthma, it is important that the medical history include standard questions designed to identify factors that seem to exacerbate symptoms. When modifiable elements of the disease are found, the client needs appropriate education in order to decrease exposures that contribute to a decline in functional status. Even with the best management, however, exacerbations may occur. Early treatment remains the best management, with the client as an active participant. Written asthma action plans guide clients in decision making so that they become more confident and proficient in self-management strategies.

Asthma self-management begins at the time of diagnosis and continues through followup, involving all members of the healthcare team (eg, primary clinicians, office and inpatient nursing staff, respiratory therapists, pharmacists). The team approach in managing asthma should be uppermost whenever the asthmatic client is seen by any provider, should reinforce basic components of care, including medication, and should refer for followup care when needed.

Factors that promote partnership include establishment of open communication with the client and family and consideration of client or caretaker preferences in a comprehensive plan of care. Effective teaching strategies are tailored to meet cultural, ethnic, and health literacy variations that impact clients' level of understanding. Using a comprehensive approach in detecting and managing asthma, with care delivered in the context of a therapeutic relationship, asthma can be managed in a way that improves symptom control and quality of life.

As advances in science lead to increased understanding of asthma, healthcare providers must bridge the gap between knowledge and practice. Clinicians who take personal responsibility for maintaining currency in their own level of expertise are well positioned to combat poor outcomes associated with this disease.

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Post Test (Asthma 238)

Use the answer sheet following the test to record your answers.

1. Current thinking regarding asthma defines the disease process and directs treatment goals through management of which of the following characteristics:

a. Barrel chest, tachypnea and wheeze

b. Orthopnea, Kussmaul respirations, and circumoral pallor

c. Inflammation, airway obstruction, and hyper-responsiveness

d. Atopy, persistent wheeze, and parental history of asthma

2. The latest Expert Panel Report, EPR 3, differs from EPR 2 primarily in that it adds the following criteria to classify asthma:

a. The severity components have been expanded to include intermittent and persistent symptoms.

b. Control and severity have been expanded to include risk and impairment.

c. The main change is recognition of a genetic component that accounts for variability of the disease.

d. Need for short-acting bronchodilators is no longer considered when determining severity of the disease.

3. The "Rules of Two" is:

a. A simple and useful tool to support the client in increasing awareness of symptoms.

b. Genetically, if one person in the family has asthma, another is likely to have it too.

c. Clients who have asthma should see their physician at least twice a year.

d. Those who have asthma should see their physician at least twice a month.

4. The description of asthma as reversible rests on client response to:

a. Inhaled corticosteroids

b. Oral corticosteroids

c. Short-acting beta agonists

d. Anticholinergics

5. The description of asthma as reversible rests on client response to:

a. Inhaled corticosteroids

b. Oral corticosteroids

c. Short-acting beta agonists

d. Anticholinergics

6. Which pulmonary function test assesses severity of airflow obstruction:

a. Forced expiratory volume in 1 second

b. Forced vital capacity

c. Maximal voluntary inspiration

d. Forced inspiratory flow rate

7. The diagnosis of asthma is established based on:

a. Spirometry alone

b. Spirometry and reversibility

c. History and symptoms

d. Spirometry, reversibility, history, and symptoms

8. When exploring an alternate diagnosis for a wheezing client, a key consideration is:

a. No improvement in asthma symptoms is noted after a trial of appropriate therapy.

b. The client does not report symptoms other than those related to airway obstruction.

c. The client is seen by multiple providers and each one recommends a different treatment strategy.

d. Wheezing is the hallmark symptom of asthma therefore the time and expense of seeking an alternate diagnosis is not warranted.

9. The primary goal in identifying and managing comorbidities in an asthmatic client is to:

a. Plan to stop medications needed to control asthma.

b. Provide documentation so the client can be referred to a specialist.

c. Ensure that comorbidities are treated to minimize asthma exacerbations.

d. Ensure that comorbidities are treated to cure asthma.

10. The following question should be asked before pursuing differential and comorbid conditions:

a. Are you taking your medication as ordered?

b. What else do you think is causing your symptoms?

c. Do you think you need to lose weight?

d. Are you stressed out all the time?

11. Testing for determination of sensitivity to allergens:

a. Is important even if it is not related to the client's asthma diagnosis.

b. Should be done only for allergens the client may be exposed to.

c. Has been shown to be unreliable in identifying specific allergens.

d. Can determine the specific immunoglobulin responsible for the client's symptoms.

12. House dust mites, often implicated in asthma symptoms:

a. Are usually not present at high altitudes or in arid areas.

b. Are eliminated by exposure to light.

c. Can be eliminated permanently by appropriate chemical agents.

d. Cause no problems in clients confined to bed.

13. Sensitization to outdoor allergens such as fungi or pollen:

a. Can be the result of toxic compounds shed by flowering trees and shrubs.

b. Are easily managed by increasing medications.

c. May be inhibited by conducting outdoor activities near sunrise or sunset.

d. Requires that clients with asthma remain indoors during the spring and summer.

14. Isocyanates are:

a. Chemicals used only in manufacture of aircraft and automobiles.

b. A group of poisons found in pesticides.

c. A risky family of chemical agents used commonly in manufacturing and warned of by OSHA.

d. Dangerous, and banned by the federal government.

15. In the current work climate, asthmatic clients need to be fully informed of the potential for employer retaliation because job loss may trigger loss of health insurance:

a. True

b. False

16. Nonsteroidal anti-inflammatory medications (NSAIDs):

a. Are recommended for asthma clients to avoid use of opioids.

b. Sometimes precipitate asthma symptoms.

c. Have not been shown to be related to asthma.

d. Have no good alternatives for asthma clients.

17. In some clients, sulfite-containing foods have caused severe asthma exacerbations. Sulfites can be found in:

a. Bananas.

b. Apples.

c. Grapes.

d. Dried fruits.

18. Immunotherapy has been shown to reduce asthma symptoms but:

a. There have been severe, sometimes fatal, reactions to it.

b. The course of treatment is typically over a period of one year.

c. Standardized extracts are not yet available.

d. It is impossible to administer effectively in healthcare facilities.

19. The most potent and effective anti-inflammatory medications currently available are:

a. Leukotriene modifiers.

b. Cromolyn sodium and nedocromil.

c. Corticosteroids.

d. Methylxanthine,

20. The preferred choice for long-term control for children of all ages is:

a. Inhaled corticosteroids.

b. Leukotriene modifiers.

c. Cromolyn sodium and nedocromil.

d. Methylxanthine.

21. The principle action of long-acting beta agonists (LABAs) is:

a. Expansion of the lungs.

b. Relaxation of smooth muscles in the upper airways.

c. Suppression of the cough reflex.

d. Expansion of the great blood vessels.

22. Rescue medications:

a. Are substituted for the client's ordinary regimen in emergent situations.

b. Are typically used by EMTs when responding to a call concerning an asthma client.

c. Should be avoided as much as possible except in life-threatening situations.

d. Are typically used as an adjunct therapy to the client's ordinary regimen.

23. The Stepwise approach to therapy is one in which:

a. The dose and number of medications is increased by increments over time.

b. The dose and number of medications is decreased by increments over time.

c. The dose and number of medications are increased as necessary and decreased when possible.

d. All medications are reviewed periodically as one step of an asthma action plan.

24. A personal best reading:

a. Is an indicator of the client's general fitness.

b. Establishes a baseline for asthma management.

c. Shows the client what can be expected after treatment.

d. Motivates the client to achieve greater fitness.

25. Instruments for symptom-based self-management of asthma include all except the:

a. Asthma Control Questionnaire.

b. Asthma Therapy Assessment Questionnaire.

c. Asthma Control Test.

d. Asthma Peak Flow Scale.

Answer Sheet

Asthma: Calming the Airways (238)

Name (Please print your name): _____

Date: _____

Passing score is 80%

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
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19. _____
20. _____
21. _____
22. _____

23. _____

24. _____

25. _____

Course Evaluation (Asthma 238)

Please use this scale for your course evaluation. Items with asterisks * are required.

- 5 = Strongly agree
- 4 = Agree
- 3 = Neutral
- 2 = Disagree
- 1 = Strongly disagree

* Upon completion of the course, I was able to:

a. Discuss the incidence and prevalence of asthma in the United States.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

b. Explain the classifying and assessing of asthma.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

c. Defend the importance of rigorous client education about asthma.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

d. Summarize the differential diagnosis and comorbidities of asthma.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

e. List the environmental factors that contribute to asthma.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

f. Explain medication management of asthma.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

g. Describe the way in which partnering with clients leads to optimal results.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

* The author(s) are knowledgeable about the subject matter.

○ 5 ○ 4 ○ 3 ○ 2 ○ 1

* The author(s) cited evidence that supported the material presented.

5 4 3 2 1

* This course contained no discriminatory or prejudicial language.

Yes No

* The course was free of commercial bias and product promotion.

Yes No

* As a result of what you have learned, do you intend to make any changes in your practice?

Yes No

If you answered Yes above, what changes do you intend to make? If you answered No, please explain why.

* Do you intend to return to ATrain for your ongoing CE needs?

- Yes, within the next 30 days.
- Yes, during my next renewal cycle.
- Maybe, not sure.
- No, I only needed this one course.

* Would you recommend ATrain Education to a friend, co-worker, or colleague?

- Yes, definitely.
- Possibly.
- No, not at this time.

* What is your overall satsfaction with this learning activity?

5 4 3 2 1

* Navigating the ATrain Education website was:

- Easy.
- Somewhat easy.
- Not at all easy.

* How long did it take you to complete this course, posttest, and course evaluation?

- 60 minutes (or more) per contact hour
- 50-59 minutes per contact hour
- 40-49 minutes per contact hour
- 30-39 minutes per contact hour
- Less than 30 minutes per contact hour

I heard about ATrain Education from:

- Government or Department of Health website.
- State board or professional association.
- Searching the Internet.
- A friend.
- An advertisement.
- I am a returning customer.
- My employer.
- Other
- Social Media (FB, Twitter, LinkedIn, etc)

Please let us know your age group to help us meet your professional needs.

- 18 to 30
- 31 to 45
- 46+

I completed this course on:

- ○ My own or a friend's computer.
- ○ A computer at work.
- ○ A library computer.
- ○ A tablet.
- ○ A cellphone.
- ○ A paper copy of the course.

Please enter your comments or suggestions here: _____

_____

_____

_____

Registration Form (Asthma 238)

Please print and answer all of the following questions (* required).

* Name: _____

* Email: _____

* Address: _____

* City: _____ * State: _____ * Zip: _____

* Country: _____

* Phone: _____

* Professional Credentials/Designations:

_____

Your name and credentials/designations will appear on your certificate.

* License Number and State: _____

* Please email my certificate:

○ Yes ○ No

(If you request an email certificate we will not send a copy of the certificate by US Mail.)

Payment Options

You may pay by credit card or by check.
Fill out this section only if you are **paying by credit card.**
4.5 contact hours: $39

Credit card information

* Name: _____

Address (if different from above): _____

* City: _____ * State: _____ * Zip: _____

* Card type:

○ Visa ○ Master Card ○ American Express ○ Discover

* Card number: _____

* CVS#: _____

* Expiration date: _____